WEAKFISH MIGRATION IN RELATION TO ITS CONSERVATION

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Explanatory Note

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United States Department of the Interior, Douglas McKay, Secretary,
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CONTENTS

ILLUSTRATIONS

TABLES

TABLES

WEAKFISH MIGRATION IN RELATION TO ITS CONSERVATION

There has been much speculation but little definite knowledge about the migrations of the fishes which summer in the inshore waters of the Middle Atlantic Bight. It has, of course, long been known that many of these species migrate seasonally. For example, the bluefish, butterfish, croakers, scup, sea bass, weakfish, and summer flounder, disappear from inshore waters with the autumnal chilling and return with vernal warming. Knowledge of their winter habitat has been fragmentary. Occasional winter captures of "summer fish" have been reported from the zone of moderate temperatures along the edge of the continent from the latitude of Cape Hatteras to the southern edge of Georges Bank. The establishment in the winter of 1929-30 of a winter fishery for some of these fishes off the Virginia Capes (Pearson, 1932; Nesbit and Neville, 1935) and the results of tagging experiments (Nesbit and Neville, 1935) all suggest that most individuals of the several species of shore fishes migrate southward as well as offshore in winter, so that the occasional fish captured along the northern part of the continental edge may be regarded as stragglers. 1/

Foremost among the questions raised by the migrations of these fishes are those concerned with the unity or diversity of the populations. It is of economic as well as scientific importance to know whether or not the populations of these fishes are composed of many local races, each with its own peculiar migratory habits. If separate population units or races exist and remain distinct throughout the summer fishing season, such conservation measures as may be found desirable may be applied by each locality independently. If, on the other hand, mixing occurs in summer as well as in winter, local conservation measures will be ineffectual, for restrictions in one locality may be expected to stimulate fishing activities elsewhere so that the strain on the general population will be moderated but slightly, if at all.

For several reasons the weakfish (Cynoscion regalis) is a particularly desirable species for study of this problem. It moves inshore for spawning in summer, and withdraws in winter. Its scales show age marks with remarkable clarity, and reveal peculiarities of surface pattern by which local races may be recognized. Considered solely from the point of view of

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1/ The hydrography of the continental shelf between Cape Cod and Cape Hatteras has been discussed by Rathbun, 1887; Parr, 1933; Bigelow, 1928; and Bigelow and Sears, 1935. The principal hydrographic features which influence the movements of the fish are: (1) the range of the seasonal cycle of temperature within the 10-fathom contour is so great (0° to 4° C. in winter, 20° to 25° in summer) that only very tolerant species can be year-round residents; (2) there is a zone along the edge of the continent where moderate temperatures (8° to 12°) prevail with remarkably little seasonal or annual variation. This offers a winter refuge for species that do not tolerate near-freezing temperatures.

adaptability for scientific study, the economic importance of the weakfish is not the least of its advantages. Quantitative studies of widespread populations in nature are for the most part limited to species for which the quantities taken are recorded, and are large enough to permit adequate sampling. Of all groups of animals the fishes are the most favorable from this point of view; and of the fishes the weakfish is more favorable than most. However, although all ages and all sizes except the smallest (less than 15 centimeters) are well represented in the catches, it is doubtful whether the samples always furnish a good cross-section of those contingents of the population present in each locality. The principal clues that have led to understanding the rather complex movements of weakfish have become evident on comparing the stocks of fish at several localities as to abundance, size, and age composition, and rate of growth. These clues have led me to erect a hypothesis which I have tested with tagging experiments and with scale studies.

Comparison of Abundance, Age and Size Composition of the Catch in Various Localities

Catch records.--Although weakfish are taken by several forms of gear (Table 1), the catches from pound nets have been chosen for this study because, (1) pound nets account for most of the catch (for the period 1929-33, inclusive, 78.2 percent); (2) they are operated over the whole range of the weakfish, from Massachusetts to North Carolina providing records from many and widely-separated localities: (3) with minor exceptions they are operated through the entire season in which weakfish are present on the coast, so that they presumably sample all classes of weakfish, (sizes, ages, races, etc.) while other forms of gear, especially mobile gear like gill nets, otter trawls, and purse seines, are selective because of their sporadic operations; and (4) more detailed records are available of the catch from pound nets than of the catches by other forms of gear.

For this study records of pound-net catches have been taken from four sources: (1) Statistical canvasses conducted by the United States Government since 1898 (Bureau of Fisheries, Fish and Wildlife Service, Table 2). For most years these records include the quantities and value of the catch and the amount of gear operated. The most serious defects of these records are lack of continuity, and inadquate information concerning fishing effort. For example, under the term "pound nets" there have been grouped large nets set in the ocean, small nets set in bays, small nets set for eels in late autumn after the departure of weakfish and other shore fishes, and for some years nets set primarily for the taking of horseshoe crabs. These several types of nets differ geratly in their capacity for taking weakfish, and since the relative numbers of them have varied considerably during the period covered by the records, it is not possible to estimate reliably the catch-per-unit of fishing effort from the records of total catch and the records of the numbers of nets operated. A further fault of the records is that they do not permit locality grouping smaller than by counties.

Table 1.--Average annual catch of weakfish, Maine to North Carolina (in pounds), by gear, 5-year period 1929-33.

State	Purse seine	Haul seine	Gill net	Hand line	Pound net	Floating trap	Fyke net	Otter trawls	Total
Maine	-	-	-	-	-	-	-	73	73
Massachusetts	-	-	-	-	58,541	-	-	41,357	99,898
Rhode Island	-	5,886	2,225	2,950	32,014	32,899	-	-	75,974
Connecticut	17,556	-	578	521	17,842	244	125	857	37,723
New York	123,060	47,284	154,179	40,543	541,302	180	-	5,323	911,871
New Jersey	2,059,587	47,365	365,046	82,022	6,698,722	851	-	193,162	9,446,755
Delaware	-	381,924	168,160	25,799	144	-	60	-	576,087
Maryland	104,590	92,266	8,533	19,020	2,148,503	-	-	860	2,373,772
Virginia	21,920	284,971	40,374	-	11,164,060	-	17,908	164,298	11,693,531
North Carolina	1,955	901,727	789,041	322	1,793,225	-	-	18,356	3,504,626
Total	2,328,668	1,761,423	1,528,136	171,177	22,454,353	34,174	18,093	424,286	28,720,310

Table 2.-- Catch of weakfish ("gray trout"), Massachusetts to North Carolina, by certain gear, for selected years, 1879-1934.

(In pounds. Does not include catch by otter trawl, except as indicated)

State and year	Pound nets and traps	Seines	Gill nets	All others	Total
MASSACHUSETTS:					
1879	....	....	....	....	103,310 1/
1880	....	....	....	....	2/
1887	102,683	....	....	26,988	129,671
1888	141,499	....	....	29,045	170,544
1889	201,026	....	15,545	....	216,571
1898	1,277,760	47,900	22,050	24,200	1,371,910
1902	3,704,717	14,500	5,000	46,000	3,770,217
1905	5,021,389	45,827	26,100	131,500	5,224,816
1908	1,848,000	1,000	30,000	92,000	1,971,000
1919	5,777	....	....	....	5,777
1924	1,646	....	....	....	1,646
1927	....	....	....	....	2/
1928	3,426	....	....	....	3,426
1929	4,363	....	....	....	4,363
1930	2,484	....	....	....	2,484
1931	3,137	....	....	....	3,137
1932	2,485	....	....	....	2,485
1933	2,048	....	....	....	2,048
RHODE ISLAND:					
1879	....	....	....	....	2/
1880	....	....	....	....	326,000
1887	252,000	7,000	9,000	....	268,000
1888	255,850	8,500	10,650	....	275,000
1889	376,964	4,500	24,750	....	406,214
1898	2,930,600	18,250	156,380	20,405	3,125,635
1902	2,703,765	268,500	107,850	78,000	3,158,115
1905	2,648,240	380,210	126,000	68,335	3,222,785
1908	2,326,000	62,000	26,000	13,000	2,427,000
1919	353,060	....	....	800	353,860
1924	56,754	2,000	....	500	59,254
1927	....	....	....	....	2/
1928	47,567	220	1,200	21,145	70,132
1929	63,304	....	1,825	....	65,129
1930	68,540	10,680	5,000	56,925	141,145
1931	43,450	6,500	1,800	400	52,150
1932	54,137	3,500	......	500	58,137
1933	50,310	8,750	2,500	1,750	63,310

1/ Not available by gear
2/ Not available

Table 2.--Catch of weakfish ("gray trout"), Massachusetts to North Carolina, by certain gear, for selected years, 1879-1934 (cont'd).

(In pounds. Does not include catch by otter trawl, except as indicated)

State and year	Pound nets and traps	Seines	Gill nets	All others	Total
CONNECTICUT:					
1879..........	....	....	....	....	3/
1880..........	....	....	....	....	102,750
1887..........	101,300	4,980	14,300	13,900	134,480
1888..........	228,500	4,480	13,180	14,400	260,560
1889..........	170,000	6,840	14,240	15,565	206,645
1898..........	179,893	3,600	6,650	3,500	193,643
1902..........	372,820	10,640	6,250	18,010	407,720
1905..........	89,253	48,100	3,600	20,626	161,579
1908..........	163,000	12,000	....	5,000	180,000
1919..........	....	....	....	23,076	23,076
1924..........	32,699	4,416	....	3,270	40,385
1927..........	23,985	....	175	900	25,060
1928..........	39,685	....	400	500	40,585
1929..........	28,460	63,703	468	255	92,886
1930..........	17,194	23,754	1,500	804	43,252
1931..........	24,000	323	....	3,800	28,123
1932..........	14,260	....	848	1,037	16,145
1933..........	17,500	....	750	940	19,190
NEW YORK:					
1880..........	....	....	....	....	4,000,000 4/
1887..........	392,720	281,860	382,360	447,620	1,504,560
1888..........	366,920	296,900	334,000	437,050	1,434,870
1889..........	....	....	....	....	2,802,341
1890..........	1,591,364	464,578	491,182	442,587	2,989,711
1891..........	1,579,006	401,030	438,517	434,100	2,852,653
1892..........	....	....	....	....	3/
1897..........	1,848,700	291,800	383,710	37,317	2,561,527
1898..........	1,486,545	197,800	351,255	41,330	2,076,930
1901..........	1,685,041	206,880	409,757	45,005	2,346,683
1904..........	3,739,190	1,956,635	562,435	81,340	6,339,600
1908..........	4,319,000	5,850,000	955,000	27,000	11,151,000
1921..........	1,523,396	210,815	164,765	22,060	1,921,036
1926..........	658,217	140,489	160,265	114,240	1,073,211
1929..........	400,647	66,450	195,805	44,600	707,502
1930..........	482,461	233,350	204,882	27,880	948,573
1931..........	1,016,679	290,665	141,349	15,350	1,464,043
1932..........	223,977	224,257	144,261	77,526	670,001
1933..........	654,793	37,000	84,600	33,500	809,893

3/ Not available
4/ not available by gear

Table 2.--Catch of weakfish ("gray trout"), Massachusetts to North Carolina, by certain gear, for selected years, 1879-1934 (cont'd).

(In pounds. Does not include catch by otter trawl, except as indicated)

State and year	Pound nets and traps	Seines	Gill nets	All others	Total
NEW JERSEY:					
1880..........	....	....	....	....	4,430,000 5/
1887..........	....	....	....	....	2,376,000 5/
1888..........	130,756	1,403,994	50,882	659,471	2,845,103
1889..........	....	....	....	....	4,716,330 5/
1890..........	878,507	794,400	198,365	2,201,736	4,073,008
1891..........	3,012,299	775,600	210,800	2,003,864	6,002,563
1892..........	....	....	....	....	6/
1897..........	6,511,187	762,295	213,300	1,207,250	8,694,032 7/
1898..........	7,129,288	731,090	202,150	1,353,422	9,415,950 7/
1901..........	10,508,448	463,440	274,075	727,431	11,973,394
1904..........	9,318,001	632,500	401,600	347,200	10,699,301
1908..........	10,035,000	815,000	385,000	579,000	11,814,000
1921..........	8,843,800	1,625,185	935,122	247,628	11,651,735
1926..........	4,254,157	2,098,200	700,330	117,580	7,170,267
1929..........	6,124,188	2,150,413	680,600	164,559	9,119,760
1930..........	8,054,464	2,311,605	423,360	79,272	10,868,701
1931..........	7,149,354	3,803,811	339,993	51,343	12,344,501
1932..........	6,025,103	1,852,014	208,143	58,375	8,143,635
1933..........	6,140,500	367,309	216,370	67,130	6,791,309
DELAWARE:					
1880..........	....	....	.	....	2,618,500 5/
1887..........	....	2,309,047	43,752	24,500	2,377,299
1888..........	....	2,410,139	26,492	15,100	2,451,731
1889..........	....	...	....	....	3,211,900 5/
1890..........	....	3,037,600	32,900	31,500	3,102,000
1891..........	....	1,114,900	23,530	26,300	1,164,730
1892	....	802,790	16,660	18,060	837,510
1897..........	23,600	1,009,380	361,900	46,000	1,440,880
1898..........	....	....	....	....	6/
1901..........	500	617,635	29,300	75,000	722,435
1904..........	300	685,100	13,300	74,600	773,300
1908..........	1,500	2,469,000	5,900	115,600	2,590,000
1921..........	300	844,625	36,275	5,350	886,550
1926..........	4,000	750,880	14,300	2,700	771,880
1929..........	....	820,192	181,250	15,100	1,016,542
1930..........	400	713,350	444,700	76,275	1,234,725
1931..........	320	228,900	149,750	21,057	400,029
1932..........	....	56,600	33,948	15,411	105,951
1933..........	....	90,580	31,150	1,450	123,180

5/ Not available by gear
6/ Not available

7/Includes conversion of "salted" to basis of "fresh"

Table 2.--Catch of weakfish ("gray trout"), Massachusetts to North Carolina, by certain gear, for selected years, 1879-1934 (cont'd).

(In pounds. Does not include catch by otter trawl, except as indicated)

State and year	Pound nets and traps	Seines	Gill nets	All others	Total
MARYLAND:					
1880	....	....	....	....	60,000[8]
1887	7,775	54,320	49,687	419,745	531,527
1888	10,775	48,990	72,390	420,856	553,011
1889	....	....	....	....	[9]
1890	93,679	179,563	83,975	329,956	687,173
1891	81,335	197,560	85,510	386,060	750,465
1897	394,109	101,140	11,425	90,505	597,179
1901	927,945	25,090	5,500	60,240	1,018,775
1902	....	....	....	....	[9]
1904	691,145	26,100	1,250	66,720	785,215
1908	1,107,000	8,800	100	75,100	1,191,000
1918	....	....	....	....	[9]
1920	2,055,041	165,060	13,450	54,939	2,288,490
1923	....	....	....	....	[9]
1925	1,239,706	205,218	6,725	28,560	1,480,209
1927	....	....	....	....	[10]
1928	....	....	....	....	[9]
1929	2,696,602	273,323	2,600	24,600	2,997,125
1930	3,461,551	258,396	1,700	32,000	3,753,647
1931	1,883,497	220,900	28,678	26,000	2,159,075
1932	1,704,756	82,058	3,950	14,600	1,805,364
1933	996,111	148,603	5,740	3,200	1,153,654
1934	1,259,600	202,700	10,300	5,100	1,477,700
VIRGINIA:					
1880	....	....	....	....	1,107,000[8]
1887	177,916	761,380	66,025	104,127	1,109,448
1888	278,674	652,297	75,260	107,797	1,114,028
1889	....	....	....	....	[9]
1890	1,969,368	639,284	67,478	1,396,174	4,072,304
1891	1,759,464	687,585	70,740	1,412,110	3,929,899
1897	5,184,128	440,868	33,025	867,485	6,525,806
1901	6,128,546	361,770	51,500	889,680	7,431,496
1902	....	....	....	....	[9]
1904	6,114,116	379,885	13,000	444,067	6,951,068
1908	3,463,000	288,000	61,000	679,000	4,491,000
1918	....	....	....	....	[9]
1920	12,305,652	287,883	48,437	266,530	12,908,502
1923	....	....	....	....	[9]
1925	11,790,230	381,871	159,010	90,939	12,422,050
1927	....	....	....	....	[9]
1928	....	....	....	....	[9]
1929	8,072,549	158,150	116,227	17,200	8,364,126
1930	14,660,362	641,300	56,100	28,200	15,385,962
1931	9,996,040	190,100	9,100	19,700	10,214,940
1932	11,336,817	371,088	12,955	13,682	11,734,542
1933	1,754,530	173,815	7,490	10,760	11,946,595
1934	12,950,800	156,800	3,200	19,200	13,130,000

8/ Not available by gear
9/ Not available
10/ Includes otter trawls

Table 2.--Catch of weakfish ("gray trout"), Massachusetts to North Carolina, by certain gear, for selected years, 1879-1934 (cont'd).

(In pounds. Does not include catch by otter trawl, except as indicated)

State and year	Pound nets and traps	Seines	Gill nets	All other	Total
NORTH CAROLINA:					
1880..........	....	....	....	....	10,000 11/
1887..........	....	....	....	....	681,788 12/
1888..........	....	....	....	....	536,505 12/
1889..........	....	....	....	....	1,478,250 12/
1890..........	....	....	....	....	1,598,250 12/
1891..........	....	....	....	....	13/
1897..........	....	....	....	....	2,342,813
1901..........	....	....	....	....	13/
1902..........	....	....	....	....	2,987,709 11/
1904..........	....	....	....	....	13/
1908..........	....	....	....	....	3,476,250 12/
1918..........	....	....	....	....	2,521,055 12/
1920..........	....	....	....	....	13/
1923..........	1,693,301	598,539	775,697	2,900	3,070,437
1925..........	....	....	....	....	13/
1927..........	2,456,375	774,134	642,555	8,200	3,581,264
1928..........	....	....	....	....	3,845,594 12/
1929..........	....	....	....	....	3,817,711 12/
1930..........	118,350	819,389	355,390	....	2,293,127
1931..........	2,584,000	481,000	905,700	500	2,971,200
1932..........	8,503,000	590,400	532,500	....	3,625,900
1933..........	....	....	....	....	13/
1934..........	3,479,000	2,077,000	2,173,000	....	7,729,000

11/ Not available by gear

12/ Estimated total of "gray trout" only from reported total "Gray and spotted trout"

13/ Not available

(2) Records of the catch of licensed pound nets in New Jersey. Since 1921 it has been required by law that pound-net operators report these to the Board of Fish and Game Commissioners (Table 3). These records are continuous and specify location of nets. Since the returns are on an annual basis, seasonal distribution of the catch is not recorded.

(3) Catch records transcribed from the books of companies and persons. In most of these, daily catches were recorded, and from the records themselves or from other sources, it has been possible to determine the numbers of nets operated. Of special interest are the records of the catch of the pound-net fishery conducted by the Vail family between 1884 and 1928 in Fort Pond Bay, Montauk, New York, (Table 4). These records were put at my disposal (with permission to publish) by Capt. Charles Vail. They cover the entire period of the remarkable temporary increase in abundance of weakfish in New York and southern New England (Bigelow and Welsh, 1925) in the first decade of the present century, and since the catches were recorded daily, it is possible to compare the seasonal distribution of the catches before, during and after the period of abundance.

(4) Daily records of pound-net catches kept since 1928 by pound-net operators on forms furnished by the United States Fish and Wildlife Service. Many of these records include accounts of the numbers of nets lifted each day as well as the numbers in operation during each part of the season.

Save for interruptions from storms and from the practice of occasionally withdrawing the nets for drying in order to kill fouling organisms, pound-nets are fishing continuously even though the catch may not be removed daily. However, some fish which enter the net escape, for Monday catches, (nets are seldom lifted on Sunday) although larger than Saturday or Tuesday catches, are on the average somewhat less than twice as large. Since detailed records of the numbers of nets lifted daily are not available for all years, the catch-per-lift could not be computed even had it been desirable to do so. Consequently the average catch-per-net was estimated by dividing the total catch reported for each locality by the number of nets operated there during the period under investigation. There is no reason to suspect that the practice of lifting nets daily on week days changed significantly during this period; hence the average catches-per-net are probably comparable from one year to another.

Biological observations.-- In each year from 1928 through 1932, field observers stationed in certain localities where pound-net catches are landed measured daily a number (usually 50) of weakfish taken at random from each pound-net boat. They also took scale samples, usually from 10 specimens in each sample of 50. They recorded lengths to the nearest half-centimeter.

For localities north of Delaware Bay, the length samples were grouped into periods of varying duration so that as nearly as could be determined by inspection, the size composition was the same for each period. In the following discussion these will be referred to as grouped samples. I then

Table 3.--New Jersey State Pound Net Records. Summary of localities

Year	BEACH HAVEN		CAPE MAY		TOTAL		Average catch per trap
	Traps	Pounds	Traps	Pounds	Traps	Pounds	
1922	31	1,484,266	23	795,777	54	2,280,043	42,223
1923	27	1,391,958	16	700,732	43	2,092,690	48,667
1924	30	868,953	13	544,281	43	1,413,234	32,866
1925	31	2,004,086	12	771,276	43	2,775,362	64,543
1926	36	1,426,570	19	797,708	55	2,224,278	40,441
1927	32	1,150,379	26	963,170	58	2,113,549	36,441
1928	31	1,806,333	18	1,322,789	49	3,129,122	63,860
1929	30	2,363,424	27	1,913,286	57	4,276,710	75,030
1930	27	1,918,876	38	2,790,598	65	4,709,474	72,453
1931	28	1,640,349	45	2,937,080	73	4,577,429	62,705
1932	28	1,179,766	37	2,883,602	65	4,063,368	62,513
1933	23	1,505,144	34	1,945,328	57	3,450,472	60,535
1934	15	1,127,587	30	2,100,768	45	3,228,355	71,741
1935	28	1,372,329	30	3,372,331	58	4,744,660	81,804
	SEASIDE PARK		NORTHERN		TOTAL		
1922	21	1,430,800	31	1,566,311	52	2,997,111	57,637
1923	21	1,849,300	30	1,836,807	51	3,686,107	72,277
1924	21	938,000	27	1,033,224	48	1,971,224	41,067
1925	21	1,019,200	29	729,825	50	1,749,025	34,981
1926	23	943,850	27	809,930	50	1,753,780	35,076
1927	19	817,000	26	677,877	45	1,494,877	33,219
1928	21	636,380	26	892,232	47	1,528,612	32,524
1929	23	582,395	26	743,608	49	1,326,003	27,061
1930	16	720,554	26	1,104,158	42	1,824,712	43,446
1931	19	608,983	22	1,011,823	41	1,620,806	39,532
1932	17	514,447	23	462,147	40	976,594	24,415
1933	16	796,982	14	942,009	30	1,738,991	57,966
1934	13	501,325	17	552,347	30	1,053,672	35,122
1935	13	360,975	14	587,785	27	948,760	35,139

Table 4.---Mean catch per trap in numbers of Weakfish of the Vail Family Pound Net Fishery in Fort Pond Bay (Montauk, New York) 1884-1928.

Year	Apr. 27 June 8	June 9 Aug. 24	Aug. 25 Nov. 23	Total
1884	350	832	1562	2744
1885	720	1104	1038	2862
1886	340	933	673	1946
1887	555	1214	793	2562
1888	260	2561	1573	4394
1889	1125	7802	636	9563
1890	282	2314	1336	3932
1891	123	2384	232	2739
1892	195	2804	1006	4005
1893	122	2792	132	3046
1894	177	3662	643	4482
1895	97	1060	113	1270
1896	18	5121	605	5744
1897	9	2172	435	2616
1898	46	2178	405	2629
1899	165	1481	621	2267
1900	51	2507	508	3066
1901	14	2797	540	3351
1902	94	9383	2011	11488
1903	204	17743	3659	21606
1904	152	11708	1010	12870
1905	112	3917	773	4802
1906	97	3965	399	4461
1907	118	8818	2732	11668
1908	129	7921	448	8498
1909	63	6508	3362	9933
1910	98	8345	514	8957
1911	43	5092	196	5331
1912	60	893	171	1124
1913	15	101	365	481
1914	42	596	210	848
1915	24	188	241	453
1916	143	1740	2008	3891
1917	126	1072	386	1584
1918	90	299	176	565
1919	244	462	811	1517
1920	229	178	100	507
1921	210	428	176	814
1922	123	852	223	1198
1923	1690	377	131	2198
1924	356	197	57	610
1925	266	78	24	368
1926	666	201	137	1004
1927	327	309	131	767
Totals -	10,370	137,089	33,302	180,761

weighted the resulting length distribution for each such period according to that period's average catch-per-net, the records being obtained as in (4) above. The computation was as follows:

$$\frac{W}{w} = N$$

where N = number of thousands of fish per net taken during grouped sample period,

W = average weight in pounds of catch per net taken during grouped sample period,

w = weight of sample adjusted to 1,000 fish.

The factor $\underline{w}$ is estimated from the length-weight curve of Crozier and Hecht (1914), corrected to allow for the weight of the viscera and the length frequency data of the grouped samples. Multiplying $\underline{N}$ times the percentage frequency distribution then gave an estimate of the number of fish at each length caught per net. The grouped samples were combined by addition into longer periods shown in Tables 5 to 8 and illustrated in Figures 1 to 4.

In both northern and southern localities weakfish are sometimes caught which are too small to be marketed. These have, of course, been omitted from the weighted distributions. For some localities in certain years, the length data are fragmentary or the catch records are not detailed enough to permit weighting the frequencies. Such length measurements as are available in such cases are presented in Table 9, and in Figure 5 are illustrated as percentage frequency distributions.

Age Composition of the Catches

In accordance with the usual practice of fishery investigators, the term "year class" refers to the year spawned and "age group" to the age attained. For example, all weakfish spawned in 1926 belong to the 1926 year class. During 1926, when they are less than one year old, they are members of age-group 0; in 1927 they are members of the I-group; in 1928 of the II-group, etc. For greater convenience in discussion, a slight departure has been made from this custom. Weakfish spawn in spring and early summer with the peak of spawning between the middle of May and the middle of June. If the rule were strictly adhered to, fish spawned in 1926 should be designated as members of the 0-group until about June 1, 1927; members of the I-group between about June 1, 1927 and about June 1, 1928, etc. For the sake of convenience the anniversary date was arbitrarily advanced by about one month so that all fish of each year class taken during the summer fishing season in a given calendar year may be considered as members of the same age group.

Age was determined by an examination of the scales. The method of age analysis was based upon repeated readings of a large number of scales taken from various areas along the coast and throughout the year until

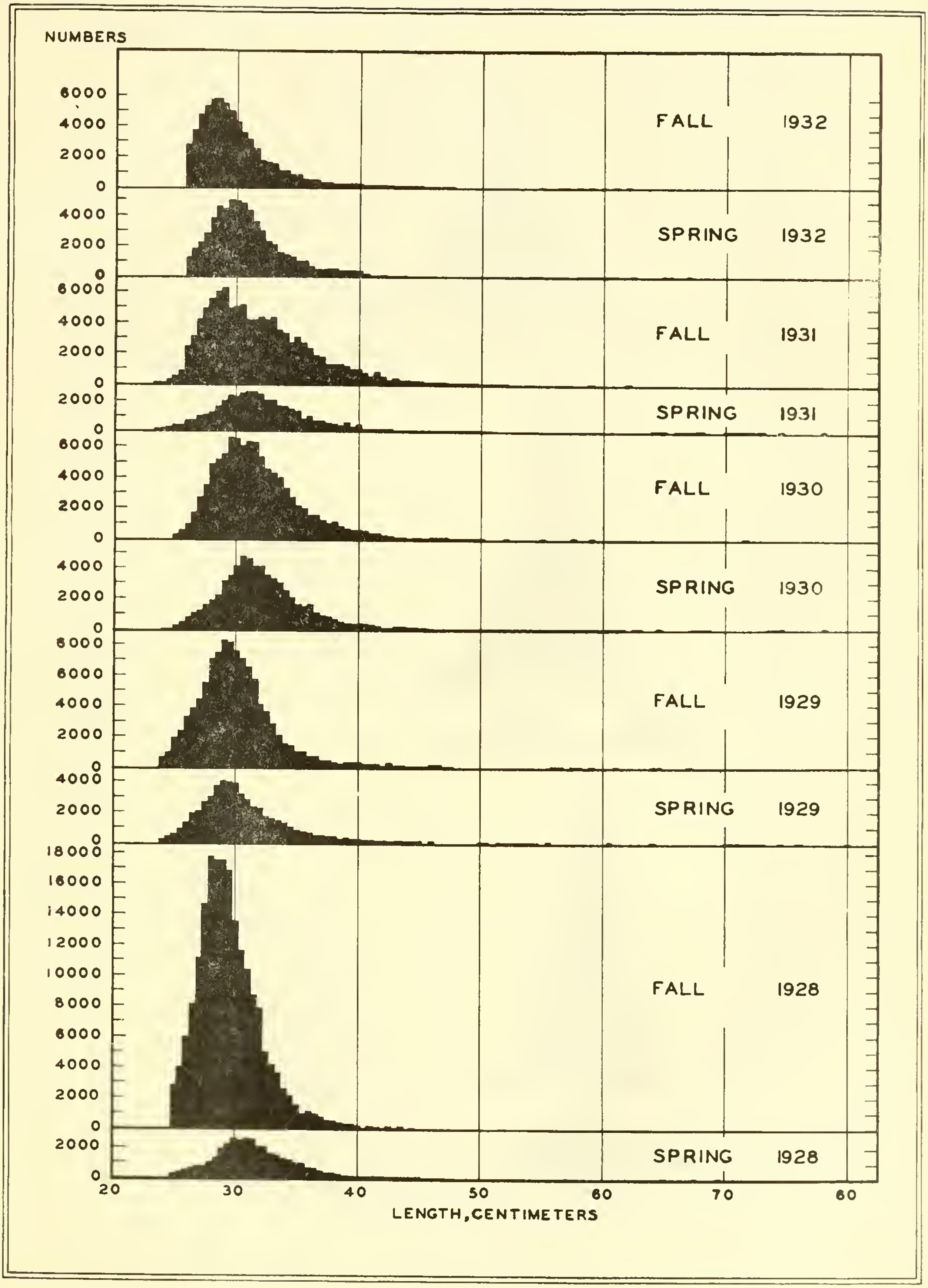

Fig. 1.--Weighted length frequencies of weakfish taken at Wildwood, N. J.

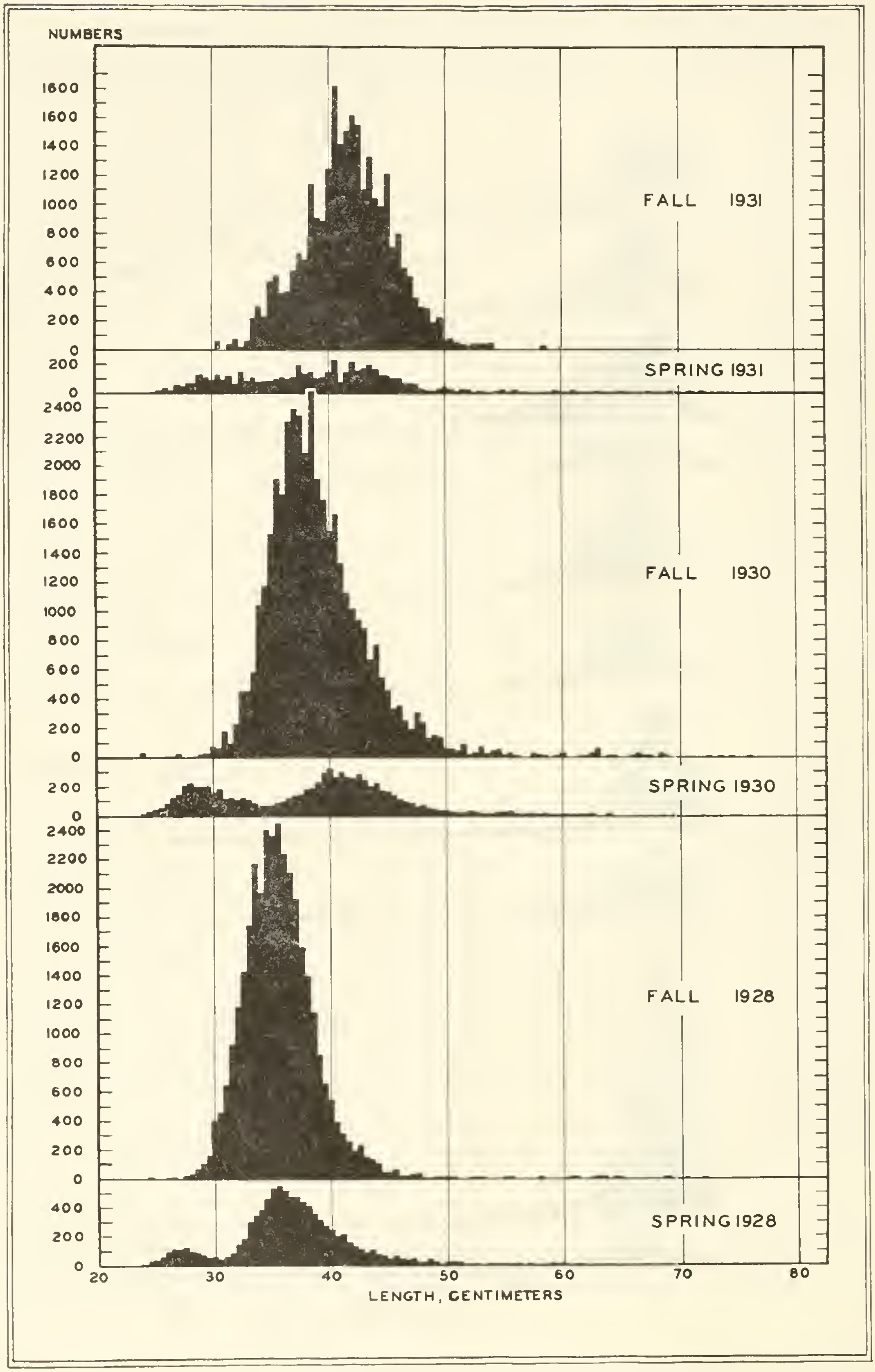

Fig. 2.--Weighted length frequencies of weakfish taken at Northern N. J.

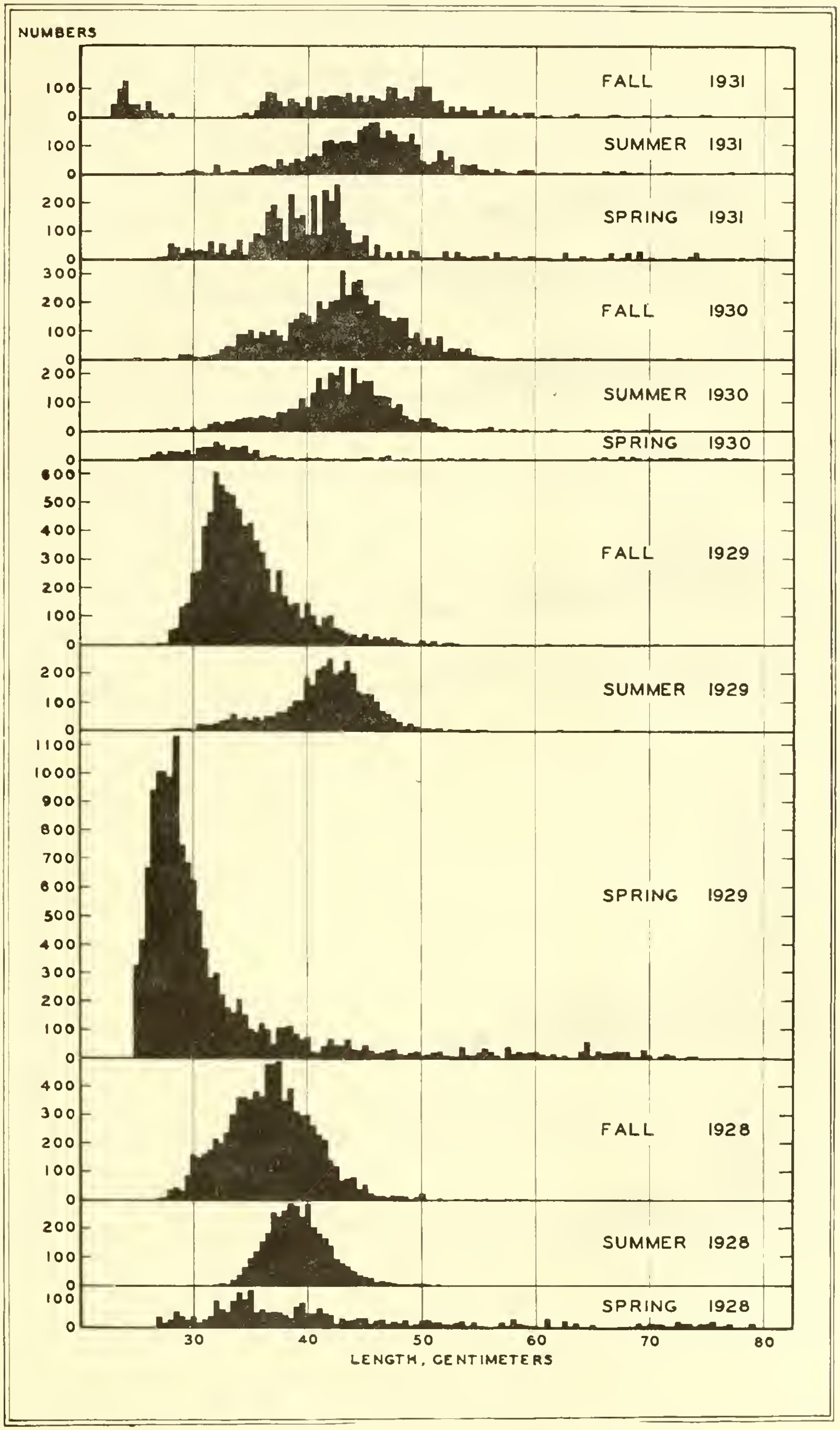

Fig. 3.--Weighted length frequencies of weakfish taken at Fire Island, N.Y.

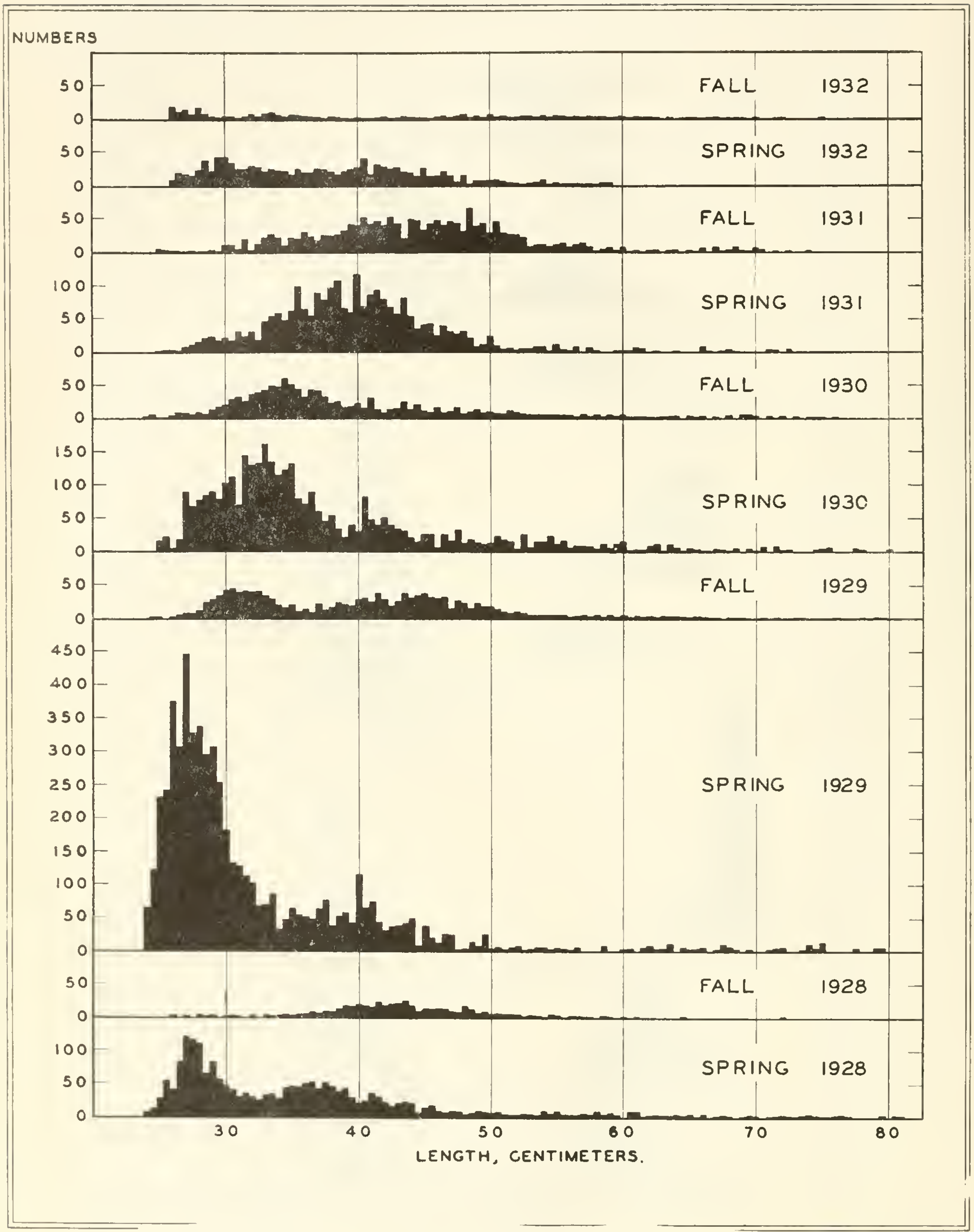

Fig. 4.--Weighted length frequencies of weakfish taken at Montauk, N.Y.

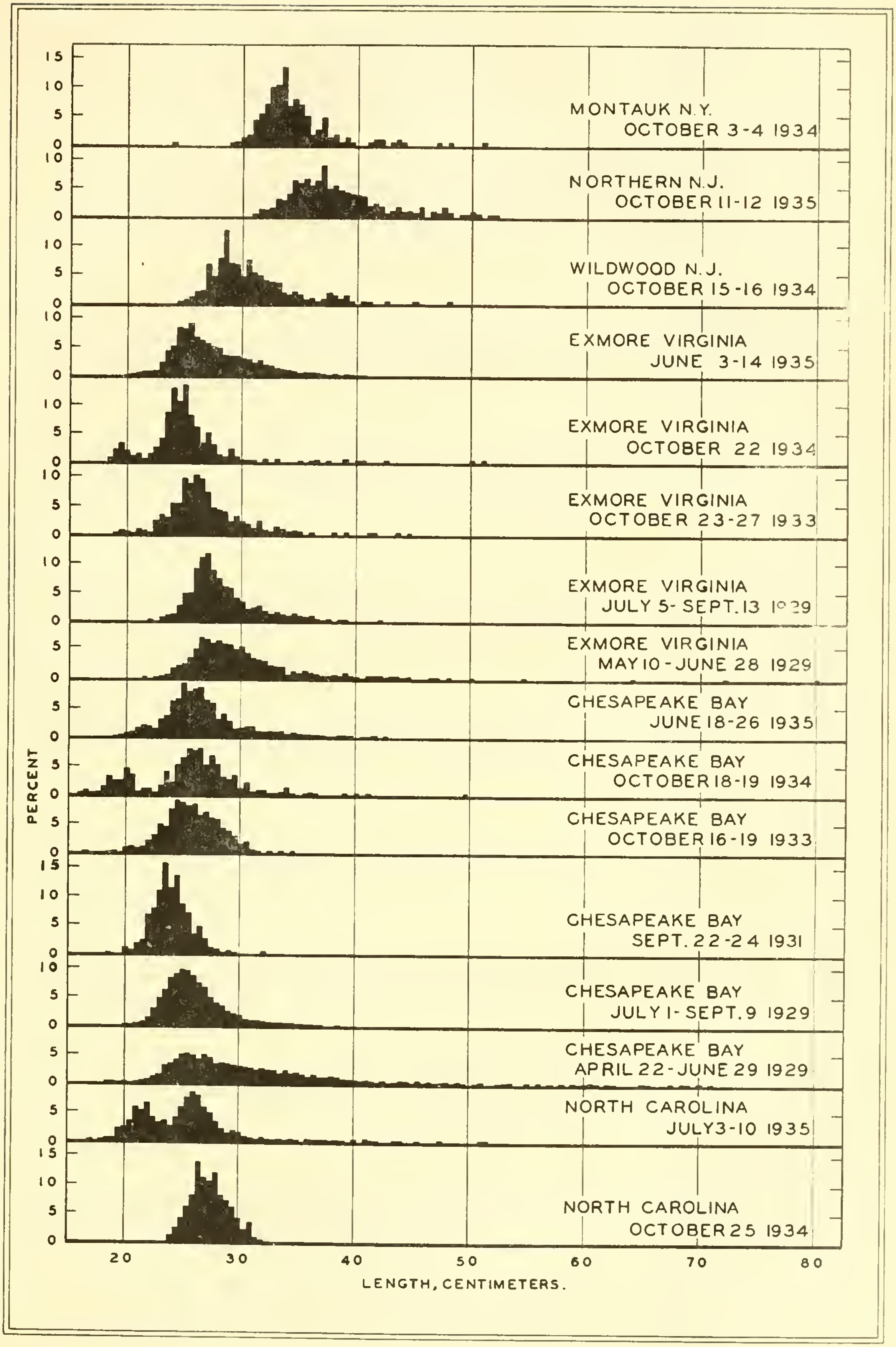

Fig. 5.--Length frequency distribution of weakfish from certain locations.

Table 5.--Weighted length frequencies of weakfish taken at Wildwood, N. J.

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	May 1 - Aug. 11	May 3 - Aug. 10	May 1 - Aug. 15	May 4 - Aug. 15	May 17 - Aug. 15	Aug. 12 - Nov. 20	Aug. 12 - Nov. 12	Aug. 16 - Nov. 3	Aug. 16 - Nov. 16	Aug. 16 - Nov. 3
23.5	-	-	-	43	-	-	-	-	31	-
24.0	-	197	1	116	-	-	626	12	96	-
24.5	-	402	3	198	-	-	904	36	239	-
25.0	305	549	223	275	-	2,782	1,903	241	566	-
25.5	454	857	415	285	-	3,937	2,383	480	829	-
26.0	579	1,283	688	437	1,237	5,906	3,254	931	2,405	2,772
26.5	716	1,878	1,057	480	1,770	8,118	3,806	1,633	3,067	3,742
27.0	863	2,001	1,397	843	2,182	11,636	4,379	2,654	4,195	4,768
27.5	847	2,591	1,546	915	2,822	14,672	5,481	3,491	4,937	5,283
28.0	1,135	2,976	1,836	1,137	3,777	17,708	7,066	4,823	5,586	5,762
28.5	1,394	3,663	2,200	1,500	4,556	17,606	7,468	5,162	6,085	5,773
29.0	1,896	3,879	3,062	1,866	4,391	17,579	8,269	5,522	6,267	5,477
29.5	2,241	3,792	3,461	2,232	4,963	16,835	8,009	6,510	4,807	4,952
30.0	2,635	3,727	4,062	2,137	4,901	13,494	7,558	6,451	4,925	4,299
30.5	2,491	3,075	4,682	2,335	4,772	11,596	7,111	6,010	5,140	3,540
31.0	2.646	2,783	4,593	2,401	4,244	10,408	6,533	6,247	4,203	3,194
31.5	2,569	2,307	4,142	2,437	3,527	8,736	5,669	6,224	4,213	2,593
32.0	2,134	2,218	4,063	2,344	2,924	7,850	4,066	5,337	4,324	1,753
32.5	2,126	1,687	3,663	1,905	2,248	4,930	3,624	4,542	4,189	1,643
33.0	1,638	1,586	3,270	1,907	2,081	4,104	2,798	4,238	4,291	1,524
33.5	1,574	1,402	2,953	1,438	1,521	3,600	2,082	3,974	3,471	1,093
34.0	1,348	1,221	2,651	1,542	1,418	2,505	1,537	3,307	3,277	1,027
34.5	1,233	967	2,068	1,362	1,305	2,104	1,458	2,652	2,702	839
35.0	1,080	791	1,632	1,226	953	1,504	998	2,223	3,044	807
35.5	994	707	1,446	712	966	904	958	1,999	2,719	575
36.0	736	618	1,517	858	694	1,053	669	1,506	2,272	519
36.5	695	420	1,017	559	528	906	671	1,504	1,895	461
37.0	519	413	865	555	525	704	435	1,139	1,776	319
37.5	408	368	801	407	494	497	421	1,009	1,277	351

Table 5.-- Weighted length frequencies of weakfish taken at Wildwood, N.J. (cont'd).

Length in centimeters	Frequencies									
	Spring					Fall				
	1928 May 1 - Aug. 11	1929 May 3 - Aug. 10	1939 May 1 - Aug. 15	1931 May 4 - Aug. 15	1932 May 17 - Aug. 15	1928 Aug. 12 - Nov. 20	1929 Aug. 12 - Nov. 12	1930 Aug. 16 - Nov. 3	1931 Aug. 16 - Nov. 16	1932 Aug. 16 - Nov. 3
38.0	419	332	607	376	458	469	339	1,082	1,330	246
38.5	281	217	514	286	386	384	254	811	1,370	246
39.0	201	266	386	428	320	269	294	700	1,182	204
39.5	179	193	359	178	296	246	325	554	958	214
40.0	131	207	327	252	255	198	272	517	972	217
40.5	125	175	321	69	184	23	174	475	667	104
41.0	121	128	270	85	135	127	181	291	511	150
41.5	76	133	193	62	109	73	171	255	751	174
42.0	57	99	118	57	107	50	116	308	460	154
42.5	67	54	138	60	100	104	207	212	297	126
43.0	53	71	127	58	68	41	127	126	324	89
43.5	29	30	128	56	76	109	132	107	286	87
44.0	50	55	74	50	34	23	83	92	233	67
44.5	23	31	96	24	46	54	125	139	196	81
45.0	22	43	61	42	45	-	85	74	228	83
45.5	14	16	63	22	47	36	87	46	166	80
46.0	19	55	37	22	24	11	185	59	116	50
46.5	19	15	37	14	24	32	185	45	134	53
47.0	13	14	36	24	24	-	87	70	115	78
47.5	6	14	43	15	16	-	81	23	71	37
48.0	10	1	26	11	18	-	33	22	80	38
48.5	-	6	16	12	11	-	71	47	74	29
49.0	5	41	17	11	15	-	59	31	48	29
49.5	4	4	23	4	7	-	81	12	62	18
50.0	10	6	11	4	7	-	82	27	19	24
50.5	5	14	13	4	9	-	26	12	2	12
51.0	3	-	7	9	1	-	10	-	10	16
51.5	3	14	4	4	4	-	26	-	31	25
52.0	1	1	9	14	9	-	16	-	8	10

Table 5.--Weighted length frequencies of weakfish taken at Wildwood, N. J. (cont'd).

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	May 1 - Aug. 11	May 3 - Aug. 10	May 1- Aug. 15	May 4 - Aug. 15	May 17 - Aug. 15	Aug. 12 - Nov. 20	Aug. 12 - Nov. 12	Aug. 16 - Nov. 3	Aug. 16 - Nov. 16	Aug. 16 - Nov. 3
52.5	2	4	4	7	4	-	26	11	8	7
53.0	2	4	10	7	6	-	17	-	17	7
53.5	3	15	4	1	-	-	10	12	-	3
54.0	-	4	6	7	4	-	26	17	-	11
54.5	2	1	6	8	3	-	17	-	-	4
55.0	1	-	3	4	3	-	16	11	-	4
55.5	2	1	9	1	5	-	-	-	-	-
56.0	3	1	3	6	3	-	26	-	-	-
56.5	2	4	2	3	1	-	30	-	-	4
57.0	6	2	4	4	2	-	-	-	-	4
57.5	-	5	4	4	-	-	14	17	-	-
58.0	4	1	1	1	1	-	10	-	-	4
58.5	7	14	2	3	1	-	-	-	-	-
59.0	3	14	2	5	-	-	16	12	2	4
59.5	5	-	4	6	1	-	-	-	-	-
60.0	2	-	4	3	1	-	-	-	-	4
60.5	5	2	3	2	3	-	-	-	-	-
61.0	3	5	2	2	1	-	14	-	-	5
61.5	-	14	1	3	-	-	-	-	-	-
62.0	-	15	1	6	-	-	-	-	8	4
62.5	2	5	-	1	2	-	-	-	-	-
63.0	3	14	3	-	1	-	-	-	-	-
63.5	1	-	1	-	1	-	-	-	-	-
64.0	-	7	-	1	-	-	10	-	-	-
64.5	-	-	3	1	-	-	10	-	-	-
65.0	4	-	3	1	-1	-	-	-	-	-
65.5	-	-	2	-	1	-	-	-	-	-

Table 5.--Weighted length frequencies of weakfish taken at Wildwood, N. J. (cont'd)

Length in centimeters	Frequencies									
	Spring					Fall				
	1928 May 1 - Aug. 11	1929 May 3 - Aug. 10	1930 May 1 - Aug. 15	1931 May 4 - Aug. 15	1932 May 17 - Aug. 15	1928 Aug. 12 - Nov. 20	1929 Aug. 12 Nov. 12	1930 Aug. 16 - Nov. 3	1931 Aug. 16 - Nov. 16	1932 Aug. 16 - Nov. 3
66.0	-	1	2	1	-	-	-	-	-	-
66.5	-	14	2	1	-	-	-	-	-	-
67.0	-	14	-	3	1	-	24	-	-	-
67.5	1	14	2	3	-	-	-	-	-	-
68.0	1	5	2	4	-	-	-	-	-	-
68.5	-	1	1	-	-	-	-	-	-	-
69.0	-	4	-	-	-	-	-	-	-	-
69.5	2	-	-	-	-	-	-	-	-	-
70.0	-	1	-	1	-	-	-	-	-	-
70.5	-	4	-	1	-	-	-	-	-	-
71.0	-	5	-	4	-	-	-	-	-	-
71.5	-	14	-	5	-	-	-	11	-	-
72.0	-	1	1	5	-	-	-	-	-	-
72.5	-	2	-	4	-	-	-	-	-	-
73.0	-	1	3	2	-	-	-	-	-	-
73.5	-	-	1	-	-	-	-	-	-	-
74.5	2	4	-	2	-	-	-	-	-	-
75.0	1	-	-	-	-	-	-	-	-	-
75.5	1	-	-	-	-	-	-	-	-	-
76.0	-	4	-	-	-	-	-	-	-	-
76.5	6	-	-	-	-	-	-	-	-	-
78.0	-	-	-	2	-	-	-	-	-	-
79.0	-	-	1	-	-	-	-	-	-	-
80.0	-	4	-	-	-	-	-	-	-	-
Total	37,267	50,818	63,267	36,829	61,680	193,823	104,316	96,085	103,564	658,872

Table 6.--Weighted length frequencies of weakfish taken in northern N. J.

Length in centimeters	Frequencies					
	Spring			Fall		
	1928	1930	1931	1928	1930	1931
	May 1 - Aug. 31	May 1 - Aug. 30	May 1 - Aug. 29	Sept. 1 - Nov. 22	Aug. 31 - Nov. 15	Aug. 30 Nov. 19
24.0	9	14	4	-	21	-
24.5	32	33	-	10	-	-
25.0	35	42	9	-	-	-
25.5	57	54	16	-	-	-
26.0	97	82	27	5	2	-
26.5	110	124	18	16	2	-
27.0	108	144	53	-	21	-
27.5	124	209	46	21	-	-
28.0	99	226	71	35	-	-
28.5	93	219	74	70	3	-
29.0	77	224	132	106	21	-
29.5	59	222	105	164	33	-
30.0	60	160	89	398	75	-
30.5	46	185	124	456	65	58
31.0	66	116	90	647	177	-
31.5	87	121	119	926	94	36
32.0	155	105	60	1,187	231	74
32.5	187	122	143	1,429	450	18
33.0	300	108	82	1,745	450	58
33.5	347	81	104	2,173	588	219
34.0	383	67	76	1,972	1,043	293
34.5	469	66	75	2,402	1,173	226
35.0	538	65	84	2,370	1,534	469
35.5	556	89	93	2,444	1,902	507
36.0	520	93	100	2,237	1,801	390
36.5	477	123	95	2,109	2,310	399
37.0	473	137	107	1,927	2,393	546
37.5	440	142	195	1,594	2,344	663
38.0	416	180	135	1,398	2,082	629
38.5	357	187	149	1,145	2,506	1,139
39.0	321	235	102	846	1,904	905
39.5	279	294	108	653	1,762	893
40.0	251	325	141	542	1,548	1,268
40.5	207	268	231	392	1,669	1,830
41.0	218	300	75	315	1,325	1,418
41.5	166	271	144	255	1,124	1,509
42.0	136	262	217	195	1,015	1,624
42.5	117	290	157	235	940	1,554
43.0	94	245	175	152	887	1,103
43.5	109	200	195	136	673	1,333
44.0	79	218	166	107	770	1,041
44.5	67	174	120	51	551	986
45.0	51	165	119	47	458	1,216
45.5	69	144	100	63	334	702
46.0	62	110	102	24	355	801
46.5	46	96	69	20	249	560
47.0	49	83	69	28	187	503
47.5	28	63	62	39	307	356
48.0	27	73	27	7	240	291
48.5	41	51	16	4	131	286
49.0	28	43	12	13	151	188
49.5	16	37	24	15	132	220
50.0	22	39	38	12	58	52
50.5	25	22	27	9	58	73

Table 6.-- Weighted length frequencies of weakfish taken in northern, N. J. (cont'd.)

Length in centimeters	Frequencies					
	Spring			Fall		
	1928	1930	1931	1928	1930	1931
	May 1 - Aug. 31	May 1 - Aug. 30	May 1 - Aug. 29	Sept. 1 - Nov. 22	Aug. 31 - Nov. 15	Aug. 30 - Nov. 19
51.0	22	19	11	1	48	48
51.5	7	18	25	-	84	36
52.0	5	31	20	5	19	28
52.5	13	25	4	5	31	36
53.0	1	16	11	5	65	36
53.5	8	17	8	-	27	36
54.0	8	14	9	-	60	40
54.5	3	22	12	-	58	-
55.0	3	20	16	5	12	-
55.5	5	34	-	8	31	-
56.0	8	13	16	-	13	-
56.5	5	6	4	-	-	-
57.0	12	13	8	-	-	-
57.5	2	11	4	-	27	-
58.0	2	5	4	5	19	-
58.5	1	16	-	1	12	18
59.0	6	7	8	-	-	-
59.5	1	6	12	-	12	-
60.0	8	8	8	-	27	-
60.5	-	3	-	1	-	-
61.0	2	7	12	5	-	-
61.5	1	4	-	-	12	-
62.0	-	4	-	-	12	-
62.5	3	8	-	5	27	-
63.0	3	2	4	10	65	-
63.5	2	5	-	6	-	-
64.0	1	8	-	1	12	-
64.5	-	2	-	5	12	-
65.0	-	3	-	1	-	-
65.5	2	5	4	-	-	-
66.0	1	5	-	-	12	-
66.5	-	2	-	-	27	-
67.0	2	-	-	1	12	-
67.5	2	5	7	4	12	-
68.0	-	1	-	5	-	-
68.5	-	7	-	1	23	-
69.0	4	-	-	10	12	-
69.5	-	7	4	-	4	-
70.0	-	2	-	-	-	-
70.5	-	2	-	1	-	-
71.0	-	2	4	-	-	-
72.0	1	3	4	4	-	-
72.5	-	2	-	-	2	-
73.5	-	2	-	-	2	-
74.5	1	4	-	-	4	-
75.0	-	2	-	-	-	-
76.0	-	2	-	-	1	-
77.0	1	2	-	-	-	-
Total	9,421	8,150	5,190	33,241	38,935	26,714

Table 7.--Weighted length frequencies of weakfish taken at Fire Island, N.Y.

Length in centimeters	Spring 1928 1/	1929 2/	1930 3/	1931 4/	Summer 1928 5/	1929 6/	1930 7/	1931 8/	Fall 1928 9/	1929 10/	1930 11/	1931 12/
23.0	-	-	-	-	-	-	-	-	-	-	-	42
23.5	-	-	-	-	-	-	-	-	-	-	-	95
24.0	-	-	-	-	-	-	-	-	-	-	-	127
24.5	-	-	-	-	-	-	-	-	-	-	-	42
25.0	-	328	-	-	-	-	-	-	-	-	6	42
25.5	-	418	4	-	-	-	3	-	-	3	-	21
26.0	-	663	4	2	-	-	3	-	-	-	-	53
26.5	-	939	16	2	-	-	3	-	-	-	-	21
27.0	38	1,005	24	8	-	-	9	4	4	9	-	11
27.5	19	1,004	12	9	-	-	9	-	9	6	6	-
28.0	29	983	28	55	-	2	6	-	35	51	-	11
28.5	57	1,130	24	44	-	5	12	-	44	57	-	-
29.0	39	748	24	24	-	6	-	4	31	131	17	-
29.5	30	687	31	45	-	6	3	12	87	143	17	-
30.0	39	621	16	31	1	-	12	15	161	250	6	-
30.5	19	520	40	34	1	21	3	12	153	257	6	-
31.0	30	382	43	29	1	20	9	8	166	411	6	-
31.5	39	287	44	61	1	20	21	4	174	462	11	-
32.0	96	299	60	20	1	23	30	32	218	605	17	-
32.5	67	227	51	58	7	34	21	4	201	560	34	-
33.0	58	179	32	19	5	39	33	6	240	536	45	-
33.5	96	161	46	36	19	56	33	12	301	522	45	-
34.0	124	209	42	70	36	39	39	8	362	474	84	5
34.5	100	155	49	16	65	42	44	7	362	418	84	13
35.0	136	102	20	61	94	37	48	24	353	423	101	5
35.5	53	90	33	91	120	48	44	28	388	364	73	24
36.0	63	125	7	83	153	37	53	36	366	322	95	56
36.5	55	102	9	169	184	52	48	27	480	265	84	89
37.0	57	54	12	181	258	50	42	19	480	185	101	83
37.5	57	108	7	145	241	62	65	52	488	260	84	56

Table 7.--Weighted length frequencies of weakfish taken at Fire Island, N.Y. (cont'd.)

Length in centimeters	Frequencies											
	Spring				Summer				Fall			
	1928 1/	1929 2/	1930 3/	1931 4/	1928 5/	1929 6/	1930 7/	1931 8/	1928 9/	1929 10/	1930 11/	1931 12/
38.0	45	108	3	62	263	63	65	32	349	170	67	38
38.5	32	113	6	229	296	83	77	40	392	137	129	65
39.0	75	85	1	146	279	105	77	54	314	146	140	51
39.5	89	67	4	155	241	106	113	46	301	92	162	38
40.0	52	73	8	87	289	187	86	64	301	146	151	70
40.5	52	25	4	222	207	159	134	74	262	104	129	24
41.0	69	19	8	86	183	214	187	66	231	69	202	75
41.5	51	42	2	246	166	226	148	118	218	98	174	70
42.0	47	69	1	202	142	254	202	120	144	101	202	75
42.5	11	47	3	264	91	196	197	108	122	60	208	75
43.0	34	43	-	129	79	208	225	117	70	51	314	70
43.5	25	65	3	104	69	248	178	118	78	39	225	83
44.0	28	30	4	56	53	200	220	108	83	36	270	51
44.5	33	27	2	58	38	145	169	154	39	27	275	75
45.0	33	46	5	81	32	126	175	168	57	39	225	51
45.5	16	26	5	10	24	128	175	180	26	18	191	75
46.0	26	18	4	50	13	101	121	180	17	30	202	65
46.5	28	21	6	4	16	69	121	126	17	21	151	56
47.0	12	26	11	24	12	60	119	153	13	15	146	108
47.5	21	29	4	5	9	46	80	140	17	27	134	102
48.0	17	16	3	30	8	30	92	113	17	15	146	65
48.5	27	11	6	4	5	16	53	112	13	-	146	70
49.0	7	19	3	34	2	28	39	145	4	6	73	56
49.5	8	26	3	29	5	15	35	101	9	6	90	108
50.0	20	11	2	6	5	11	42	47	26	18	50	108
50.5	28	16	1	5	2	11	42	36	4	6	73	108
51.0	19	20	2	7	1	8	27	43	4	12	50	51
51.5	19	23	4	5	2	11	12	83	9	-	84	56
52.0	9	11	2	27	1	2	12	49	-	9	28	19
52.5	7	10	4	3	-	8	3	60	-	9	39	38
53.0	16	6	1	25	1	2	6	-	4	3	39	19
53.5	24	40	4	8	-	2	3	35	-	-	28	38

Table 7.--Weighted length frequencies of weakfish taken at Fire Island, N. Y. (cont'd).

Length in centimeters	Frequencies											
	Spring				Summer				Fall			
	1928 1/	1929 2/	1930 3/	1931 4/	1928 5/	1929 6/	1930 7/	1931 8/	1928 9/	1929 10/	1930 11/	1931 12/
54.0	7	12	-	4	1	3	3	51	4	-	39	24
54.5	20	12	1	6	1	-	-	35	4	-	17	24
55.0	6	22	-	8	1	3	6	18	-	-	11	5
55.5	5	37	4	13	-	1	9	18	4	-	11	24
56.0	1	25	-	1	-	-	15	6	-	-	11	38
56.5	3	11	-	24	-	-	-	20	-	-	6	13
57.0	22	3	1	9	-	-	6	11	-	-	-	24
57.5	5	41	1	7	-	-	-	6	4	-	-	5
58.0	32	15	-	9	-	-	3	-	-	3	-	13
58.5	12	26	-	2	-	-	-	11	4	-	6	5
59.0	1	20	-	4	-	-	6	17	4	-	-	19
59.5	5	24	1	10	-	-	-	17	-	-	-	19
60.0	1	26	-	7	-	-	-	-	-	-	-	-
60.5	2	17	-	6	-	-	-	7	-	-	6	5
61.0	33	11	-	7	1	-	-	6	4	3	-	5
61.5	1	14	-	2	-	-	6	6	-	-	6	-
62.0	1	5	-	1	1	1	-	-	4	-	-	-
62.5	21	11	-	23	1	-	-	7	-	-	-	-
63.0	2	6	-	4	-	-	-	6	-	3	-	5
63.5	11	8	-	4	-	-	-	6	-	-	6	13
64.0	1	26	-	9	-	-	-	-	-	3	-	-
64.5	1	64	-	6	-	-	3	6	-	-	6	-
65.0	14	14	5	3	--	-	-	-	-	-	-	-
65.5	1	26	-	6	-	-	-	-	-	-	-	-
66.0	1	20	6	4	-	-	-	-	-	3	-	-
66.5	1	19	1	24	-	-	-	11	-	-	-	-
67.0	1	21	-	1	1	2	6	6	4	-	-	5
67.5	2	22	11	4	-	-	-	11	-	-	-	5
68.0	3	21	-	24	-	-	-	6	-	-	-	-
68.5	2	8	9	-	-	-	-	-	-	-	-	-
69.0	20	7	7	30	-	-	-	6	-	-	-	-
69.5	2	38	-	-	-	-	3	-	-	-	-	5

Table 7.--Weighted length frequencies of weakfish taken at Fire Island, N.Y. (cont'd)

Length in centimeters	Frequencies											
	Spring				Summer				Fall			
	1928 1/	1929 2/	1930 3/	1931 4/	1928 5/	1929 6/	1930 7/	1931 8/	1928 9/	1921 10/	1930 11/	1931 12/
70.0	12	13	3	3	-	-	-	-	-	-	-	-
70.5	11	-	-	1	-	-	3	-	-	3	-	-
71.0	10	7	4	-	-	-	-	-	-	-	6	-
71.5	-	16	4	-	-	-	-	7	-	-	-	5
72.0	-	12	5	4	-	-	-	-	-	-	-	-
72.5	19	-	7	1	-	-	-	-	-	-	6	-
73.0	11	1	3	2	-	-	-	-	-	-	-	-
73.5	11	4	1	9	-	-	-	-	-	-	-	-
74.0	-	2	1	25	-	-	-	-	-	-	-	-
74.5	10	-	-	3	-	-	-	-	-	-	-	5
75.0	10	-	3	-	-	-	-	-	-	-	-	5
75.5	19	1	-	2	-	-	-	-	-	-	-	-
76.0	-	1	1	2	-	-	-	-	-	-	-	-
76.5	-	-	3	2	-	-	-	-	-	-	-	-
77.0	10	-	-	2	-	-	-	6	-	-	-	-
77.5	-	-	4	-	-	-	-	-	-	-	-	-
78.0	-	2	3	5	-	-	-	-	-	-	-	-
78.5	-	-	1	-	-	-	-	-	-	-	-	-
79.0	10	-	-	1	-	-	-	6	-	-	-	-
79.5	-	-	-	5	-	-	-	-	-	-	-	-
80.0	-	1	-	2	-	-	-	-	-	-	- -	-
Total	2,654	13,401	887	4,027	3,728	3,677	3,897	3,597	8,280	8,236	5,602	3,120

1/ May 5 to July 5, inc.
2/ May 8 to July 2, inc.
3/ May 1 to Aug. 16, inc. (6/18-8/16 catch insignificant, included with spring period)
4/ May 4 to July 7, inc.
5/ July 6 to Sept. 18, inc.
6/ July 3 to Sept. 21, inc.
7/ Aug. 17 to Sept. 26, inc.
8/ July 8 to Sept. 22, inc.
9/ Sept.19 to Nov. 14, inc.
10/ Sept. 22 to Nov. 15, inc.
11/ Sept. 27 to Nov. 20, inc.
12/ Sept. 23 to Nov. 19, inc.

Table 8.--Weighted length frequencies of weakfish taken at Montauk, N. Y.

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	Apr. 30 - June 9	May 7 - June 15	Apr. 28 June 19	May 4 - June 19	May 2 - June 6	June 10 - Sept. 27	June 16 - Oct. 31	June 20 - Oct. 31	June 20 - Oct. 31	June 7 - Oct. 25
24.0	7	65	-	-	-	-	-	1	-	-
24.5	11	122	-	-	-	-	1	5	-	-
25.0	26	232	16	1	-	-	1	1	6	-
25.5	54	243	22	2	-	-	--	1	3	-
26.0	41	376	6	3	9	2	2	3	3	17
26.5	83	307	18	3	20	-	5	7	1	11
27.0	119	447	89	7	17	1	7	7	1	12
27.5	116	328	67	11	15	-	7	5	2	8
28.0	111	338	79	14	23	4	12	7	1	17
28.5	65	296	84	20	38	1	24	6	1	8
29.0	82	307	91	22	22	2	29	13	3	4
29.5	55	254	79	17	43	-	34	18	-	3
30.0	45	182	103	20	43	1	43	19	11	5
30.5	40	134	113	17	35	2	46	27	11	5
31.0	31	127	71	30	26	1	39	31	6	4
31.5	35	112	146	24	26	-	41	25	19	5
32.0	31	103	131	30	30	2	40	36	2	8
32.5	25	68	132	17	29	-	41	38	12	6
33.0	32	70	163	45	23	4	35	42	23	9
33.5	33	86	135	52	26	2	31	48	27	10
34.0	26	32	116	58	24	2	19	48	22	8
34.5	43	48	124	47	24	4	17	60	11	5
35.0	45	65	133	61	18	3	21	50	22	8
35.5	45	54	80	98	25	5	11	43	20	7
36.0	50	52	73	63	20	6	14	33	31	6
36.5	52	49	89	54	21	8	9	43	24	5
37.0	42	63	61	89	27	7	22	42	18	4
37.5	52	77	47	78	25	9	12	33	25	3
38.0	46	39	54	96	22	9	17	22	25	4
38.5	39	63	34	107	18	13	24	24	26	4

Table 8.--Weighted length frequencies of weakfish taken at Montauk, N.Y. (cont'd.)

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	Apr. 30 - June 9	May 7 - June 15	Apr. 28 - June 19	May 4 - June 19	May 2 - June 6	June 10 - Sept. 27	June 16 - Oct. 31	June 20 - Oct. 31	June 20 - Oct. 31	June 7 - Oct. 25
39.0	43	57	22	64	23	17	20	16	33	3
39.5	30	43	41	59	25	17	19	17	42	3
40.0	21	115	29	115	27	18	29	21	41	3
40.5	24	66	83	67	40	18	31	16	51	2
41.0	36	75	47	85	17	15	25	31	43	1
41.5	30	44	40	92	33	23	37	13	46	3
42.0	22	31	51	78	29	18	29	7	40	4
42.5	16	37	40	66	25	21	19	13	53	3
43.0	20	38	33	57	27	21	26	14	43	3
43.5	22	42	30	81	21	25	37	25	20	4
44.0	20	50	20	53	19	18	32	12	50	4
44.5	7	8	13	33	14	9	34	19	47	3
45.0	14	38	25	39	26	14	37	11	34	3
45.5	18	20	25	42	14	13	33	9	42	2
46.0	10	12	5	24	14	14	30	16	47	4
46.5	7	21	25	39	20	14	32	8	40	4
47.0	10	20	15	31	14	9	15	10	44	2
47.5	9	2	32	26	5	8	27	16	42	4
48.0	4	3	12	31	15	16	23	8	32	7
48.5	5	14	17	20	2	12	15	9	65	3
49.0	8	9	13	8	7	8	23	13	39	4
49.5	6	26	10	10	7	9	17	7	43	3
50.0	6	3	13	22	8	6	17	8	29	7
50.5	7	6	23	10	9	6	14	8	45	3
51.0	5	4	19	4	7	5	11	6	29	6
51.5	3	6	15	5	4	5	9	10	28	3
52.0	2	8	4	2	4	4	11	8	27	3
52.5	5	2	25	5	2	3	9	6	23	5
53.0	4	3	6	5	4	4	6	5	9	6
53.5	4	6	14	7	5	3	6	5	11	2

Table 8.--Weighted length frequencies of weakfish taken at Montauk, N.Y.(cont'd.)

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	Apr. 30 - June 9	May 7 - June 15	Apr. 28 - June 19	May 4 - June 19	May 2 June 6	June 10 - Sept. 27	June 16 - Oct. 31	June 20 - Oct. 31	June 20 - Oct. 31	June 7 - Oct. 25
54.0	8	6	14	8	8	2	6	6	11	6
54.5	6	2	22	1	2	5	6	5	9	3
55.0	8	6	11	11	4	4	5	6	11	4
55.5	5	3	16	3	2	3	5	4	12	4
56.0	4	2	5	1	2	2	1	4	8	3
56.5	3	6	6	6	3	2	2	3	11	3
57.0	6	-	6	-	2	1	3	5	13	2
57.5	4	-	7	6	2	1	2	3	9	4
58.0	10	-	3	1	2	-	5	4	2	2
58.5	3	8	11	-	4	1	3	3	3	4
59.0	6	-	5	-	4	1	5	4	6	1
59.5	3	-	11	1	-	-	2	2	2	2
60.0	-	2	14	1	1	1	2	5	6	5
60.5	6	2	1	1	-	-	1	2	1	1
61.0	6	-	2	5	-	1	2	2	3	4
61.5	1	6	2	5	-	-	3	2	-	2
62.0	2	8	8	-	-	-	3	1	3	2
62.5	2	2	11	1	-	-	1	1	4	1
63.0	2	3	1	-	-	-	3	2	1	1
63.5	2	11	11	-	-	-	3	2	3	2
64.0	4	-	5	1	-	-	3	3	4	-
64.5	8	5	1	-	-	1	2	-	1	1
65.0	5	2	4	-	-	-	1	2	2	2
65.5	1	3	3	-	-	-	2	1	1	1
66.0	4	6	1	7	-	-	2	2	6	2
66.5	-	-	1	1	-	-	1	-	1	1
67.0	1	2	3	-	-	-	1	1	7	2
67.5	3	10	3	1	-	-	-	-	1	1

Table 8.--Weighted length frequencies of weakfish taken at Montauk, N. Y. (cont'd)

Length in centimeters	Frequencies									
	Spring					Fall				
	1928	1929	1930	1931	1932	1928	1929	1930	1931	1932
	Apr. 30 - June 9	May 7 - June 15	Apr. 28 - June 19	May 4 - June 19	May 2 June 6	June 10- Sept. 27	June 16 - Oct. 31	June 20 - Oct. 31	June 20 - Oct. 31	June 7 - Oct. 25
68.0	2	6	1	4	-	-	1	3	3	1
68.5	-	2	5	1	-	-	1	-	6	1
69.0	2	-	1	-	-	-	1	4	1	1
69.5	2	2	3	-	-	-	-	4	1	-
70.0	2	-	1	-	-	-	-	2	4	2
70.5	-	-	8	-	-	-	1	-	4	-
71.0	2	2	-	5	-	-	-	2	-	-
71.5	3	5	8	4	-	-	1	1	1	1
72.0	4	5	2	-	-	1	-	2	-	1
72.5	1	-	2	5	-	-	-	-	2	-
73.0	1	-	-	-	-	-	1	1	-	-
73.5	2	2	-	-	-	-	1	-	-	-
74.0	5	10	-	-	-	-	-	1	2	-
74.5	2	5	3	-	-	-	-	1	-	-
75.0	1	14	4	-	-	-	-	1	-	1
75.5	1	-	5	-	-	-	-	-	-	-
76.0	2	-	-	-	-	-	1	1	-	-
76.5	2	-	-	-	-	-	-	-	-	-
77.0	1	-	-	-	-	-	-	-	-	-
77.5	-	5	4	-	-	-	-	-	-	-
78.0	-	-	2	-	-	-	1	-	-	-
79.0	-	5	-	-	-	-	1	-	-	-
79.5	2	5	-	-	-	-	1	-	-	-
80.0	1	-	2	-	-	-	-	-	-	-
80.5	1	-	-	-	-	-	-	-	-	-
81.0	1	-	-	-	-	-	-	-	-	-
84.0	1	-	-	-	-	-	-	-	-	-
86.5	1	-	-	-	-	-	-	-	-	-
Total	2,049	5,711	3,342	2,346	1,152	487	1,363	1,203	1,659	367

Table 9.--Length frequency distribution of weakfish from certain locations.

Length in	Frequencies																								
	North Carolina	Chesapeake Bay				Exmore			Wildwood			Beach Haven		Northern New Jersey				Fire Island			Montauk				
centimeters	1934	1929	1931	1933	1934	1929	1933	1934	1928	1930	1934	1930	1931	1928	1930	1931	1934	1930	1931	1934	1929	1930	1931	1932	1934
22.0	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.0	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.5	-	-	1	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24.0	-	-	1	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24.5	-	4	2	3	-	-	-	6	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25.0	3	9	4	5	2	1	7	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25.5	-	1	2	11	3	-	9	3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.0	2	9	1	7	1	1	12	7	3	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.5	15	3	4	2	5	1	16	-	11	15	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-
27.0	3	7	-	17	5	3	18	6	16	9	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
27.5	12	3	-	9	14	3	13	4	26	17	4	1	-	-	-	-	-	-	-	-	2	-	-	-	-
28.0	14	3	-	10	5	2	11	1	27	23	6	-	-	1	-	-	-	-	-	-	7	-	1	-	-
28.5	11	2	1	7	4	-	13	1	33	27	12	1	1	-	2	-	-	-	-	-	15	-	-	-	-
29.0	15	-	1	8	1	3	8	3	22	16	9	5	1	-	-	-	-	-	-	-	15	1	-	-	-
29.5	8	1	-	5	3	-	6	3	29	14	5	2	2	1	1	-	-	-	-	-	20	-	-	-	1
30.0	5	2	-	2	1	-	7	1	23	8	2	9	2	5	1	-	-	-	-	-	19	4	2	-	3
30.5	2	-	-	1	3	-	3	-	8	6	5	7	11	7	6	-	-	-	-	-	32	6	2	-	3
31.0	3	-	-	3	1	-	1	1	13	6	4	5	9	7	4	-	-	-	-	-	23	7	1	-	10
31.5	-	-	-	-	-	-	9	-	4	-	3	6	12	8	4	1	1	-	-	-	33	8	1	-	10
32.0	-	-	1	-	1	-	3	1	6	2	3	12	21	8	4	1	3	1	-	-	37	8	2	3	15
32.5	-	-	-	-	-	-	3	-	2	1	5	5	15	16	15	-	1	1	-	-	39	5	1	-	21
33.0	-	-	-	-	-	-	2	-	2	1	1	2	22	14	7	-	4	2	-	-	36	5	5	-	23
33.5	-	-	-	-	2	-	3	-	6	-	-	-	13	7	7	2	5	2	-	-	21	5	6	-	27
34.0	-	-	-	-	-	-	3	-	-	-	-	3	13	9	6	3	3	1	-	-	26	7	4	2	13
34.5	-	-	-	-	-	-	2	-	-	2	1	-	12	7	2	4	8	5	1	1	18	7	8	3	17
35.0	-	-	-	-	-	-	2	-	-	-	-	1	8	4	6	6	3	3	-	-	16	8	1	5	13
35.5	-	-	-	-	-	-	-	-	-	-	-	1	4	5	3	6	4	1	1	2	11	7	4	4	11
36.0	-	-	-	-	-	-	-	1	1	-	-	1	5	2	3	3	2	1	2	-	13	3	7	8	1
36.5	-	-	-	-	1	-	-	1	-	-	-	-	2	2	6	9	4	-	2	1	11	3	7	3	5
37.0	-	-	-	-	-	-	-	-	-	-	-	-	1	3	5	4	5	-	2	-	16	4	8	5	11
37.5	-	-	-	-	-	-	-	-	-	-	1	1	3	-	-	11	3	2	4	1	9	1	5	2	3
38.0	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	7	1	-	2	2	7	1	6	3	4
38.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	8	-	-	3	1	5	2	4	4	-
39.0	-	-	-	-	-	-	-	1	-	-	1	-	1	1	-	4	-	1	1	1	5	1	4	1	2
39.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	2	-	1	1	-	3	-	2	1	1
40.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	8	1	-	-	-	7	-	-	1	-
40.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	3	-	1	3	-	2	2	-
41.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	1	1	-	-	1
41.5	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	-	1	-	1	-	1	1	1
42.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	1	-
42.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	4	-	1	-	-
43.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	2	-	-	-	-	1
43.5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1
44.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1
44.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1
45.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
45.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
46.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-
47.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
47.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
49.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
51.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
65.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Total	93	44	21	94	53	14	158	46	235	161	65	63	159	109	87	96	53	24	27	15	469	96	86	50	200

consistent criteria of interpretation were found. The method was confirmed by a quantitative analysis of the intra-circuli distance. In all the samples examined, those taken in July and in some localities in the early part of August, were impossible to interpret. No attempt has been made, therefore, to estimate the numbers of fish of each age group in the average catch-per-net for the season.

The 0 and I-groups were oversampled in reading the scale collections from Wildwood, N. J. in 1931 and 1932 and from northern New Jersey in 1931. This was done to secure as many representatives of this group as possible in the samples used for measuring circulus spacing. Weakfish older than the V-group have been omitted as they are two few to be important.

In tables 10 to 20 each age group is represented in most localities by samples from more than one year class. In figures 6 to 8 these samples have been combined for each age group and the length frequencies are given in percentages, owing to the disparity in numbers between dominant and subdominant groups.

Judging from these data, it appears that during the period of the study,

1) Juvenile (O-group) weakfish were taken in autumn in many localities from eastern Long Island to North Carolina (table 10, figure 6).

The numbers in these samples do not indicate relative abundance in the several localities, for in several instances special effort was made to secure large samples of O-group fish.

For reasons set forth later, (Section "Origin of Northern Juveniles") it is an open question whether all of the O-group fish were spawned in the localities where they were captured or whether rather extensive migrations had occurred between spawning in June and capture in October.

2) The length frequency distributions from localities south of Delaware Bay indicate that the stocks there were made up in the main of small fish among which yearlings (I-group) were well represented. In North Carolina, fish of this age group were present through the whole season, (Higgins and Pearson, 1927) but in Virginia they were not numerous until midsummer (fig. 6).

3) North of Delaware Bay yearlings occurred in significant numbers only in southern New Jersey (Wildwood and Beach Haven). There they did not appear until midsummer, but they did not constitute more than 20 percent of the catch in any of the years in which observations were made.

Apparently most O-group weakfish winter off the coast of North Carolina, for most of them strike in there in spring as I-group fish. Perhaps many of the I-group fish migrate from North Carolina to Virginia and a few to southern

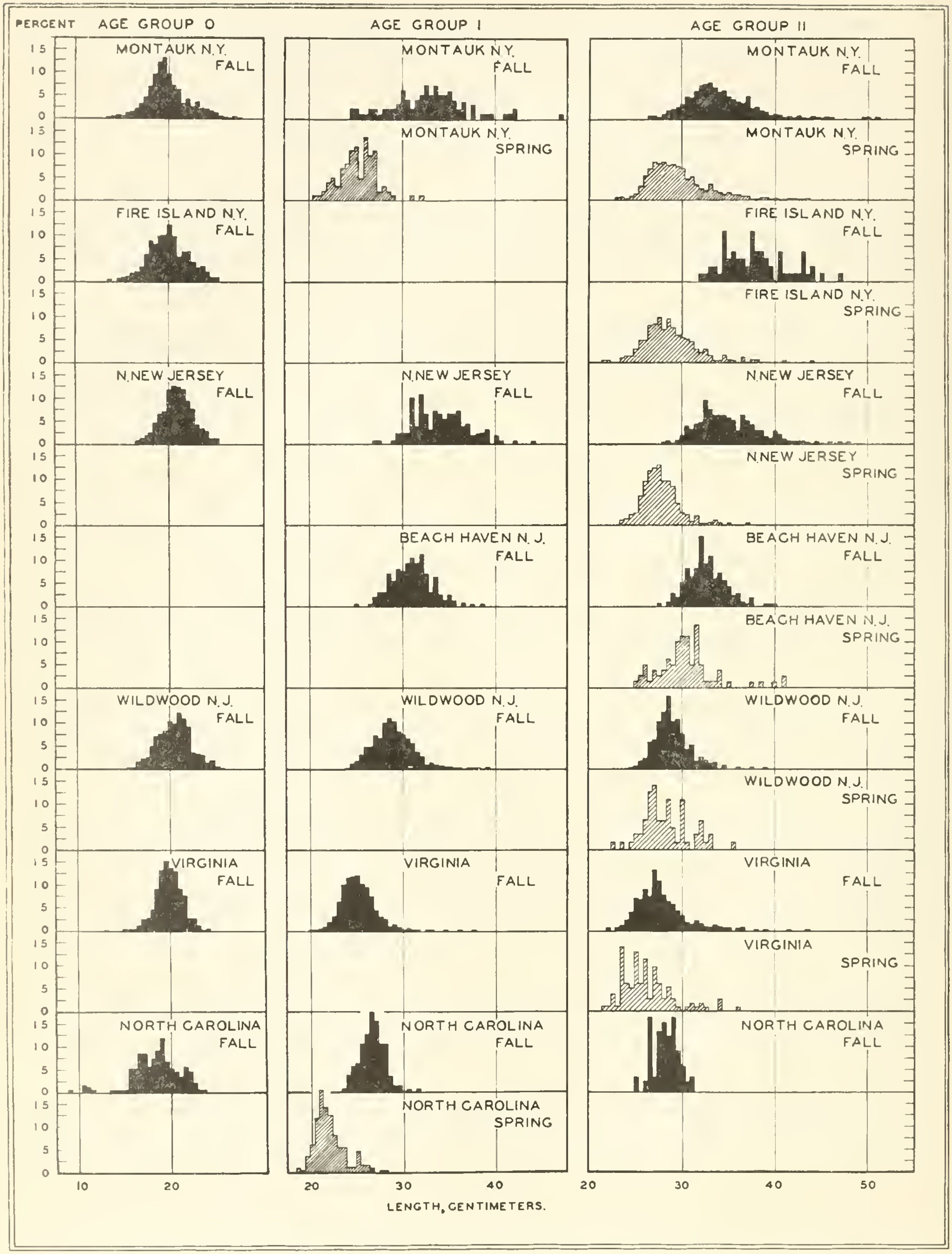

Fig. 6--Length frequency distributions, age groups 0 to II.

Table 10. Length frequency distribution of age group O weakfish, fall sample

Length in	Frequencies																									
	North Carolina		Chesapeake Bay			Exmore		Wildwood			Beach Haven		Northern New Jersey					Fire Island				Montauk				
centimeters	1933	1934	1931	1933	1934	1933	1934	1930	1932	1934	1930	1931	1928	1929	1930	1931	1934	1928	1929	1930	1931	1929	1930	1931	1932	1934
9.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.0	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
14.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-
14.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	5	1	1	-	-
15.0	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	2	2	1	-	-
15.5	9	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	14	-	-	11	2	-	-	-
16.0	9	-	-	-	1	1	-	-	-	1	-	-	-	-	-	-	-	-	27	-	-	10	3	1	-	-
16.5	13	2	-	-	3	5	-	-	-	6	-	-	-	-	1	-	3	-	31	-	-	11	7			2
17.0	15	-	-	-	3	14	1	-	-	8	-	-	-	-	2	-	6	-	48	1	-	8	11	2	-	10
17.5	8	2	-	-	-	17	2	-	-	9	-	1	1	-	8	-	3	2	100	1	1	13	10	1	2	19
18.0	12	1	-	-	3	25	4	-	-	18	-	-	5	-	4	-	8	-	156	2	-	7	16	6	9	30
18.5	11	5	-	-	9	44	9	-	-	26	-	-	11	1	7	1	12	1	136	3	2	17	20	2	11	44
19.0	15	6	-	-	7	57	26	-	-	28	-	-	16	1	9	-	20	3	172	4	1	22	21	4	23	49
19.5	4	8	-	-	9	71	24	2	3	25	-	-	9	-	9	-	30	1	175	3	1	26	16	8	25	54
20.0	3	6	1	-	15	56	21	1	4	30	1	-	39	-	9	1	32	3	208	3	3	12	27	7	20	30
20.5	3	5	-	2	11	65	11	5	9	24	-	-	32	-	13	-	42	6	158	8	4	9	15	7	12	29
21.0	2	4	-	1	2	51	9	5	13	29	-	-	21	-	13	2	49	2	89	3	1	11	28	9	5	9
21.5	1	9	-	-	3	46	3	4	5	31	-	-	22	-	17	2	41	4	91	14	4	3	6	12	6	4
22.0	2	6	-	-	-	16	2	6	4	24	2	-	18	1	17	4	26	4	98	8	4	6	12	14	5	4
22.5	-	4	-	-	-	17	1	4	2	7	1	-	6	1	18	6	22	1	46	11	10	2	7	9	4	2
23.0	-	1	-	-	-	7	1	5	3	5	-	-	6	-	5	3	14	-	33	12	4	2	11	18	2	1
23.5	-	1	-	-	-	2	-	6	3	2	1	-	3	-	5	6	8	-	35	9	9	-	3	16	2	-
24.0	-	-	-	-	-	3	-	4	1	1	-	-	4	-	7	6	1	-	15	6	12	-	2	16	1	-
24.5	-	-	-	-	-	-	-	4	-	3	-	-	4	1	1	2	1	-	5	3	4	1	2	12	-	-
25.0	-	-	-	-	-	-	-	-	-	2	1	-	1	-	1	7	-	-	7	1	4	-	1	10	1	-
25.5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-	-
26.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
26.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
27.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
27.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Total	118	60	1	3	66	502	114	46	47	281	6	1	198	5	146	40	318	27	1,661	92	64	181	225	168	128	287

Table 11.--Length frequency distribution of age group I weakfish, spring sample.

Length in Centimeters	Frequencies							
	North Carolina		Chesapeake Bay	Exmore	Montauk			
	1925	1935	1929	1935	1929	1930	1931	1932
15.0	2	-	-	-	-	-	-	-
16.0	2	-	-	-	-	-	-	-
18.0	3	-	-	-	-	-	-	-
18.5	-	2	-	-	-	-	-	-
19.0	8	1	-	-	-	-	-	-
19.5	-	6	-	2	-	-	-	-
20.0	10	10	-	3	-	-	-	-
20.5	-	20	-	5	-	-	-	1
21.0	14	30	-	2	-	-	-	1
21.5	-	24	-	5	-	2	-	-
22.0	12	21	-	4	-	2	1	1
22.5	-	14	1	2	-	3	-	2
23.0	5	9	-	1	-	2	-	1
23.5	-	9	-	-	-	1	-	6
24.0	2	2	-	-	-	3	1	4
24.5	-	2	-	-	-	2	-	9
25.0	-	8	-	1	1	-	1	10
25.5	-	3	-	-	-	1	-	4
26.0	-	3	-	-	-	1	1	12
26.5	-	2	-	-	-	-	-	10
27.0	-	-	-	-	-	-	-	11
27.5	-	1	-	-	-	-	-	2
28.0	-	1	-	-	-	-	-	3
28.5	-	-	-	-	-	-	-	2
29.0	-	-	-	-	-	-	-	1
31.0	-	-	-	-	-	-	-	1
32.0	-	-	-	-	-	-	-	1
Total	58	168	1	25	1	17	4	82

Table 12. Length frequency distribution of age group I weakfish, fall sample.

Length in centimeters	Frequencies: North Carolina 1934	Chesapeake Bay 1929	Chesapeake Bay 1931	Chesapeake Bay 1933	Chesapeake Bay 1934	Exmore 1929	Exmore 1933	Exmore 1934	Wildwood 1928	Wildwood 1930	Wildwood 1931	Wildwood 1932	Wildwood 1934	Beach Haven 1930	Beach Haven 1931	Northern New Jersey 1928	Northern New Jersey 1930	Northern New Jersey 1931	Northern New Jersey 1934	Fire Island 1930	Montauk 1929	Montauk 1930	Montauk 1931	Montauk 1932
20.0	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.5	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21.0	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21.5	-	-	5	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.0	-	1	15	4	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.5	-	1	20	6	-	-	5	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.0	-	1	27	14	6	-	13	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.5	1	4	41	22	12	-	13	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24.0	5	9	34	25	6	-	23	42	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
24.5	8	5	44	23	17	-	23	29	1	-	-	11	1	-	-	-	-	-	-	1	-	2	-	-
25.0	9	2	24	21	18	-	40	39	2	-	2	10	1	-	1	-	-	-	-	-	2	-	-	-
25.5	15	-	20	26	20	-	36	21	4	4	1	20	4	-	-	-	-	-	-	-	-	1	-	-
26.0	18	9	12	19	26	1	34	13	8	4	6	28	6	-	-	-	-	-	-	-	1	-	-	-
26.5	25	2	11	18	23	-	24	13	1	12	8	25	6	-	1	-	-	-	-	-	2	-	-	-
27.0	22	1	5	10	12	-	14	12	2	5	15	47	10	1	4	-	1	-	-	-	1	1	-	-
27.5	15	2	2	7	12	-	6	7	3	9	19	36	6	-	7	1	-	-	-	-	1	-	-	-
28.0	15	-	1	10	10	-	7	4	1	8	26	59	14	1	6	-	-	-	-	-	-	2	-	-
28.5	5	1	-	3	2	-	5	1	3	8	29	60	20	2	15	-	-	-	-	-	1	1	-	-
29.0	2	-	-	7	5	-	3	2	-	6	23	73	10	2	11	-	1	-	-	-	1	-	1	-
29.5	2	-	-	1	3	-	5	-	1	7	17	61	2	3	16	2	-	2	-	2	1	1	-	1
30.0	-	-	-	1	1	-	2	-	-	4	27	46	4	-	18	1	2	1	-	1	1	1	1	3
30.5	1	-	-	-	2	-	4	1	-	6	19	40	5	2	21	-	1	3	-	-	-	2	-	2
31.0	-	-	-	-	1	-	2	-	2	6	22	30	1	5	20	1	9	7	-	-	-	-	-	2
31.5	1	-	-	1	-	-	1	-	-	3	15	22	1	-	23	-	-	6	-	-	1	1	-	2
32.0	-	-	-	-	-	-	-	-	-	3	15	12	1	2	26	1	4	13	-	1	1	-	-	4
32.5	-	-	-	1	-	-	-	-	-	-	3	8	-	2	15	-	2	9	-	1	1	1	-	5
33.0	-	-	-	-	-	-	-	1	-	2	4	9	-	1	6	-	1	4	-	2	-	-	1	4
33.5	-	-	-	-	-	-	-	-	-	2	4	5	1	2	13	1	3	8	-	-	1	-	-	6
34.0	-	-	-	-	-	-	-	-	-	1	3	4	1	-	6	-	1	10	-	-	-	-	-	5
34.5	-	-	-	1	-	-	-	-	-	-	3	2	-	-	3	-	3	6	-	-	-	1	-	4
35.0	-	-	-	-	-	-	-	-	-	1	1	4	-	1	5	1	2	8	-	2	1	2	-	3
35.5	-	-	-	-	-	-	-	-	-	-	-	4	-	1	2	-	2	8	1	2	-	-	-	4
36.0	-	-	-	1	-	-	-	-	-	-	1	3	-	-	-	-	4	8	-	3	-	-	-	2
36.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	6	-	-	-	1	-	3
37.0	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	7	-	-	-	-	-	-
37.5	-	-	-	1	-	-	-	-	-	-	-	2	-	-	1	-	2	1	-	-	-	-	-	3
38.0	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	2	-	1	-	-	-	-
38.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	-	-	1	-	-	-
39.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	4	-	-	-	-	-	1
39.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
40.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-
40.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
41.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
41.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
42.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
44.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Total	144	38	269	226	178	1	260	238	29	92	265	623	94	26	222	8	41	122	1	16	17	19	3	58

Table 13.--Length frequency distribution of age group II weakfish, spring sample.

Length in centimeters	Frequencies														
	North Carolina	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
	1925	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
21.5	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
22.0	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-
22.5	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-
23.0	-	1	-	-	-	-	-	-	-	-	-	1	1	-	-
23.5	-	15	1	1	-	-	3	1	3	-	-	1	1	1	-
24.0	2	7	-	-	-	-	4	-	5	-	-	1	-	-	-
24.5	-	6	-	1	-	-	7	-	5	-	-	5	-	-	-
25.0	7	15	-	1	1	1	8	2	11	-	-	7	1	-	-
25.5	-	6	1	2	-	2	19	1	21	-	-	13	4	1	1
26.0	14	12	1	3	1	4	29	-	22	-	-	25	4	3	3
26.5	-	2	1	6	2	1	36	5	32	-	-	33	9	1	2
27.0	12	9	2	8	1	3	38	3	35	-	-	37	12	4	1
27.5	-	7	-	2	2	2	40	14	31	-	-	32	11	6	4
28.0	7	2	1	2	2	3	29	7	25	-	1	26	18	4	6
28.5	-	6	-	3	4	5	29	8	32	2	1	17	12	14	7
29.0	5	3	-	2	1	4	26	11	22	-	1	21	13	13	5
29.5	-	-	1	1	-	8	14	6	19	1	1	26	7	7	8
30.0	1	-	-	4	3	9	8	8	16	-	1	20	7	9	9
30.5	-	1	-	-	1	9	7	-	23	-	1	8	7	9	7
31.0	-	2	-	-	-	4	2	6	10	-	5	11	6	11	5
31.5	-	1	-	1	1	11	6	2	8	-	3	6	5	4	7
32.0	-	2	-	1	3	4	1	2	7	-	1	3	2	2	9
32.5	-	1	-	-	1	1	1	6	3	-	4	1	3	2	8
33.0	-	-	-	2	-	1	-	-	3	1	3	3	2	8	10
33.5	-	-	-	-	-	1	3	2	-	-	-	4	1	3	4
34.0	-	3	-	-	-	3	1	1	-	-	1	2	-	2	6
34.5	-	-	-	-	-	-	-	7	-	-	-	-	3	-	6
35.0	-	-	-	-	-	1	1	3	-	-	-	3	1	1	5
35.5	-	-	-	1	-	-	-	2	-	-	-	-	1	1	4
36.0	-	1	-	-	-	-	-	-	-	-	-	1	-	-	5
36.5	-	-	-	-	-	-	-	4	-	-	1	-	2	-	2
37.0	-	-	-	-	-	-	1	-	-	-	-	-	-	1	3
37.5	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-
38.0	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
38.5	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-
39.0	-	.		-	-	-		-	-	-	-	-	-	2	-
40.0	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
41.0	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-
41.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
42.0	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
43.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
44.0	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Total	48	108	8	42	23	82	313	107	334	4	25	307	136	110	129

Table 14.— Length Frequency Distribution of Age Group II Weakfish, Fall Sample

Length cm	Frequencies: North Carolina	Chesapeake Bay				Exmore			Wildwood			Beach Haven		Northern New Jersey				Fire Island			Montauk				
	1934	1929	1931	1933	1934	1929	1933	1934	1928	1930	1934	1930	1931	1928	1930	1931	1934	1930	1931	1934	1929	1930	1931	1932	1934
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	1	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	1	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	4	2	3	-	-	-	6	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	3	9	4	5	2	1	7	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	1	2	11	3	-	9	3	3	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	2	9	1	7	1	1	12	7	3	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	3	4	2	5	1	16	-	11	22	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-
27	3	7	-	17	5	3	18	6	16	13	3	1	-	-	-	-	-	-	-	-	3	-	-	-	-
	12	3	-	9	14	3	13	4	26	28	4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
28	14	3	-	10	5	2	11	1	27	35	6	1	-	1	-	-	-	-	-	-	6	-	-	-	-
	11	2	1	7	4	-	13	1	33	37	12	5	1	-	2	-	-	-	-	-	13	-	-	-	-
29	15	-	1	8	1	3	8	3	22	35	9	2	1	-	-	-	-	-	-	-	14	1	-	-	-
	8	1	-	5	3	-	6	3	29	28	5	9	2	1	1	-	-	-	-	-	18	-	2	-	1
30	5	2	-	2	1	-	7	1	23	19	2	7	2	5	1	-	-	-	-	-	17	4	2	-	3
	2	-	-	1	3	-	3	-	8	28	5	5	11	7	6	-	-	-	-	-	23	6	1	-	3
31	3	-	-	3	1	-	1	1	13	16	4	6	9	7	4	-	-	-	-	-	19	7	1	-	10
	-	-	-	-	-	-	9	-	4	2	3	12	12	8	4	1	1	-	-	-	23	8	2	-	10
32	-	-	1	-	1	-	3	1	6	4	3	5	21	8	4	1	3	1	-	-	26	8	1	3	15
	-	-	-	-	-	-	3	-	2	4	5	2	15	16	15	-	1	1	-	-	27	5	5	-	21
33	-	-	-	-	-	-	2	-	2	3	1	-	22	14	7	-	4	2	-	-	19	5	6	-	23
	-	-	-	-	2	-	3	-	6	1	-	3	13	7	7	2	5	2	-	-	13	5	4	-	27
34	-	-	-	-	-	-	3	-	-	1	-	-	13	9	6	3	3	1	-	-	12	7	8	2	13
	-	-	-	-	-	-	2	-	-	2	1	1	12	7	2	4	8	5	1	1	12	7	1	3	17
35	-	-	-	-	-	-	2	-	-	2	-	1	8	4	6	6	3	3	-	-	6	8	4	5	13
	-	-	-	-	-	-	-	-	-	-	-	1	4	5	3	6	4	1	1	2	4	7	7	4	11
36	-	-	-	-	1	-	-	1	1	-	-	-	5	2	3	3	2	1	2	-	7	3	7	8	1
	-	-	-	-	-	-	-	1	-	-	-	-	2	2	6	9	4	-	2	1	2	3	8	3	5
37	-	-	-	-	-	-	-	-	-	-	-	1	1	3	5	4	5	-	2	-	7	4	5	5	11
	-	-	-	-	-	-	-	-	-	-	1	-	3	-	-	11	3	2	4	1	3	1	6	2	3
38	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	7	1	-	2	2	2	1	4	3	4
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	8	-	-	3	1	3	2	4	4	-
39	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	4	-	1	1	1	2	1	2	1	2
	-	-	-	-	-	-	-	-	-	-	1	-	1	-	2	2	-	1	1	-	1	-	-	1	1
40	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	8	1	-	-	-	5	-	2	1	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	3	-	1	-	-	-	2	-
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-	1	1	-	1
	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	-	-	1	-	1	-	-	1	1
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	1	1	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	1	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	2	-	-	-	-	1
	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1
44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	93	44	21	94	53	14	158	46	235	298	65	63	159	109	87	96	53	24	27	15	296	96	86	50	200

New Jersey in midsummer. It is far more likely that the August increase in numbers of I-group fish in Virginia is due to migration from the group which strikes in on the North Carolina coast in spring than that they represent a belated wave of migrants direct from the winter grounds, for by early August, vernal warming in both Virginia and southern New Jersey has long since been completed, and weakfish of older age groups are well represented there.

4) Two-year-old (age-group II) weakfish are well represented in the samples from southern New Jersey and from Montauk, N. Y. In only one year of the period studied (1929) were they abundant at Fire Island; and they were present in northern New Jersey only in minor quantities and only in the spring. The numerous two year old fish at Montauk and Fire Island in 1929 was not preceded by an abundance of yearlings in these localities in 1928. Furthermore not enough yearlings were observed in southern New Jersey to account for all of the two year old fish seen there the next year. These observations suggest that most of the two year old fish north of Delaware Bay are immigrants, presumably recruited from the stocks of yearlings in localities south of Delaware Bay where such weakfish are regularly present.

5) The fish of three years and more constitute the bulk of the catch only in northern New Jersey and (in some years) at Fire Island. This suggests that just as the two year old fish in southern New Jersey are immigrants from the numerous yearling stocks in the South, the older fish in northern New Jersey and at Fire Island are derived from the southern New Jersey two year old stocks.

6) The rate of growth of weakfish is greater in northern localities than in southern ones. For example, in the autumn, three year old fish have modal lengths of only about 29 centimeters in Virginia, 32 centimeters in southern New Jersey, 35 centimeters in northern New Jersey and 40 centimeters at Montauk (fig. 7).

7) In all localities where samples are available for comparing the sizes of spring-caught and fall-caught weakfish, the fall one and two-year old fish are, as might be expected from growth, larger than spring fish of these age groups (fig. 6). This is also true of age-groups III, IV, and V in New York and northern New Jersey (fig. 7 and 8). But in Virginia and in southern New Jersey the reverse is true. The fall-caught fish of these age-groups are <u>smaller</u> than the spring fish. This is just what would be expected if some of the spring fish in these localities had spent one or more of their previous summers in northern New Jersey or New York where the growth is faster, and were enroute thither when taken. That this phenomenon is limited to the III-group and older fish is explained by the lack of I-group fish in the localities where growth is rapid. Limitation of the phenomenon to Virginia and southern New Jersey localities is explained by the fact that there are no localities where growth is faster than in northern New Jersey and New York, hence no localities whence larger fish might some in spring.

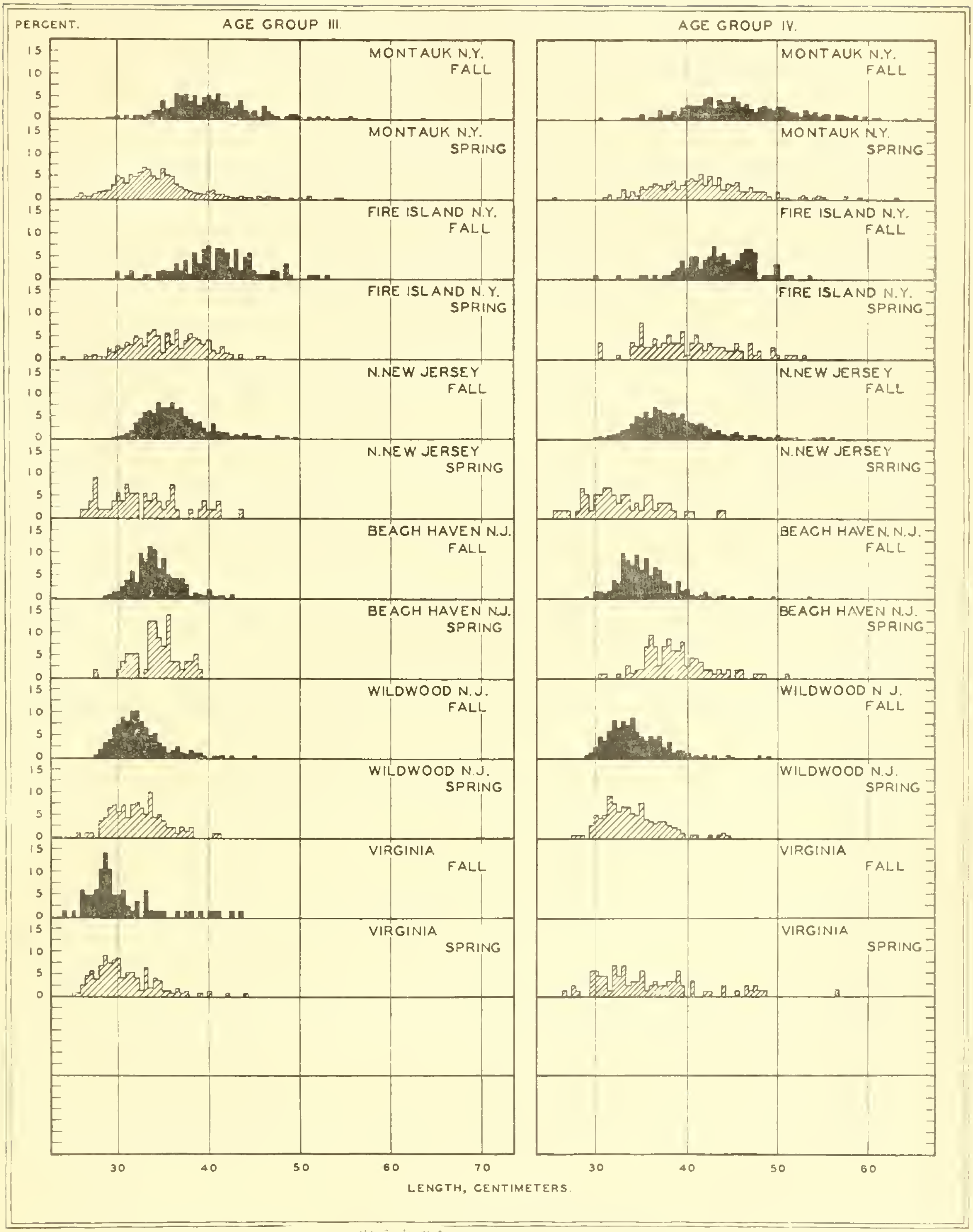
PERCENT.
AGE GROUP III.
AGE GROUP IV.
MONTAUK N.Y.
FALL
MONTAUK N.Y.
SPRING
FIRE ISLAND N.Y.
FALL
FIRE ISLAND N.Y.
SPRING
N.NEW JERSEY
FALL
N.NEW JERSEY
SPRING
BEACH HAVEN N.J.
FALL
BEACH HAVEN N.J.
SPRING
WILDWOOD N.J.
FALL
WILDWOOD N.J.
SPRING
VIRGINIA
FALL
VIRGINIA
SPRING
N.NEW JERSEY
SRRING
BEACH HAVEN. N.J.
WILDWOOD N J.
15
10
5
0
30
40
50
60
70
LENGTH, CENTIMETERS.

Table 15.--Length frequency distribution of age group III weakfish, spring sample.

Length in	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
centimeters	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
24.0	-	-	-	-	-	-	-	1	-	-	-	-	-	-
25.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-
25.5	1	-	-	1	-	-	-	-	-	-	-	-	-	1
26.0	4	-	-	-	-	1	-	-	-	-	2	-	-	3
26.5	5	3	1	-	-	1	-	2	-	-	-	-	-	2
27.0	6	4	1	-	-	2	-	1	-	-	-	1	-	1
27.5	7	-	-	-	1	5	2	-	-	-	-	-	-	4
28.0	5	7	-	5	-	1	1	-	-	-	-	1		6
28.5	12	4	3	3	-	1	1	-	-	-	-	1	.	7
29.0	11	2	4	5	-	1	1	3	1	-	2	1	1	5
29.5	11	3	5	5	-	2	2	2	-	-	1	5	-	8
30.0	8	7	3	5	1	3	1	3	1	1	3	10	1	9
30.5	6	1	3	7	2	2	2	2	1	-	1	13	-	7
31.0	7	2	2	4	3	4	3	3	2	-	3	6	2	5
31.5	9	-	4	6	3	3	2	4	1	-	1	14	2	7
32.0	6	1	8	3	3	3	3	6	2	-	2	10	1	9
32.5	2	-	7	2	-	-	3	5	1	1	2	14	3	8
33.0	9	2	3	4	1	3	1	2	3	-	6	14	1	10
33.5	2	1	4	10	7	2	3	7	3	-	8	14	4	4
34.0	7	-	5	1	7	3	3	6	4	1	1	14	2	6
34.5	5	1	3	4	5	2	-	8	2	1	2	9	3	6
35.0	2	-	5	-	4	1	1	2	-	-	4	13	9	5
35.5	2	-	3	-	8	2	2	7	3	-	3	10	7	4
36.0	1	-	1	2	2	4	2	5	-	-	3	10	4	5
36.5	2	1	1	-	2	1	3	10	-	1	1	9	2	2
37.0	1	-	2	1	1	-	2	3	-	-	2	6	1	3
37.5	1	1	-	2	2	-	-	9	-	-	1	3	5	-
38.0	-	-	3	-	2	1	4	7	-	1	-	8	-	-
38.5	-	-	-	-	3	-	-	9	-	1	-	6	-	-
39.0	1	-	-	-	1	1	2	7	-	-	-	3	2	-
39.5	-	-	-	-	-	2	2	5	-	-	-	1	3	-
40.0	2	-	-	-	-	1	1	6	1	1	1	5	1	-
40.5	-	-	1	-	-	1	2	2	-	-	1	7	1	-
41.0	-	-	1	-	-	2	1	2	-	-	-	3	1	-
41.5	-	-	-	-	-	-	2	4	-	-	-	2	1	1
42.0	1	-	-	-	-	-	-	3	-	-	-	2	-	-
42.5	-	-	-	-	-	-	1	1	-	-	-	-	1	-
43.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
43.5	-	-	-	-	-	1	-	2	-	-	-	1	-	1
44.0	1	-	-	-	-	-	-	-	-	-	-	-	1	-
44.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-
45.5	-	-	-	-	-	-	1	-	-	-	-	2	-	-
46.0	-	-	-	-	-	-	1	-	-	-	-	1	-	-
46.5	-	-	-	-	-	-	-	-	-	-	-	3	-	-
47.0	-	-	-	-	-	-	-	-	-	-	-	-	1	-
47.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1
49.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
50.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
51.0	-	-	-	-	-	-	-	-	-	-	-	1	1	-
54.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1
54.5	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Total	138	40	73	70	58	56	55	139	25	8	50	227	62	131

Table 16.--Length frequency distribution of age group III weakfish, fall sample.

Length in	Frequencies																						
	North Carolina	Chesapeake Bay			Exmore			Wildwood			Beach Haven		Northern New Jersey				Fire Island			Montauk				
centimeters	1934	1929	1933	1934	1929	1933	1934	1928	1930	1934	1930	1931	1928	1930	1931	1934	1930	1931	1934	1929	1930	1931	1932	1934
24.0	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25.0	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.0	1	2	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.5	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27.0	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27.5	3	1	1	-	-	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28.0	5	3	-	3	1	2	-	2	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28.5	3	1	5	2	1	1	2	6	7	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
29.0	1	3	2	-	1	-	3	11	6	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-
29.5	5	-	2	-	-	2	-	8	18	2	3	1	-	1	-	-	-	-	-	1	-	-	-	-
30.0	3	1	-	2	-	1	-	13	16	2	3	1	1	1	-	-	2	-	-	2	1	-	-	-
30.5	3	-	2	2	-	1	-	11	20	7	2	5	3	-	1	-	-	-	-	1	1	-	-	-
31.0	2	-	-	-	1	1	-	10	17	7	6	6	3	3	1	-	1	-	-	2	1	-	-	-
31.5	1	1	-	-	-	-	-	15	24	5	9	9	9	4	-	-	2	-	-	-	2	-	-	-
32.0	1	-	-	1	-	1	1	16	23	5	5	5	18	6	1	1	-	-	-	1	2	-	-	1
32.5	-	-	-	-	-	-	-	18	14	2	12	18	26	6	-	-	-	-	-	1	3	-	-	-
33.0	-	-	-	-	-	4	1	9	13	6	11	15	38	4	1	-	1	-	-	-	2	-	-	-
33.5	-	-	1	-	-	-	-	5	14	2	9	26	37	5	4	-	1	-	-	3	2	-	-	-
34.0	-	-	-	1	-	-	-	8	12	3	8	25	31	5	5	-	-	-	-	2	4	2	-	-
34.5	-	-	-	1	-	-	-	5	6	3	3	17	50	6	4	-	1	-	1	1	7	-	-	1
35.0	-	-	-	-	-	-	1	-	8	2	6	21	34	14	1	1	2	-	-	8	6	3	1	3
35.5	-	-	-	-	-	-	-	-	2	2	3	13	34	8	5	3	2	-	-	2	7	2	-	-
36.0	-	-	-	-	-	-	-	1	3	2	2	11	41	9	4	5	2	-	-	5	5	1	-	1
36.5	-	-	-	-	-	-	1	2	8	-	3	10	28	9	8	3	3	-	1	6	14	7	-	1
37.0	-	-	-	-	-	-	-	1	3	-	4	9	24	8	14	5	2	-	-	7	13	6	-	-
37.5	-	-	-	-	-	-	1	1	-	2	2	7	16	13	6	1	4	-	1	4	18	5	-	-
38.0	-	-	-	-	-	1	-	1	3	3	-	1	14	5	9	3	-	-	1	4	10	6	-	-
38.5	-	-	-	-	-	-	-	1	1	2	2	1	5	9	6	5	6	-	1	10	11	4	-	1
39.0	-	-	-	-	-	-	1	-	-	4	1	1	8	10	8	1	2	-	2	3	9	2	-	-
39.5	-	-	-	-	-	-	-	-	1	-	-	1	3	2	7	3	5	1	2	5	13	4	2	-
40.0	-	-	-	1	-	-	-	-	-	-	3	3	-	5	2	2	6	-	3	6	13	5	2	-
40.5	-	-	-	-	-	-	1	-	-	1	1	-	1	13	5	5	1	-	1	4	8	8	1	-
41.0	-	-	-	-	-	1	-	-	-	1	-	1	2	2	5	1	3	-	5	3	20	5	1	-
41.5	-	-	-	-	-	-	-	-	1	-	1	-	1	2	5	1	1	1	6	4	12	2	1	-
42.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6	1	4	-	3	3	11	2	3	-
42.5	-	-	-	-	-	-	1	-	-	1	2	-	-	1	1	-	1	-	2	1	9	-	1	-
43.0	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	1	7	-	1	2	8	3	1	-
43.5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	1	1	-	1	3	17	-	-	1
44.0	-	-	-	-	-	-	-	-	-	-	-	-	1	4	1	1	4	-	2	5	3	2	-	-
44.5	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	1	3	1	6	1	-	-
45.0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3	-	-	-	2	1	4	2	2	-
45.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	1	-	-	1	1	-	-	-
46.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	10	1	2	-
46.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	5	1	1	-
47.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2	-	2	-
47.5	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	1	-	1	-	3	-	-	-
48.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	-	1	-
48.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	2	-	3	-	-	-
49.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	1	2	-
49.5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	3	-	-	-
50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
51.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	1
51.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
52.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	-	-
52.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
53.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	1	-
54.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
55.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
55.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
56.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
57.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
63.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
71.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Total	31	13	15	13	5	23	18	145	225	67	104	207	429	165	121	45	76	6	42	110	285	77	27	10

Table 17.--Length frequency distribution of age group IV weakfish, spring sample.

Length in	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
centimeters	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
25.5	-	-	-	-	-	1	-	-	-	-	1	-	-	-
26.0	-	-	-	-	-	1	-	-	-	--	-	-	-	-
26.5	-	1	-	-	-	1	-	-	-	-	-	-	-	-
27.0	-	-	-	-	-	1	-	-	-	-	-	-	-	-
27.5	1	1	-	1	-	-	-	-	-	-	-	-	-	-
28.0	1	-	-	1	-	1	-	-	-	-	-	-	-	-
28.5	-	-	-	1	-	4	-	-	-	-	-	-	-	-
29.0	-	-	-	-	-	3	-	-	-	-	-	-	-	-
29.5	3	2	-	6	-	1	-	-	-	-	-	-	-	-
30.0	3	2	1	10	-	3	-	-	-	-	-	-	-	-
30.5	3	1	2	8	1	3	1	1	1	1	-	-	-	-
31.0	3	1	1	10	1	4	-	-	-	-	1	-	-	-
31.5	1	-	2	19	-	4	-	-	-	-	-	1	1	-
32.0	6	-	5	12	-	3	-	-	-	-	-	-	-	-
32.5	3	1	6	7	1	2	1	-	-	-	-	-	1	-
33.0	4	2	2	13	-	3	-	-	-	-	1	1	4	-
33.5	-	2	9	6	3	3	-	-	-	-	-	-	1	-
34.0	3	-	4	8	1	1	2	2	-	-	-	-	5	-
34.5	3	-	8	3	2	2	2	-	1	-	-	-	2	-
35.0	4	1	6	11	2	1	6	2	-	1	1	2	5	-
35.5	1	-	5	4	8	3	1	-	1	1	1	-	4	1
36.0	2	-	2	6	11	3	-	3	-	-	3	-	5	-
36.5	2	1	4	3	8	1	1	2	-	2	2	1	7	-
37.0	2	-	1	7	3	2	-	2	-	1	1	1	6	1
37.5	2	-	4	4	8	2	4	-	-	-	1	1	4	-
38.0	3	-	4	2	10	2	5	1	-	-	1	1	7	1
38.5	3	-	4	1	7	1	1	1	-	2	3	2	7	-
39.0	4	1	2	2	7	-	2	-	-	2	2	1	2	1
39.5	2	-	-	2	9	-	4	1	-	2	1	3	5	-
40.0	-	-	-	-	3	1	-	-	1	-	3	-	8	1
40.5	2	1	1	-	5	1	-	-	-	4	3	5	2	3

Table 17.--Length frequency distribution of age group IV weakfish, spring sample (cont'd).

Length in	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
centimeters	192	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
41.0	-	-	1	-	5	-	2	2	-	2	2	2	6	2
41.5	-	-	-	-	4	-	-	-	-	4	2	5	7	2
42.0	1	-	-	-	2	-	1	-	-	1	2	4	1	2
42.5	1	-	-	1	2	-	-	2	-	2	1	5	7	2
43.0	-	-	-	-	1	-	2	-	-	1	2	2	4	1
43.5	-	-	-	1	2	1	2	1	-	-	2	2	7	3
44.0	2	-	-	2	1	1	1	2	-	-	2	-	4	-
44.5	-	-	-	1	2	-	1	1	-	-	1	1	7	1
45.0	-	-	-	-	-	-	-	-	-	2	-	3	5	1
45.5	1	-	-	-	2	-	1	2	-	1	1	1	9	-
46.0	-	-	-	-	2	-	1	-	-	1	1	-	4	-
46.5	2	-	-	-	-	-	-	-	-	-	1	-	4	-
47.0	1	-	-	-	-	-	2	2	-	-	1	-	7	-
47.5	2	-	-	-	1	-	1	-	-	-	1	1	3	-
48.0	1	-	-	-	1	-	-	2	-	-	-	-	5	-
48.5	1	-	-	-	1	-	-	-	-	-	2	2	1	-
49.0	-	-	-	-	-	-	-	-	-	-	1	-	1	-
49.5	-	-	-	-	-	-	2	1	-	-	-	-	-	-
50.0	-	-	-	-	-	-	1	-	-	-	-	-	5	-
50.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-
51.0	-	-	-	-	1	-	-	-	1	-	1	-	-	-
51.5	-	-	-	-	-	-	-	1	-	-	-	-	-	-
52.0	-	-	-	-	-	-	-	1	-	-	-	-	-	-
52.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-
53.0	-	-	-	-	-	-	1	-	-	-	-	-	1	-
54.0	-	-	-	-	-	-	-	-	-	-	-	-	1	-
54.5	-	-	-	-	-	-	-	-	-	-	-	-	2	-
55.0	-	-	-	-	-	-	-	-	-	-	-	-	1	-
56.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-
57.5	-	-	-	-	-	-	-	-	-	-	-	1	1	-
59.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
63.0	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Total	74	17	74	152	117	60	48	32	5	30	49	49	171	22

Table 18.--Length frequency distribution of age group IV weakfish, fall sample.

Length in	Frequencies																						
	North Carolina	Chesapeake Bay		Exmore			Wildwood			Beach Haven		Northern New Jersey				Fire Island			Monteuk				
centimeters	1934	1929	1934	1929	1933	1934	1928	1930	1934	1930	1931	1928	1930	1931	1934	1930	1931	1934	1929	1930	1931	1932	1934
26.0	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27.0	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29.0	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
29.5	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.0	1	-	-	1	-	-	-	11	-	3	1	-	1	-	-	1	-	-	-	-	-	-	-
30.5	-	-	1	-	-	-	2	19	-	4	-	2	1	-	-	-	-	-	1	-	-	-	-
31.0	1	-	-	-	-	-	2	16	1	2	1	-	1	-	1	-	-	-	-	-	-	-	-
31.5	-	-	-	-	-	-	2	25	1	4	1	2	4	-	2	-	-	-	-	-	-	-	-
32.0	-	-	-	-	2	-	2	33	3	10	2	2	6	1	-	-	-	-	-	-	-	-	-
32.5	-	-	-	-	-	-	1	27	2	2	8	6	6	1	-	1	-	-	-	-	-	-	-
33.0	-	-	-	-	-	-	-	37	-	22	8	14	8	2	1	-	-	-	-	-	1	-	-
33.5	-	-	-	-	-	-	6	27	-	12	13	9	14	1	2	-	-	-	-	-	1	-	-
34.0	-	-	-	-	-	-	3	38	-	17	5	17	23	3	2	-	-	-	-	-	1	-	-
34.5	-	1	-	-	-	-	4	22	1	20	9	35	24	2	4	-	-	-	1	-	-	-	-
35.0	-	-	-	-	-	-	4	17	-	9	10	25	27	8	3	-	-	1	3	-	-	-	-
35.5	-	-	1	-	-	-	2	14	-	16	11	27	41	7	5	1	-	-	-	-	-	-	-
36.0	-	-	1	-	-	-	5	16	1	10	5	20	29	10	2	-	-	-	-	-	1	-	-
36.5	-	-	-	-	-	-	-	17	1	8	13	36	38	8	11	1	-	-	-	-	1	-	-
37.0	-	-	-	-	-	-	3	17	2	11	8	20	47	9	11	-	-	-	2	-	4	-	-
37.5	-	-	-	-	-	-	-	9	1	5	6	19	46	8	5	1	-	-	-	-	3	-	-
38.0	-	-	-	-	-	-	1	14	1	5	5	10	46	8	7	-	-	1	1	-	2	-	-
38.5	-	-	-	-	-	-	-	5	-	-	3	16	45	10	5	1	-	1	2	-	3	-	-
39.0	-	-	-	-	-	-	-	7	-	9	2	10	42	8	4	1	-	2	-	-	3	-	-
39.5	-	-	-	-	-	-	1	5	1	2	3	7	43	14	9	2	1	2	1	-	7	-	-
40.0	-	-	-	-	-	1	-	5	-	4	2	7	31	11	3	1	1	1	3	1	5	-	-
40.5	-	-	-	-	-	-	-	1	-	2	-	2	29	12	4	4	1	1	2	-	7	-	-
41.0	-	-	-	-	-	-	-	2	-	1	-	4	26	10	2	4	-	2	2	3	4	-	-
41.5	-	-	-	-	-	-	-	1	-	-	2	3	18	16	6	1	1	1	4	3	1	1	-
42.0	-	-	-	-	-	-	-	4	-	2	2	2	18	14	3	1	-	4	4	-	9	-	1
42.5	-	-	-	-	-	-	-	1	-	1	-	1	17	8	2	3	1	2	5	-	7	3	-
43.0	-	-	-	-	-	-	1	2	-	-	-	2	13	4	1	5	1	3	1	-	6	-	-
43.5	-	-	-	-	-	-	-	1	-	1	-	-	15	8	2	2	1	3	4	5	2	2	-
44.0	-	-	-	-	-	-	-	1	-	1	1	-	5	5	1	6	-	1	3	4	3	2	-
44.5	-	-	-	-	-	-	-	3	-	-	-	-	3	4	2	1	2	2	1	3	5	3	-
45.0	-	-	-	-	-	-	-	1	-	1	-	1	7	4	2	3	1	-	9	4	2	-	-
45.5	-	-	-	-	-	-	-	-	-	-	-	-	9	7	3	2	2	1	3	1	8	-	-
46.0	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-	3	3	1	-	3	4	1	-
46.5	-	-	-	-	-	-	-	-	-	-	-	1	2	1	-	2	4	2	1	1	7	1	-
47.0	-	-	-	-	-	-	-	-	-	1	-	-	2	6	-	4	3	1	1	2	4	-	-
47.5	-	-	-	-	-	-	-	-	-	-	-	1	4	1	4	1	5	1	3	1	-	1	-
48.0	-	-	-	-	-	-	-	1	1	-	-	-	1	3	-	-	-	-	3	2	2	-	1
48.5	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	1	4	4	-	-
49.0	-	-	-	-	-	-	-	1	-	-	-	-	1	2	1	1	-	-	1	-	4	2	-
49.5	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	1	1	1	3	1	-
50.0	-	-	-	-	-	1	-	-	-	-	-	1	2	3	2	1	2	1	-	2	4	2	-
50.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	3	1	3	1	-
51.0	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	1	2	2	1	-
51.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	2	1	-	-
52.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	3	-	-
52.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
53.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-
53.5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	2	1	-
54.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	4	1	-
54.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	1	-
55.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	-	-
55.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
56.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
56.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	1	-
57.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-
57.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
58.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
58.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-
59.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
60.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
61.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
64.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
65.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Total	2	1	4	2	2	3	39	409	16	188	121	302	704	227	118	57	30	36	75	56	143	32	2

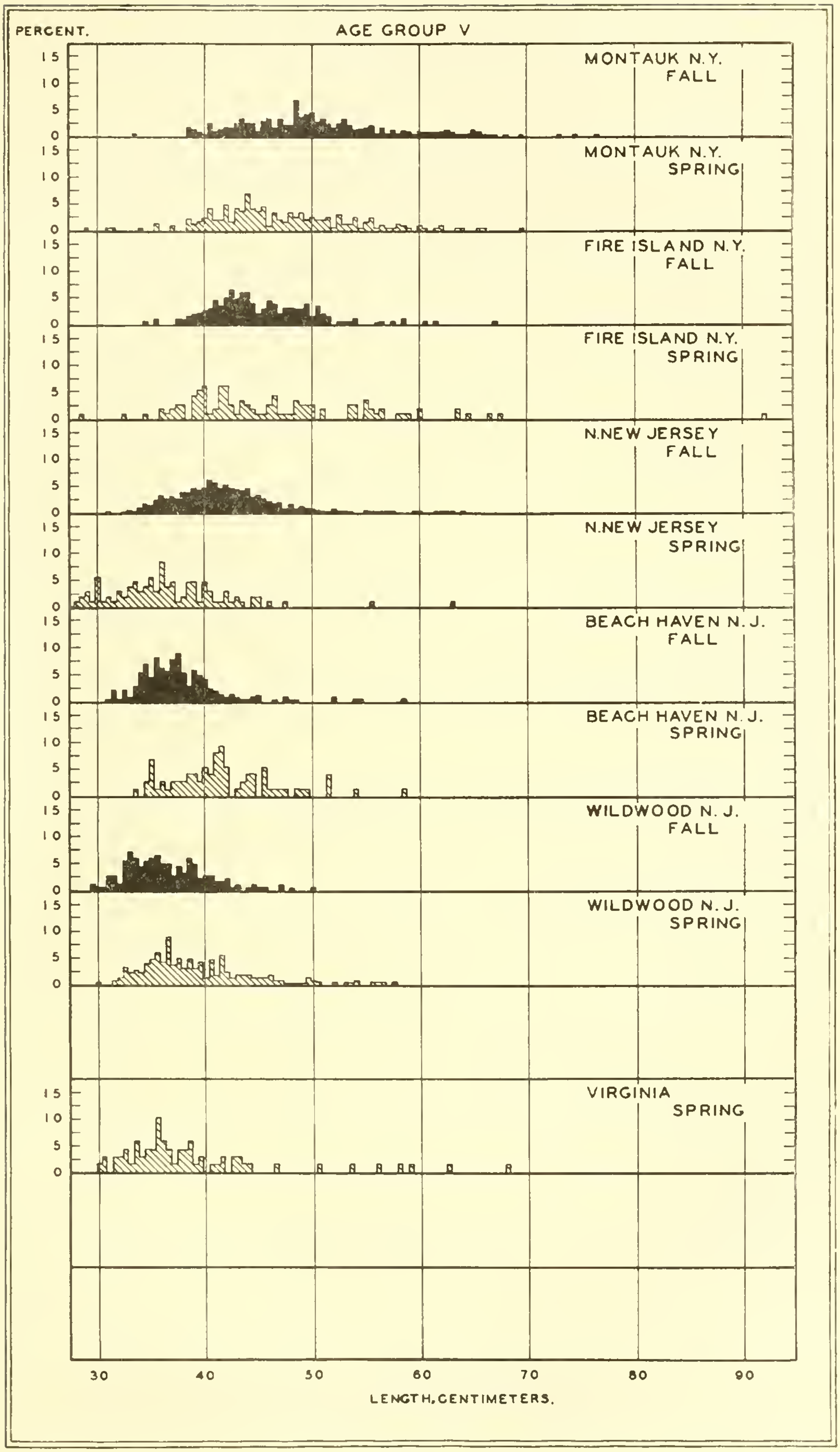

Fig. 8.--Length frequency distributions, age group V.

Table 19.--Length frequency distribution of age group V weakfish, spring sample.

Length in	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
centimeters	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
23.0	-	-	-	-	-	1	-	-	-	-	-	-	-	-
28.0	-	-	-	-	-	1	-	-	-	-	-	-	-	-
28.5	-	-	-	-	-	2	-	-	1	-	-	-	-	-
29.0	-	-	-	-	-	3		-	-	-	1	-	-	-
29.5	-	-	-	-	-	1	-	-	-	-	-	-	-	-
30.0	1	-	1	-	-	6	-	-	-	-	-	-	-	-
30.5	1	1	-	-	-	1	-	-	-	-	-	-	-	-
31.0	-	-	-	-	-	2	-	-	-	-	-	1	-	-
31.5	1	1	-	2	-	1	-	-	-	-	1	-	-	-
32.0	1	1	-	3	-	6	-	-	-	-	-	-	-	-
32.5	3	-	3	4	-	3	1	-	-	-	-	-	-	-
33.0	1	-	1	4	-	4	-	-	-	-	-	-	-	-
33.5	3	1	1	5	1	5	-	-	-	-	-	-	-	-
34.0	2	-	-	5	-	3	-	-	-	-	-	-	1	-
34.5	3	-	3	6	2	4	1	-	-	-	-	-	-	-
35.0	2	1	1	10	5	6	-	-	-	-	-	-	-	-
35.5	4	3	7	7	1	3	-	-	-	-	1	-	-	2
36.0	3	1	-	10	2	9	1	1	-	-	-	-	-	-
36.5	2	1	1	20	1	4	-	1	-	-	-	-	-	-
37.0	1	-	3	6	2	5	-	2	-	-	2	-	-	-
37.5	3	-	3	8	2	1	3	-	-	-	-	-	-	-
38.0	2	1	3	4	2	2	2	1	-	-	-	-	-	-
38.5	3	1	3	8	3	5	-	-	-	-	-	2	1	2
39.0	1	-	3	4	3	5	5	-	-	-	-	2	1	-
39.5	2	-	6	4	2	1	3	2	1	-	3	-	-	1
40.0	-	-	1	2	4	5	1	5	-	1	2	1	1	2
40.5	1	-	1	10	3	3	1	-	-	-	2	3	-	5

Table 19.--Length frequency distribution of age group V weakfish, spring sample. (cont'd)

Length in centimeters	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
41.0	1	-	3	1	6	1	1	-	-	1	1	2	-	2
41.5	1	1	4	9	7	1	4	2	-	1	1	2	-	2
42.0	-	-	1	4	4	3	4	3	-	-	2	5	-	5
42.5	2	-	1	2	-	1	3	-	-	-	-	2	1	1
43.0	2	-	-	4	1	2	1	-	-	-	1	1	-	8
43.5	1	-	1	3	2	1	1	2	-	1	5	3	1	-
44.0	1	-	2	2	3	-	2	-	1	-	7	6	1	3
44.5	-	-	-	3	3	2	2	-	-	-	3	2	2	3
45.0	-	-	1	2	-	2	-	-	1	-	4	-	-	5
45.5	-	-	-	3	4	-	1	-	-	-	4	2	1	4
46.0	-	-	2	2	1	1	3	-	-	-	-	-	1	1
46.5	1	-	1	1	1	-	3	1	-	1	2	2	1	3
47.0	-	-	-	2	1	-	-	-	1	-	2	-	1	2
47.5	-	-	1	-	1	1	-	-	1	-	2	1	1	-
48.0	-	-	1	-	-	-	-	-	-	1	1	1	2	4
48.5	-	-	-	1	1	-	1	1	-	2	2	1	3	-
49.0	-	-	1	-	1	-	3	-	-	-	3	2	1	2
49.5	-	-	-	3	1	-	1	2	-	-	2	2	-	1
50.0	-	-	1	1	-	-	2	-	1	-	1	2	1	2
50.5	1	-	-	1	-	-	-	-	-	-	1	3	1	-
51.0	-	-	-	-	-	-	1	-	1	-	1	3	-	1
51.5	-	-	-	-	3	-	-	-	-	-	3	1	-	2
52.0	-	-	-	1	-	-	-	-	-	-	1	-	-	-
52.5	-	-	-	-	-	-	-	-	-	-	-	3	3	1
53.0	-	-	1	-	-	-	-	-	-	-	-	1	1	1
53.5	1	-	1	-	-	-	2	-	1	-	1	1	-	1
54.0	-	-	-	2	1	-	2	1	-	-	-	1	3	2
54.5	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Table 19.--Length frequency distribution of age group V weakfish, spring sample (cont'd.)

Length in	Frequencies													
	Chesapeake Bay	Exmore	Wildwood		Beach Haven	Northern New Jersey	Fire Island				Montauk			
centimeters	1929	1929	1928	1930	1931	1928	1928	1929	1930	1931	1929	1930	1931	1932
55.0	-	-	-	-	-	-	3	1	-	-	1	2	1	-
55.5	-	-	-	1	-	1	-	1	-	1	2	1	2	1
56.0	1	-	-	1	-	-	1	-	-	-	-	-	1	-
56.5	-	-	-	1	-	-	1	-	-	1	-	-	1	1
57.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
57.5	-	-	-	1	-	-	-	-	-	-	1	-	-	-
58.0	1	-	-	-	-	-	1	-	-	-	1	-	1	1
58.5	-	-	-	-	1	-	-	1	-	-	1	-	-	1
59.0	1	-	-	-	-	-	-	1	-	-	-	-	-	1
59.5	-	-	-	-	-	-	1	1	-	-	-	1	1	-
60.0	-	-	-	-	-	-	1	1	-	-	-	1	1	-
60.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-
61.5	-	-	-	-	-	-	-	-	-	-	1	-	-	-
62.0	-	-	-	-	-	-	-	-	-	-	1	1	-	-
62.5	1	-	-		-	-	-	-	-	-	-	-	-	-
63.0	-	-	-	-	-	1	-	-	-	-	-	-	-	-
63.5	-	-	-	-	-	-	-	-	-	2	-	1	-	-
64.0	-	-	-	-	-	-	-	-	-	-	-	1	-	-
64.5	-	-	-	-	-	-	-	1	-	-	-	-	-	-
65.5	-	-	-	-	-	-	-	-	-	-	-	1	-	-
66.0	-	-	-	-	-	-	-	-	-	-	1	-	-	-
66.5	-	-	-	-	-	-	-	-	1	-	-	-	-	-
67.5	-	-	-	-		-	1	-	-	-	-	-	-	-
68.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-
69.5	-	-	-	-	-	-	-	-	-	-	1	-	-	-
92.0	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Total	56	13	63	173	75	109	63	30	11	12	73	67	37	73

Table 20.--Length frequency distribution of age group V weakfish, fall sample.

Length in Centimeters	North Carolina 1934	Chesapeake Bay 1934	Exmore 1933	Wildwood 1928	Wildwood 1930	Wildwood 1934	Beach Haven 1930	Beach Haven 1931	Northern New Jersey 1928	Northern New Jersey 1930	Northern New Jersey 1931	Northern New Jersey 1934	Fire Island 1930	Fire Island 1931	Fire Island 1934	Montauk 1929	Montauk 1930	Montauk 1931	Montauk 1932
	Frequencies																		
27.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29.5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.0	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31.0	-	-	-	-	5	-	1	-	-	-	1	-	-	-	-	-	-	-	-
31.5	-	-	-	-	5	-	4	1	-	-	-	-	-	-	-	-	-	-	-
32.0	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
32.5	-	-	-	-	10	-	2	3	1	-	-	-	-	-	-	-	-	-	-
33.0	-	-	-	1	12	-	1	1	-	2	2	-	-	-	-	-	-	-	-
33.5	-	-	-	-	11	-	-	7	1	2	-	-	-	-	-	1	-	-	-
34.0	-	-	-	-	8	-	3	10	8	2	-	-	-	-	-	-	-	-	-
34.5	-	-	-	-	10	-	9	8	7	13	2	-	1	-	-	-	-	-	-
35.0	-	-	-	1	9	1	1	10	5	9	5	-	-	-	-	-	-	-	-
35.5	-	-	-	-	12	-	5	15	8	17	8	-	2	-	-	-	-	-	-
36.0	-	-	-	-	9	-	6	9	13	22	10	-	-	-	-	-	-	-	-
36.5	-	-	-	-	9	-	3	11	7	24	7	-	-	-	-	-	-	-	-
37.0	-	-	-	-	5	-	2	17	9	27	7	1	-	-	-	-	-	-	-
37.5	-	-	1	-	7	1	5	17	7	22	9	-	2	-	-	-	-	-	-
38.0	-	-	-	-	6	-	4	9	7	37	8	1	2	-	-	-	-	-	-
38.5	-	-	-	-	11	-	1	6	10	28	12	3	3	-	-	2	-	2	-
39.0	-	1	-	-	9	-	8	6	8	35	22	-	4	-	-	3	-	-	-
39.5	-	-	-	-	4	-	4	8	5	41	14	1	4	-	-	2	-	-	-
40.0	-	-	-	1	4	-	6	4	5	36	21	2	5	-	-	1	-	-	-
40.5	-	-	-	-	5	-	-	6	5	40	43	-	6	-	-	5	-	1	-
41.0	-	-	-	-	3	-	4	1	4	46	31	1	9	-	-	1	1	-	-
41.5	-	-	-	-	3	-	2	1	3	37	24	2	7	-	-	1	1	1	-
42.0	-	-	-	-	4	-	1	1	1	43	28	1	10	-	-	3	-	-	1
42.5	-	-	-	-	1	-	2	1	2	30	32	-	11	1	1	-	2	2	-
43.0	-	-	-	-	2	-	1	1	-	37	25	-	9	-	1	3	-	1	2
43.5	-	-	-	-	-	-	1	-	3	25	30	1	12	-	-	3	3	2	-
44.0	-	-	-	-	1	-	-	1	1	32	32	-	11	1	-	4	-	-	2
44.5	-	-	-	-	2	-	1	1	-	20	23	-	8	-	-	4	-	2	-
45.0	-	-	-	-	1	-	1	2	-	15	33	-	4	-	-	-	-	1	2
45.5	-	-	-	-	1	-	-	-	1	13	23	1	3	3	-	2	3	1	1
46.0	-	-	-	-	-	-	-	-	-	17	13	-	7	1	1	3	1	1	3
46.5	-	-	-	-	-	-	-	1	1	9	13	-	6	1	1	3	-	1	-
47.0	-	-	-	-	2	-	-	-	-	10	14	-	3	1	-	1	1	4	3
47.5	-	-	-	-	-	-	-	2	-	7	6	-	5	1	-	3	1	1	-
48.0	-	-	-	-	1	-	1	-	-	8	14	-	5	1	-	-	1	2	2
48.5	-	-	-	-	-	-	-	1	-	5	5	-	3	3	-	6	4	5	2
49.0	-	-	-	-	-	-	-	-	-	3	11	-	2	4	-	2	3	-	4
49.5	-	1	-	-	-	-	-	-	-	6	6	-	4	4	-	2	-	4	4
50.0	-	-	-	-	1	-	-	-	-	5	6	-	2	1	-	4	-	2	5
50.5	-	-	-	-	-	-	-	-	-	3	3	-	5	2	-	4	1	1	1
51.0	-	-	-	-	-	-	-	-	-	1	2	-	2	2	-	3	-	3	2
51.5	-	-	-	-	-	-	-	-	-	1	2	-	3	-	-	3	-	2	1
52.0	-	-	-	-	-	-	2	-	1	3	4	-	-	-	-	2	-	2	-
52.5	-	-	-	-	-	-	-	-	-	4	-	-	1	-	-	-	2	3	1
53.0	-	-	-	-	-	-	-	-	1	2	2	-	1	-	-	-	2	2	4
53.5	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	1	-	2
54.0	-	-	-	-	-	-	1	-	-	-	1	-	-	2	-	1	-	-	2
54.5	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	-	2
55.0	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-	-	1	-	3
55.5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	3
56.0	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	1
56.5	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	1	2	-	1
57.0	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
57.5	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	2
58.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
58.5	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	2	-	1
59.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
59.5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
60.0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
60.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1
61.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
61.5	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-	1
62.0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1
62.5	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	1	-	1
63.0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
63.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
64.0	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-
64.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
65.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
65.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
66.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
66.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
67.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
68.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
69.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
73.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
74.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
76.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Total	2	2	1	3	179	2	85	161	125	756	558	14	166	33	4	85	43	49	73

8) In New Jersey most of the catch is made in the fall; at Montauk, N. Y., it is made in the spring. At Fire Island when spring catches are large, as in 1929, the fish are similar in size to those taken at Montauk; but when the fall catches are large, the fish are similar in size and age composition to those taken in northern New Jersey. This together with the observation that different year classes have dominated the Montauk and the New Jersey fisheries, suggests two distinct stocks of weakfish north of Delaware Bay.

The movements of weakfish indicated by the foregoing are summarized below in the form of a hypothesis which will be tested, and in some respects elaborated, by tagging experiments and studies of the scales.

A Hypothesis

First period, from the first to the second autumn.--Young weakfish, (O-group) resulting from the year's spawning (which takes place during late spring and early summer) become distributed, by fall, all along the coast from Long Island to North Carolina. During November and December they migrate into the warm waters off Virginia and North Carolina, where they spend their first winter. In the following spring, these fish (now I-group) move inshore, most of them sojourning along the North Carolina coast, progressively fewer from there northward. Some of the yearlings remain in North Carolina through the summer, but many others stay no longer than the middle of August. Most of them then migrate northward along the coast to Virginia, but a few which had spent the preceding autumn north of Delaware Bay (as O-group fish) go as far as New Jersey.

Second period, from the second to the third autumn.--With the autumnal cooling, the yearlings again move into the deeper, warmer offshore water, probably off North Carolina and Virginia. There they spend the winter. The following spring they again move inshore, (now as II-group fish) to North Carolina and Virginia, some of them to New York and New Jersey. During summer, there is a general movement from south to north, bringing fish from Virginia and North Carolina to as far north as southern New Jersey. Not all of the II-group make this migration for they are usually well represented in the fall samples taken in southern localities.

At the end of the period, that is, by the third autumn, three contingents of weakfish may be described according to their movements during the summer just finished: the first which had remained south of Delaware Bay all summer; and the second which had appeared there (mainly in southern New Jersey) in midsummer; and the third which had appeared in New York in early spring and remains all summer. This group is usually only in eastern Long Island; occasionally, as in 1929, at Fire Island.

Third period, and subsequent periods, from the third to the fourth autumn, the fourth to the fifth, etc.--The II-group fish of these three contingents migrate in late autumn to winter off Virginia and North Carolina. The following spring some of the New Jersey contingent, and perhaps a few of the Southern, migrate to New Jersey, but most of both contingents appear in the inshore waters south of Delaware Bay. Most of the Southern contingent probably remains there all summer. Most of the New Jersey contingent reaches southern New Jersey in the middle of August, and part of it reaches northern New Jersey and the western part of Long Island (Fire Island) in early September. The New York contingent migrates directly from the winter grounds to eastern Long Island, N. Y., where it remains the rest of the summer.

In subsequent periods these movements are repeated, save that a larger proportion of the IV-group and older fish of the New Jersey contingent migrate to northern New Jersey and to Fire Island in midsummer, few appearing in southern New Jersey.

Tests of the Hypothesis

Tagging Experiments.--The results of tagging experiments designed to test, and where appropriate, to modify this hypothesis, are presented in Tables 21 to 25. The results of two of them are illustrated in Figures 9 and 10.

In all of these experiments, celluloid belly tags were used. Since these are not found until the fish are cleaned, many were returned by retail dealers or consumers, frequently from inland communities. In some instances, nothing further could be learned. In other instances, it was possible, by correspondence, to trace the shipment to the port of landing or even to the actual point of recapture.

Even those reports giving only the locality where the tag was found are of considerable significance. For most commercially caught fish are consumed in fairly well-defined market areas near the ports of landing. Thus probably most or all of the tagged fish reported by retailers or consumers in Virginia, Maryland, the District of Columbia and North Carolina were caught south of Delaware Bay, while most of those reported from New York, Pennsylvania, New Jersey and Delaware were caught in or north of Delaware Bay.

Within the general southern market area, it is more difficult to allocate the less definite reports between North Carolina and Virginia. The great majority of fish traced back to shipments by coastal wholesalers in North Carolina may safely be assumed to have been caught in North Carolina waters. But it cannot safely be assumed that shipments from Virginia coastal wholesalers consist wholly of fish caught locally. During the years when these experiments were carried out, a considerable part of the North Carolina catch was distributed through Virginia dealers. There was also considerable overlapping of the market areas served by North

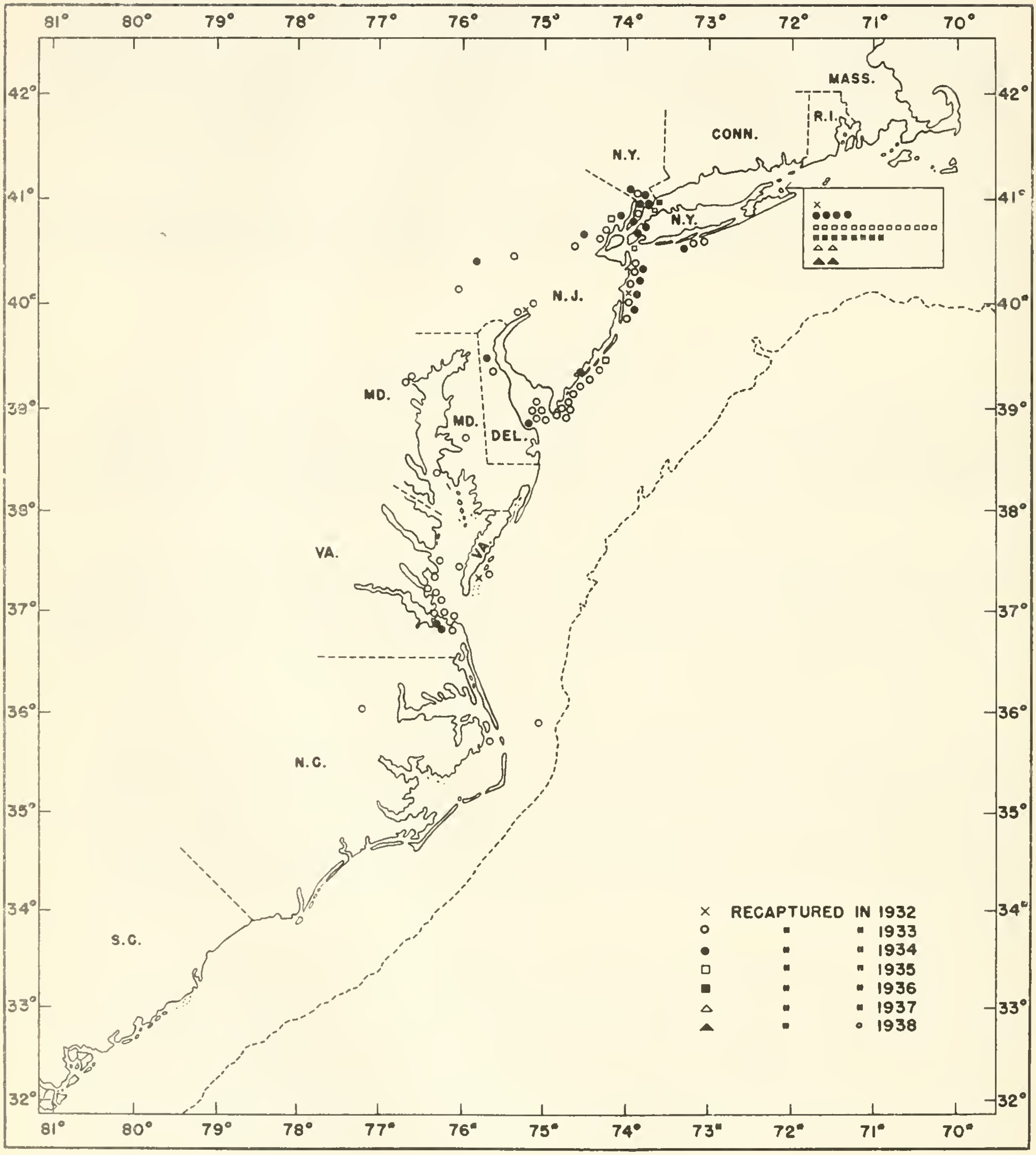

Fig. 3.--Location of recoveries from 1932 tagging experiment at Montauk, N.Y.

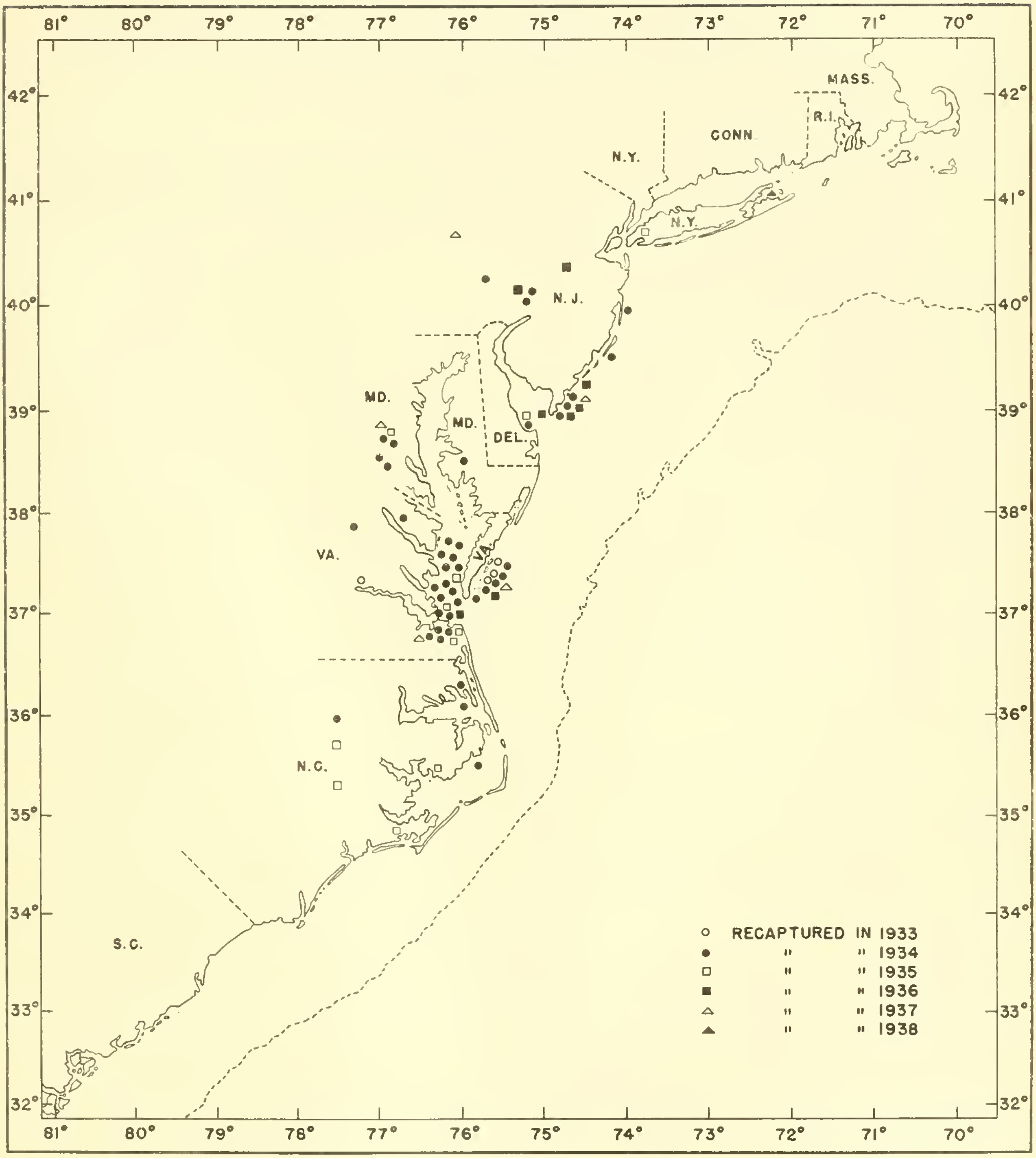

Fig. 10.--Location of recoveries from 1933 tagging experiment off Exmore, Virginia.

Table 21.-- Recaptured weakfish from the October 1932 tagging experiment at Montauk, New York. 1,859 weakfish tagged.

Locality	Year							Total
	1932	1933	1934	1935	1936	1937	1938	
Caught in North Carolina waters	-	2	-	-	-	-	-	2
Returned by retailers or consumers in North Carolina	-	1	-	-	-	-	-	1
Caught in Virginia waters	1	11	-	-	-	-	-	12
Shipped by coastal wholesalers in Virginia	-	1	2	-	-	-	-	3
Returned by retailers or consumers in Virginia, Maryland or the District of Columbia	1	3	-	-	-	-	-	4
Caught off the southern New Jersey coast or in Delaware Bay	-	14	2	1	-	-	-	17
Caught off the northern New Jersey coast	1	5	4	-	-	-	-	10
Caught in Peconic Bay, New York	1		4	14	8	2	2	31
Caught in other New York waters	-	2	1	2	1	-	-	6
Returned by retailers or consumers in New York, New Jersey, Delaware or Pennsylvania	1	10	11	1	-	-	-	23
No data	-	-	1	-	-	-	-	1
Total	5	49	25	18	9	2	2	110

Table 22.--Recaptured weakfish from the October and November 1931 tagging experiment in lower Chesapeake Bay. 1,250 weakfish tagged.

Locality	Year			Total
	1931	1932	1933	
Caught in North Carolina waters	1	3	1	5
Shipped by coastal wholesalers in North Carolina	-	1	1	1
Caught in Virginia waters	1	10	-	11
Shipped by coastal wholesalers in Virginia	-	1	-	1
Returned by retailers or consumers in Virginia, Maryland or the District of Columbia	-	2	1	3
No data	-	1	-	1
Total	2	18	3	22

Table 23.--Recaptured weakfish from the October 1933 tagging experiment off Exmore, Virginia. 931 weakfish tagged.

Locality	Year 1933	1934	1935	1936	1937	1938	Total
Caught in North Carolina waters	-	2	-	-	-	-	2
Shipped by coastal wholesalers in North Carolina	-	1	2	-	-	-	3
Returned by retailers or consumers in North Carolina	-	1	2	-	-	-	3
Caught in Virginia waters. (Outer coast)	3	5	-	1	1	-	10
Caught in Virginia waters. (Chesapeake Vay)	-	13	2	1	-	-	16
Shipped by coastal wholesalers in Virginia	-	4	2	-	1	-	7
Returned by retailers or consumers in Virginia, Maryland or the District of Columbia	1	7	1	-	1	-	10
Caught in New York or New Jersey waters	-	6	1	4	1	1	13
Returned by retailers or consumers in New York, New Jersey, Delaware or Pennsylvania	-	3	1	2	1	-	7
No data	-	1	-	-	-	-	1
Total	4	43	11	8	5	1	72

Table 24.--Recaptured weakfish from the October 1932 tagging experiment in Pamlico Sound, North Carolina. 1,749 weakfish tagged.

Locality	Year					Total
	1932	1933	1934	1935	1936	
Caught in North Carolina waters	65	45	11	6	1	128
Shipped by coastal wholesalers in North Carolina	-	19	7	2	-	28
Returned by retailers or consumers in North Carolina	-	23	10	2	1	36
Caught in Virginia waters	-	10	1	1	-	12
Shipped by coastal wholesalers in Virginia	-	10	5	-	-	15
Returned by retailers or consumers in Virginia, Maryland or the District of Columbia	-	7	3	1	-	11
Caught off the coast of southern New Jersey	-	1	-	-	-	1
Returned by retailers or consumers in New York, New Jersey, Delaware or Pennsylvania	-	-	-	1	-	1
No data	-	-	2	-	-	2
Total	65	115	39	13	2	234

Table 25.-- Recaptured weakfish from the June 1937 tagging experiment in Pamlico Sound, North Carolina. 2,200 weakfish tagged.

Locality	Year 1937	1938	1939	Total
Caught in North Carolina waters	16	6	-	22
Shipped by coastal wholesalers in North Carolina	3	4	-	7
Returned by retailers or consumers from North Carolina	16	3	-	19
Caught in Virginia waters	1	2	-	3
Shipped by coastal wholesalers in Virginia	-	-	1	1
Returned by retailers or consumers in New York, New Jersey, Delaware or Pennsylvania	-	-	1	1
No data	4	1	-	5
Total	40	16	2	58

Carolina and Virginia dealers. Consequently, in allocating reports from retailers and consumers and from Virginia coastal wholesalers, reports from both sources may well be grouped and allocated in approximate proportion to the numbers definitely assignable to the fisheries of the two states.

The October 1932 experiment at Montauk, N. Y. on Long Island (Table 21, Figure 9) was designed to test the postulate that part of the O-group weakfish from northern areas are included in the stocks of I-group fish observed in the South the following season. In this experiment, 1,859 O-group fish were tagged. They were taken from pound nets at Montauk. They probably represent a group of fish which spent their juvenile summer in Peconic Bay and which had formed into schools for seasonal migration to southern winter grounds.

In 1933, 18 of 49 returns were from southern waters or from the southern market area. Of the remainder, known or presumed to have been taken in the North, Delaware Bay and southern New Jersey contributed most to the definitely located recaptures. Conspicuous is the absence of definitely located recaptures from the tagging locality in eastern Long Island.

In 1934, only two were reported from the southern area. In contrast to 1933, most of the definitely located recaptures were in northern New Jersey or New York rather than in southern New Jersey, and four of the New York recaptures were in Peconic Bay near the tagging locality.

In 1935 and subsequently, not only were nearly all of the returns from New York, but most of these were from fish taken by anglers in Peconic Bay.

The remaining experiments were conducted in southern waters. Most of the fish recaptured were adults (I-group or older) when tagged.

Two experiments were made in Virginia waters. In the October-November 1931 experiment in lower Chesapeake Bay (Table 22), the tagging was done by W. C. Schroeder. All of the few returnes from this experiment were from southern localities or from the southern market area. To the extent that migration was observed at all, it was southward rather than northward.

Results of the 1933 experiment off Exmore, Virginia (Table 23 and Figure 10) were more nearly in accordance with those to be expected from the hypothesis. Of 67 returns in 1934 and subsequently, for which data are available, 20 or nearly 30% were from northern localities or from the northern market area.

The two experiments in Pamlico Sound, North Carolina (Tables 24 and 25) indicate that the North Carolina sounds do not contribute materially to the northern stocks. Of the 184 returns from these two experiments in years subsequent to the years when the fish were tagged and for which data are available, only 3, or 1.6% were from northern waters or from the northern market area. A somewhat larger movement to Virginia waters is indicated. If, for the 1932 experiment, returns from the southern market area including those traced to Virginia coastal wholesalers be allocated as suggested above, a total of 19 recaptures in Virginia waters is indicated. This corresponds to 11.4% of the 167 returns in 1933 and subsequently, for which data are available. A similar computation for the 1937 experiment indicates that 9.4% of the recaptures were made in Virginia waters.

In the June 1937 experiment in Pamlico Sound, the tagging was done by W. C. Neville. Most of the fish tagged were of the I-group and since they were just beginning their second season's growth, they were small. The combination of the small size of the fish and the high temperature of the water in June probably accounts for the low percentage returns from this experiment.

This experiment was particularly designed to test one detail of the hypothesis. The observation that I-group fish are poorly represented in the Virginia catches until midsummer while they are abundant in the spring and early summer catches in North Carolina suggested that the late summer I-group fish in Virginia pass through the North Carolina fishery in early summer. The results of the experiment do not bear this out. It appears more probable that the fish taken in the late summer run in Virginia avoid the traps until midsummer.

The October 1932 experiment at Montauk was based on O-group weakfish. The results indicated a strong homing instinct for, as noted, most of the recaptures in 1935 and subsequently were traced to Peconic Bay. As will be seen later, there is evidence from studies of the scales that a significant part of the northern adult stocks cannot be identified with the northern O-group stocks, hence represent immigrants which do not show a marked homing instinct. Unfortunately, direct evidence from tagging that southern juveniles eventually contribute materially to the northern stocks is lacking. Of the returns from southern experiments, only nine were from fish which were juveniles when tagged. Five of these, tagged in North Carolina in 1932, were all from southern localities or from the southern market area. Of the four returns from the Virginia experiments, only one was from a northern locality (Cape May, New Jersey).

The results of these tagging experiments do not bear out the hypothesis in all details. The 1932 Montauk experiment indicates that only a part of the northern juveniles passes through the southern fishery. Only the 1933 Exmore experiment is consistent with the postulate that most of the northern fish of the II-group and older are derived from the southern I-group stocks. The large stocks of this age group in the North Carolina sounds and in Chesapeake Bay appear to contribute little.

In addition to their contribution to the understanding of migration, the tagging experiments cast some light on mortality rates. Percentage recaptures do not indicate the percentages removed from the stocks by the fishery, for the weakfish is a delicate species, subject to high mortality as the result of tagging. But on the assumption that the tags are retained

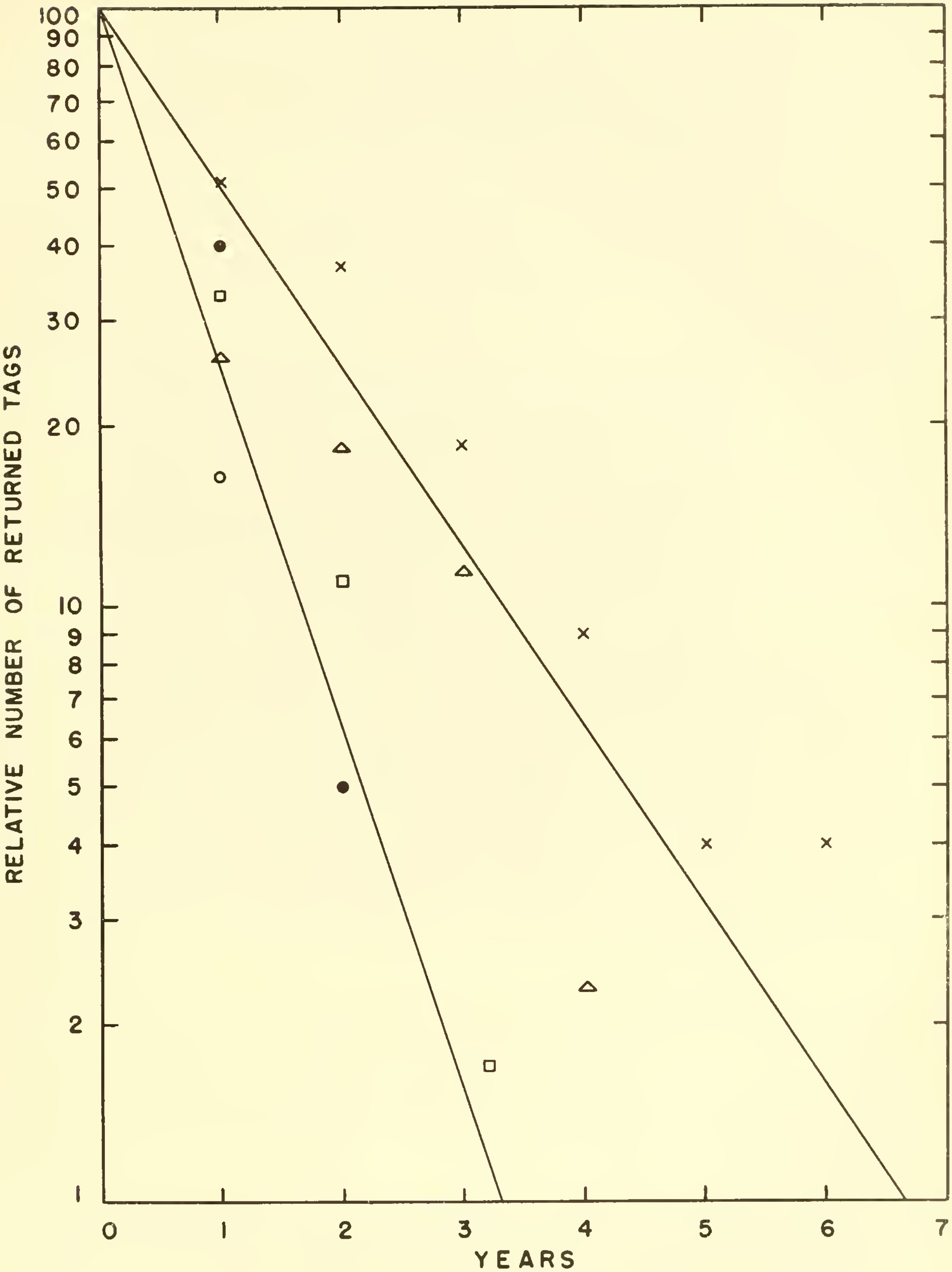

Fig. 11.--Rates of decline in numbers of tags returned. Upper line represents 50 percent rate of decline; lower line, 75 percent. Symbols as follows: x, Montauk, N. Y., 1932; circle, Lower Chesapeake Bay, 1931; triangle, Exmore, Virginia, 1933; square, Pamlico Sound, N. C., 1932; dot, Pamlico Sound, 1937.

indefinitely by the survivors of the tagging ordeal, and on the further assumption that the probability of finding the tags is about the same in each of several years after tagging, the rate of decline in the numbers of tags returned should correspond to the rate of decline in the numbers of fish in the population represented by the tagging sample.

Figure 11 represents the logarithms of the relative numbers of tags returned in each year for each experiment, compared with lines corresponding to 50% and 75% rates of decline. It will be noted that most of the points representing the southern experiments fall within these lines, while only those from the Montauk experiment lie above the line corresponding to a 50% mortality rate. Whether this difference is due to lower fishing intensity or to lower natural mortality rates in the northern area is not known.

Evidence from the Scales

Scales may be used to distinguish races or to trace migrations if the portions of the scales formed while fish are present in any locality are sufficiently different from the corresponding portions of scales formed in other localities to be recognized subsequently.

Gilbert, 1919, demonstrated the existence of distinct races among the sockeye salmon (Oncorhynchus nerka) spawning in the Fraser River system by means of differences in the stream growth portion of the scales of salmon spawning in various tributaries. Lea, 1919, observed that the annuli are more sharply defined and the growth zones narrower on the scales of young herring from northern Norway than on those of herring from the southern part of the West coast. Runnstrom, 1936, applied these observations to detailed studies of the subsequent migrations of young herring originating in these localities. From the marked differences in numbers of circuli in the first growth zone of the scales of cod living north of Cape Cod, Schroeder, 1930, concluded that he could distinguish the stocks living in these localities.

In the present study, it was desired to extimate the proportions in which weakfish originating in various localities are mixed in the adult stocks. This was done by comparing frequency distributions of measurements of the mean spacing between a selected group of circuli of the first growth zone of the scales of adult weakfish with the corresponding distributions from the scales of 0-group weakfish from three areas: New York-New Jersey (hereinafter designated as "Northern"), Virginia and North Carolina.

Ten marginal circuli of the lateral field (Figures 12 and 13) were chosen for measurement. The scales were examined directly with a binocular dissecting microscope and measurements were made with a comparator in units of 1/2400 inch. Marginal circuli were chosen because the spacing

Fig. 12.— Scale of juvenile weakfish. Dark bar shows 10 marginal circuli measured.

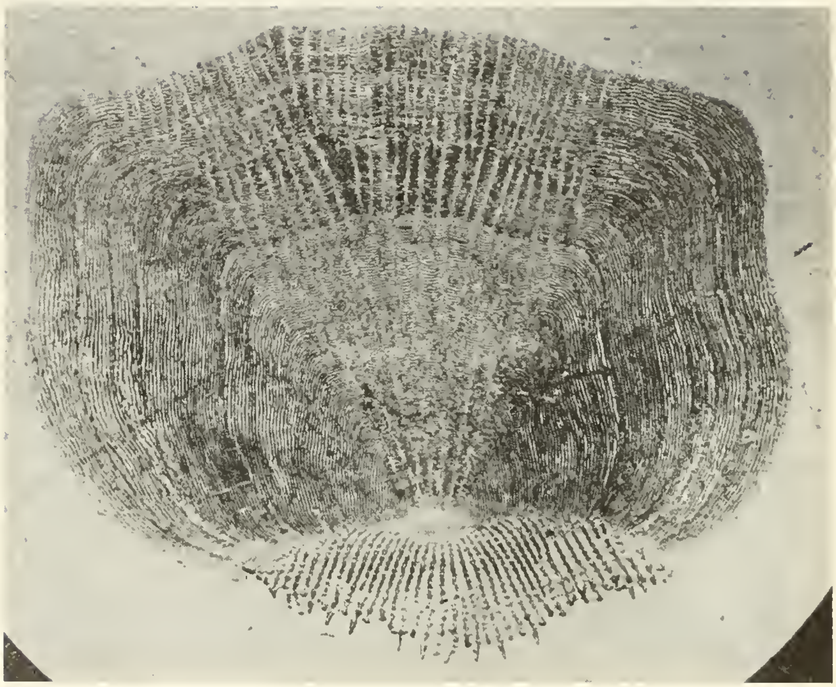

Fig. 13.--Scale of adult weakfish. Dark bar shows 10 marginal circuli measured.

is more uniform than between those near the focus. The lateral field was chosen in preference to the anterior field because the coarser spacing of the former facilitates counting and because there is closer agreement between several scales taken from the same fish. The width of the band comprising ten circuli was measured from three scales from each fish. Frequency distributions of the averages of these three measurements are presented in Tables 26, 27 and 28. In Table 26, only those O-group weakfish taken in October or November are included in order to exclude individuals which had not completed their growth for the season.

An examination of these frequency distributions indicates differences between year classes at the same location. As an example, an analysis of variance of the Montauk,N.Y. samples for 1930, 1931, 1932, and 1934 gives the following results:

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	746	667,434	
Mean	1	663,384	
Years	3	85	28.33
Within Years	742	3,965	5.34
	$F = 5.3$	$P < 0.01$	

Since there are significant differences in measurements between different year classes at the same geographical location, it is necessary to separate year classes before making any comparison between geographical areas. From table 26, measurements can be obtained for the 1934 O-group weakfish for North Carolina, Virginia (Exmore and Chesapeake Bay), and northern localities (Wildwood, N. J., Northern New Jersey, and Montauk, N. Y.). Analysis of variance gives:

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	999	850,626	
Mean	1	845,329	
Areas	2	926	463
Within Areas	996	4,371	4.39
	$F = 105.47$	$P < 0.001$	

The differences indicate separate populations-- a southern group and a northern group. The difference between North Carolina and Virginia, however, is not significant ($F = 0.29$, d.f. $=$ 1 and 233, $P > 0.05$).

It has been shown that differences exist between year classes in the same locality. To learn whether I-group fish spend their first summer in

Table 26.—Frequency distributions of 0-group weakfish according to the mean spacing between the 10 marginal circuli of the lateral field of scales collected in October and November

Locality of collection	Units (1/24000 inch)																			Total
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	
North Carolina:																				
1933	-	1	1	6	14	24	27	20	11	10	1	1	-	-	-	-	-	-	-	116
1934	-	-	-	1	2	1	10	22	14	3	4	1	-	-	-	-	-	-	-	58
Total	-	1	1	7	16	25	37	42	25	13	5	2	-	-	-	-	-	-	-	174
Virginia:																				
Chesapeake Bay --																				
1931	-	-	-	-	1	-	1	3	1	1	-	-	-	-	-	-	-	-	-	7
1933	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	3
1934	-	-	1	-	2	4	12	10	13	12	7	3	2	-	-	-	-	-	-	66
Total	-	-	1	-	3	4	16	13	14	13	7	3	2	-	-	-	-	-	-	76
Exmore --																				
1933	-	-	1	1	7	13	24	44	58	48	33	17	8	3	1	-	-	-	-	258
1934	-	-	1	1	4	17	18	22	19	19	7	1	1	1	-	-	-	-	-	111
Total	-	-	2	2	11	30	42	66	77	67	40	18	9	4	1	-	-	-	-	369
Grand total	-	-	3	2	14	34	58	79	91	80	47	21	11	4	1	-	-	-	-	445
Northern localities:																				
Wildwood, N. J. --																				
1930	-	-	-	-	-	-	1	1	4	3	20	7	4	2	3	-	1	-	-	46
1932	-	-	-	-	-	-	-	1	3	9	3	10	9	5	2	1	-	1	-	44
1934	-	-	-	-	5	5	12	23	34	30	32	32	17	6	1	3	1	-	-	201
Total					5	5	13	25	41	42	55	49	30	13	6	4	2	1	-	291
Beach Haven, N. J.-																				
1930	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	3
Total	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	3
Northern New Jersey																				
1930	-	-	-	-	-	1	2	2	4	8	7	6	2	5	2	1	1	1	-	42
1931	-	-	-	-	-	-	-	1	2	1	8	3	2	2	-	-	-	-	-	19
1934	-	-	-	-	-	2	6	12	32	55	59	44	36	14	6	7	2	-	-	275
Total	-	-	-	-	-	3	8	15	38	64	74	53	40	21	8	8	3	1	-	336
Fire Island, N. Y.-																				
1929	-	-	-	-	-	1	-	2	4	1	6	5	6	1	-	-	-	-	-	26
1930	-	-	-	-	-	-	-	-	-	-	8	4	1	2	2	-	-	-	-	17
1931	-	-	-	-	-	-	-	-	1	1	3	1	1	2	-	1	-	-	-	10
Total	-	-	-	-	-	1	-	2	5	2	17	10	8	5	2	1	-	-	-	53
Montauk, N.Y. --																				
1930	-	-	-	-	4	4	8	13	21	34	33	36	21	15	7	8	2	-	-	206
1931	-	-	-	-	1	4	11	10	13	23	21	20	16	10	5	4	1	-	1	140
1932	-	-	-	-	-	1	3	4	13	18	19	23	15	11	4	1	-	-	-	112
1934	-	-	-	-	2	6	20	25	36	68	44	41	27	8	7	2	1	1	-	288
Total	-	-	-	-	7	15	42	52	83	143	117	120	79	44	23	15	4	1	1	740
Grand total	-	-	-	-	12	24	63	94	167	251	264	232	158	83	40	28	9	3	1	1,429

Table 27.—Frequency distributions of I-group weakfish from northern localitites according to the mean spacing between the 10 marginal circuli of the lateral field of the first growth zone of the scales

Locality of collection	Units (1/24000 inch)															
	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Total
Wildwood, N. J.:																
1930	1	2	2	5	16	16	12	16	10	3	4	2	-	-	1	90
1931	-	-	3	9	13	25	59	49	41	33	28	7	5	-	1	273
1932	3	5	12	38	66	92	97	110	96	48	28	15	8	5	3	626
1934	-	-	3	3	11	12	21	19	19	8	3	1	1	-	-	101
Total	4	7	20	55	106	145	189	194	166	92	63	25	14	5	5	1,090
Beach Haven, N. J.:																
1930	-	-	-	-	2	3	3	8	8	-	-	-	-	-	-	24
1931	-	2	2	2	15	14	39	51	36	36	8	4	1	-	-	210
Total	-	2	2	2	17	17	42	59	44	36	8	4	1	-	-	234
Northern New Jersey:																
1930	-	-	1	2	6	9	5	3	4	3	3	-	-	1	-	37
1931	-	-	-	8	7	16	21	21	26	14	7	2	3	-	1	126
Total	-	-	1	10	13	25	26	24	30	17	10	2	3	1	1	163
Fire Island, N. Y.:																
1930	-	-	-	1	-	4	2	3	3	2	3	-	-	-	-	18
Montauk, N. Y.:																
1930	-	1	1	2	1	4	4	8	6	3	4	-	2	-	-	36
1931	-	-	-	-	-	-	-	4	1	1	-	1	-	-	-	7
1932	1	1	1	6	9	22	28	31	12	13	10	4	-	1	-	139
Total	1	2	2	8	10	26	32	43	19	17	14	5	2	1	-	182

Table 28.—Frequency distributions of adult weakfish according to the mean spacing between the 10 marginal circuli of the lateral field of the first growth zone of the scales

Locality and season of collection	Units (1/24000 inch)																				
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	
North Carolina:																					
Autumn of 1934—																					
Year class —																					
1929	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
1930	-	-	-	-	-	-	1	3	1	-	-	-	-	-	-	-	-	-	-	-	5
1931	-	-	-	-	4	4	7	8	9	1	1	1	1	-	-	-	-	-	-	-	36
1932	-	-	2	-	4	14	26	16	15	4	3	2	-	1	-	-	-	-	-	-	87
1933	-	-	2	1	4	14	16	25	27	20	13	10	3	-	-	-	-	-	-	-	135
Total	-	-	4	1	12	33	50	52	52	25	17	14	4	1	-	-	-	-	-	-	265
Spring of 1935 —																					
Year class —																					
1934	-	-	-	-	1	1	6	17	29	24	40	23	8	11	5	2	1	-	-	-	168
	-	-	-	1	9	19	19	41	48	39	25	17	8	5	4	-	-	-	-	-	235
Total	-	-	-	1	10	20	25	58	77	63	65	40	16	16	9	2	1	-	-	-	403
Chesapeake Bay:																					
Autumn of 1931 —																					
Year class —																					
1929	-	-	1	1	4	3	4	4	1	1	-	1	-	-	-	-	-	-	-	-	20
1930	-	-	1	6	13	32	45	61	55	29	20	9	2	1	-	-	-	-	-	-	274
Total	-	-	2	7	17	35	49	65	56	30	20	10	2	1	-	-	-	-	-	-	294
Autumn of 1933 —																					
Year class —																					
1930	-	-	-	1	1	-	4	4	2	1	-	-	-	-	-	-	-	-	-	-	13
1931	-	-	1	2	4	11	18	22	12	5	4	5	1	1	-	-	-	-	-	-	86
1932	-	-	1	3	14	25	44	43	27	23	18	13	7	-	1	-	1	-	-	-	220
Total	-	-	2	6	19	36	66	69	41	29	22	18	8	1	1	-	1	-	-	-	319
Autumn of 1934 —																					
Year class —																					
1929	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2
1930	-	-	-	1	-	-	-	2	2	-	-	1	-	-	-	-	-	-	-	-	6
1931	-	-	-	-	3	3	1	5	3	4	1	-	-	-	-	-	-	-	-	-	20
1932	-	-	2	1	5	10	8	14	7	1	4	1	-	-	-	-	-	-	-	-	53
1933	-	-	1	2	6	15	31	42	25	31	17	6	1	1	-	-	-	-	-	-	178
Total	-	-	3	4	14	28	40	64	37	36	23	8	1	1	-	-	-	-	-	-	259
Exmore, Va.:																					
Autumn of 1933 —																					
Year class —																					
1928	-	-	-	-	-	1	-	-	-	-	-	-	-	-	.	-	-	-	-	-	1
1929	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1930	-	-	1	-	-	3	3	6	6	6	1	1	1	-	-	-	-	-	-	-	28
1931	-	-	-	2	3	8	27	23	31	21	15	14	5	-	2	1	-	-	-	-	152
1932	-	-	-	1	4	24	31	46	45	39	25	18	13	6	2	-	1	-	-	-	255
Total	-	-	1	3	7	36	62	75	82	66	41	33	19	6	4	1	1	-	-	-	437
Autumn of 1934 —																					
Year class —																					
1930	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	2
1931	-	-	-	1	2	2	3	3	2	2	-	2	-	-	-	-	-	-	-	-	17
1932	1	-	-	2	5	9	7	7	9	4	2	-	-	1	-	-	-	-	-	-	47
1933	-	1	1	1	9	31	42	50	46	27	17	11	1	1	-	-	-	-	-	-	238
Total	1	1	1	4	16	42	52	61	57	34	19	13	1	2	-	-	-	-	-	-	304
Spring of 1935 —																					
Year class —																					
1929	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2
1930	-	-	-	-	-	1	6	4	2	1	1	-	-	-	-	-	-	-	-	-	15
1931	-	-	-	-	1	4	6	14	7	4	1	2	-	-	-	-	-	-	-	-	39
1932	-	-	-	-	-	11	11	14	8	4	3	4	2	1	-	-	-	-	-	-	58
1933	-	-	1	1	2	4	11	23	23	24	18	5	2	1	-	-	-	-	-	-	115
1934	-	-	-	-	-	1	3	1	4	4	2	3	1	-	-	-	-	-	-	-	19
Total	-	-	1	1	3	21	38	56	44	38	25	14	5	2	-	-	-	-	-	-	248
Wildwood, N. J.:																					
Autumn of 1930 —																					
Year class —																					
1923	-	-	-	-	-	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	5
1924	-	-	-	-	-	1	-	5	5	9	6	8	3	3	-	-	-	-	-	-	40
1925	-	-	-	1	4	6	20	31	38	33	27	8	6	2	1	-	-	-	-	-	177
1926	-	-	-	4	6	10	31	56	70	77	54	40	24	14	5	3	-	-	-	-	394
1927	-	-	-	1	3	12	24	30	65	30	28	20	9	3	1	-	1	-	-	-	227
1928	-	-	-	2	9	14	38	46	55	39	38	23	16	6	1	-	-	-	-	-	287
1929	-	-	-	1	2	2	5	16	16	12	16	10	3	4	2	-	-	1	-	-	90
Total	-	-	-	9	24	47	120	185	249	200	169	109	61	32	10	3	1	1	-	-	1,220
Autumn of 1934 —																					
Year class —																					
1928	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1929	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
1930	-	-	-	-	-	1	1	2	3	-	4	3	1	1	1	-	-	-	-	-	17
1931	-	-	-	-	1	2	6	15	8	10	9	8	4	3	2	1	-	-	-	-	69
1932	-	-	-	-	2	1	4	10	9	8	12	12	5	4	-	-	-	-	-	-	67
1933	-	-	-	-	-	3	3	11	12	21	19	19	8	3	1	1	-	-	-	-	101
Total	-	-	-	-	4	7	14	38	32	39	44	42	19	11	4	2	-	-	-	-	256

Table 28.--Frequency distributions of adult weakfish according to the mean spacing between the 10 marginal circuli of the lateral yield of the first growth zone of the scales (continued)

Locality and season of collection	Units (1/24000 inch)																				
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	
Beach Haven, N. J.:																					
Autumn of 1930 —																					
Year class —																					
1922	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	3
1923	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3
1924	-	-	-	-	-	1	1	1	3	1	-	2	1	-	1	-	-	-	-	-	11
1925	-	-	-	-	1	5	9	13	13	15	12	5	4	2	-	-	-	-	-	-	79
1926	-	-	-	-	5	9	7	20	26	38	23	14	8	7	2	3	-	-	-	-	162
1927	-	-	-	-	1	3	6	13	18	14	17	10	5	1	1	-	-	-	-	-	89
1928	-	-	-	1	1	-	4	1	5	5	6	1	2	1	-	1	-	-	-	-	28
1929	-	-	-	-	-	-	-	2	3	3	8	8	-	-	-	-	-	-	-	-	24
Total	-	-	-	1	9	19	27	50	70	77	67	40	20	11	4	4	-	-	-	-	399
Spring of 1931 —																					
Year class —																					
1922	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1923	-	-	-	-	-	1	-	1	-	2	-	-	1	-	-	-	-	-	-	-	5
1924	-	-	-	-	1	-	-	-	3	5	2	1	1	1	-	-	-	-	-	-	14
1925	-	-	-	-	1	1	4	7	3	10	10	9	2	1	-	-	-	-	-	-	48
1926	-	-	-	-	2	1	7	7	10	11	8	10	7	2	2	-	1	1	-	-	69
1927	-	-	-	2	4	8	12	28	24	14	15	3	4	2	-	-	-	-	-	-	116
1928	-	-	-	-	1	2	2	8	12	10	12	3	2	2	1	-	-	-	-	-	55
1929	-	-	-	-	1	-	2	4	16	18	15	13	4	5	1	1	-	-	-	-	80
Total	-	-	-	2	10	14	27	55	68	70	62	39	21	13	4	1	1	1	-	-	388
Autumn of 1931 —																					
Year class —																					
1923	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1924	-	-	-	-	-	-	-	2	-	-	-	1	1	-	-	-	-	-	-	-	4
1925	-	-	-	-	-	1	4	6	11	7	12	3	3	1	1	3	-	-	-	-	52
1926	-	-	-	-	4	4	11	22	22	21	19	16	14	2	6	-	-	1	-	-	142
1927	-	-	-	1	-	6	8	18	26	17	13	6	6	4	2	1	2	-	-	-	110
1928	-	-	-	-	2	2	17	23	42	37	31	21	11	5	2	1	1	-	-	-	195
1929	-	-	-	1	2	9	11	22	24	21	16	20	11	3	3	2	-	-	-	-	145
1930	-	-	-	-	2	2	2	15	14	39	51	36	36	8	4	-	1	-	-	-	210
Total	-	-	-	2	10	25	53	108	139	142	142	103	82	23	18	7	4	1	-	-	859
Northern New Jersey:																					
Autumn of 1930 —																					
Year class —																					
1921	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2
1922	-	-	-	-	-	2	2	1	2	2	1	-	-	-	-	-	-	-	-	-	10
1923	-	-	-	-	2	6	9	10	14	9	9	3	1	2	-	-	-	-	-	-	65
1924	-	-	1	1	-	7	24	25	29	41	37	28	14	6	3	1	1	-	-	-	218
1925	-	-	-	2	10	29	63	125	143	140	113	54	30	15	1	2	-	-	-	-	727
1926	-	-	1	1	9	22	50	92	118	148	106	78	33	19	10	3	2	-	-	-	692
1927	-	-	-	-	5	9	15	26	34	29	18	12	7	2	2	-	-	-	-	-	159
1928	-	-	-	-	1	4	6	8	16	16	13	11	10	2	2	-	-	-	-	-	89
1929	-	-	-	-	-	1	2	6	9	5	3	4	3	3	-	-	1	-	-	-	37
Total	-	-	2	4	27	81	171	293	365	390	301	190	98	49	18	6	4	-	-	-	1,999
Autumn of 1931 —																					
Year class —																					
1922	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	2
1923	-	-	-	-	-	-	-	1	4	-	-	1	-	-	-	-	-	-	-	-	6
1924	-	-	-	-	2	2	4	11	15	7	12	12	8	5	-	-	-	-	-	-	78
1925	-	-	-	2	5	14	35	58	58	35	38	20	5	6	3	-	-	-	-	-	279
1926	-	-	2	5	9	28	31	62	91	74	74	53	29	9	5	1	1	-	-	-	474
1927	-	-	-	-	2	16	20	36	40	34	36	10	9	2	-	1	-	-	-	-	206
1928	-	-	-	-	3	4	21	16	29	11	12	8	6	4	-	-	-	-	-	-	114
1929	-	-	-	-	-	2	9	8	14	17	13	13	10	2	2	-	-	-	-	-	90
1930	-	-	-	-	-	-	-	1	1	3	6	9	5	2	1	2	-	1		-	31
Total	-	-	2	7	21	66	121	193	252	181	191	126	73	30	11	4	1	1	-	-	1,260
Autumn of 1934 —																					
Year class —																					
1926	-	-	-	-	-	-	-	1	-	1	1	1	1	-	-	-	-	-	-	-	5
1928	-	-	-	-	1	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-	5
1929	-	-	-	-	-	2	2	2	5	1	2	3	1	1	-	-	-	-	-	-	19
1930	-	-	-	-	3	2	10	14	13	27	21	5	10	6	5	1	-	-	-	-	117
1931	-	-	1	1	4	11	11	28	28	38	29	24	17	5	3	1	-	1	-	-	202
1932	-	-	-	-	1	-	2	6	6	16	7	8	5	2	2	-	-	-	-	-	55
1933	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Total	-	-	1	1	9	15	20	53	53	83	60	41	35	14	10	2	-	1	-	-	404

Table 28. - Frequency distributions of adult weakfish according to the mean spacing between the 10 marginal circuli of the lateral yield of the first growth zone of the scales (continued)

Locality and season of collection	Units (1/24000 inch)																				
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	
Fire Island, N. Y.:																					
Spring of 1930 —																					
Year class —																					
1918	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
1921	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2
1922	-	-	-	-	1	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	4
1923	-	-	-	-	1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	4
1924	-	-	-	-	-	-	-	1	1	1	1	1	1	-	-	-	-	-	-	-	6
1925	-	-	-	-	-	-	-	2	3	1	1	3	-	1	-	-	-	-	-	-	11
1926	-	-	-	-	-	-	1	1	1	1	1	-	-	1	-	-	-	-	-	-	6
1927	-	-	-	1	1	1	1	8	4	4	3	1	1	-	-	-	-	-	-	-	25
1928	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	1	-	-	-	-	4
Total	-	-	-	1	3	2	2	12	11	10	7	7	5	2	-	1	-	-	-	-	63
Autumn of 1930 —																					
Year class —																					
1919	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
1920	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1921	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	2
1922	-	-	-	-	1	1	1	1	2	2	-	-	1	-	-	-	-	-	-	-	9
1923	-	-	-	2	1	2	5	7	3	5	4	1	1	1	1	-	-	-	-	-	33
1924	-	-	-	-	2	5	6	5	9	9	11	8	5	2	1	1	-	-	-	-	64
1925	-	-	-	-	2	18	22	23	31	32	18	18	5	4	1	-	-	-	-	-	174
1926	-	-	-	1	-	5	6	12	7	6	9	4	3	2	1	-	-	-	-	-	56
1927	-	-	1	2	2	5	9	12	13	11	15	10	4	-	-	-	-	-	-	-	85
1928	-	-	-	-	-	-	2	1	-	8	4	5	4	2	-	-	-	-	-	-	26
1929	-	-	-	-	-	-	1	-	4	2	3	3	2	3	-	-	-	-	-	-	18
Total	-	-	1	5	8	38	53	61	69	76	65	49	25	14	4	1	-	-	-	-	469
Spring of 1931 —																					
Year class —																					
1918	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
1919	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1920	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
1921	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
1922	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	3
1923	-	-	-	-	-	1	1	-	2	1	-	-	-	-	-	-	-	-	-	-	5
1924	-	-	-	-	-	1	2	3	2	-	1	-	-	-	-	-	-	-	-	-	9
1925	-	-	-	-	-	-	1	3	2	1	-	-	3	-	-	-	-	-	-	-	10
1926	-	-	-	-	1	1	-	3	2	1	3	-	-	-	-	-	-	-	-	-	11
1927	-	-	-	-	-	5	6	3	5	6	1	1	-	-	-	-	-	-	-	-	27
1928	-	-	-	-	-	-	-	-	4	2	1	1	-	-	1	-	-	-	-	-	9
1929	-	-	-	-	-	-	3	3	4	5	2	5	2	2	-	-	-	-	-	-	26
Total	-	-	-	-	1	9	13	17	22	18	9	7	5	2	1	-	-	-	-	-	104
Autumn of 1931																					
Year class --																					
1922	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
1923	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
1924	-	-	-	-	-	-	3	1	1	5	2	-	-	-	-	-	-	-	-	-	12
1925	-	-	-	-	-	5	6	6	7	7	3	1	1	-	-	-	-	-	-	-	36
1926	-	-	-	1	3	3	4	1	3	3	2	1	3	-	-	1	-	-	-	-	25
1927	-	-	-	1	3	1	5	7	3	4	3	2	-	-	-	-	-	-	-	-	29
1928	-	-	-	-	-	-	1	1	1	1	1	-	-	-	-	-	-	-	-	-	5
1929	-	-	-	-	-	-	4	6	4	2	6	6	1	-	1	-	-	-	-	-	30
Total	-	-	-	2	6	9	23	22	20	23	17	10	5	-	1	1	-	-	-	-	139

Table 28.—Frequency distributions of adult weakfish according to the mean spacing between the 10 marginal circuli of the lateral yield of the first growth zone of the scales (continued)

Locality and season of collection	Units (1/24000 inch) 20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	
Montauk, N. Y.:																					
Spring of 1930 —																					
Year class —																					
1917	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1918	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
1919	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1920	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2
1921	-	-	-	-	-	-	-	2	1	-	1	2	1	-	-	-	-	-	-	-	7
1922	-	-	-	-	-	5	1	-	5	3	1	3	-	1	-	-	-	-	-	-	19
1923	-	-	-	-	1	3	11	5	6	9	4	3	1	1	-	-	-	-	-	-	44
1924	-	-	-	-	-	3	4	6	5	10	10	8	4	1	-	-	-	-	-	-	51
1925	-	-	-	-	-	2	6	6	8	12	16	7	3	2	-	-	-	-	-	-	62
1926	-	-	1	-	1	2	3	4	7	13	4	4	5	2	-	1	-	-	-	-	47
1927	-	-	-	1	8	14	23	34	43	36	27	22	10	2	3	2	-	-	-	-	225
1928	-	-	-	-	1	4	6	17	12	16	23	18	17	10	8	2	1	-	-	-	135
1929	-	-	-	-	-	-	2	1	1	2	4	4	2	1	-	1	-	-	-	-	18
Total	-	-	1	1	11	33	57	78	89	101	90	71	43	20	11	6	1	-	-	-	613
Autumn of 1930 —																					
Year class —																					
1921	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1922	-	-	-	-	1	-	-	1	1	1	1	-	1	-	-	-	-	-	-	-	6
1923	-	-	-	-	-	3	4	3	3	-	3	1	1	-	-	-	-	-	-	-	18
1924	-	-	-	-	-	2	7	1	3	7	3	2	1	-	-	1	-	-	-	-	27
1925	-	-	-	-	-	-	3	4	7	7	11	5	2	1	1	-	-	-	-	-	41
1926	-	-	-	-	1	1	5	7	7	5	7	7	4	5	1	1	1	-	-	1	53
1927	-	-	1	4	7	24	35	40	48	55	28	20	12	4	3	-	-	1	-	-	282
1928	-	-	-	-	-	1	2	10	16	14	28	11	9	3	1	1	-	-	2	-	98
1929	-	-	-	-	1	1	-	-	3	2	4	2	1	3	-	1	-	-	-	-	18
Total	-	-	1	4	10	32	57	66	88	91	85	48	31	16	6	4	1	1	2	1	544
Spring of 1931 —																					
Year class —																					
1920	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
1921	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
1922	-	-	-	-	-	-	1	-	2	2	-	-	-	-	-	-	-	-	-	-	5
1923	-	-	-	-	1	1	-	1	2	-	1	2	1	-	-	-	-	-	-	-	9
1924	-	-	-	-	-	-	3	5	2	2	1	3	1	1	-	-	-	-	-	-	18
1925	-	-	-	-	2	4	3	3	3	5	5	5	1	1	-	-	-	-	-	-	32
1926	-	-	-	-	-	-	2	6	10	6	9	2	1	1	-	-	-	-	-	-	37
1927	-	-	1	1	7	9	17	28	34	23	24	13	4	4	2	-	1	1	-	-	169
1928	-	-	-	-	-	-	1	4	5	14	13	9	7	5	2	1	-	-	-	-	61
1929	-	-	-	-	-	4	10	5	23	13	18	9	15	10	-	2	1	-	-	-	110
1930	-	-	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	4
Total	-	-	1	1	10	18	37	53	81	65	73	44	31	23	4	3	2	1	-	-	447
Autumn of 1931 —																					
Year class —																					
1922	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
1923	-	-	-	-	-	-	1	2	-	-	1	-	-	1	-	-	-	-	-	-	5
1924	-	-	-	-	-	-	2	-	1	-	3	1	-	-	-	-	-	-	-	-	7
1925	-	-	-	-	1	2	2	3	2	11	3	5	1	1	-	-	-	-	-	-	31
1926	-	-	-	-	1	4	2	5	8	4	5	4	2	1	1	1	-	-	-	-	38
1927	-	-	-	2	3	14	17	23	21	26	13	7	5	4	1	-	1	-	-	-	137
1928	-	-	-	1	-	-	5	10	12	10	15	6	7	4	2	1	1	-	-	-	74
1929	-	-	-	-	-	-	2	8	17	12	18	10	7	8	-	2	-	-	-	-	84
1930	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	3
Total	-	-	-	3	5	20	31	51	62	63	60	33	22	19	5	4	2	-	-	-	380
Spring of 1932 —																					
Year class —																					
1923	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
1925	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2
1926	-	-	-	-	1	1	1	-	2	-	1	1	-	-	-	-	-	-	-	-	7
1927	-	-	-	-	-	3	5	9	16	13	9	7	5	1	1	1	-	-	-	-	70
1928	-	-	-	-	-	-	-	1	1	3	5	4	4	-	1	1	-	-	-	-	20
1929	-	-	-	-	-	1	2	8	10	8	12	7	5	4	2	-	-	-	-	-	59
1930	-	-	-	-	1	2	5	10	20	25	19	17	13	6	1	3	3	-	-	-	125
1931	-	-	-	1	1	-	3	7	14	15	19	7	6	6	1	-	-	-	-	-	80
Total	-	-	-	1	3	7	17	35	63	65	66	43	33	17	6	5	3	-	-	-	364
Autumn of 1932 —																					
Year class —																					
1923	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3
1924	-	-	-	-	-	-	1	1	-	3	1	1	1	-	-	-	-	-	-	-	8
1925	-	-	-	-	-	2	-	4	2	1	5	2	3	2	1	-	-	-	-	-	22
1926	-	-	-	-	1	2	6	3	5	1	-	4	-	2	-	-	-	-	-	-	24
1927	-	-	1	-	-	4	5	14	14	9	6	3	7	-	-	-	-	-	-	-	63
1928	-	-	-	-	-	-	3	2	7	6	2	3	3	1	1	1	-	-	-	-	29
1929	-	-	-	-	-	-	-	3	4	9	4	3	2	1	-	-	-	-	-	-	26
1930	-	-	-	-	-	1	4	6	7	11	5	8	4	3	2	-	-	-	-	-	51
1931	-	-	-	-	-	1	3	2	8	13	12	5	7	4	3	-	1	-	-	-	59
Total	-	-	1	-	1	10	22	37	48	53	35	29	27	13	7	1	1	-	-	-	285
Autumn of 1934 —																					
Year class —																					
1930	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2
1931	-	-	-	-	1	-	-	-	2	1	2	-	5	1	-	-	-	-	-	-	12
1932	-	-	-	-	2	4	11	22	36	27	35	23	13	15	5	3	2	-	-	-	198
Total	-	-	-	-	3	4	11	22	38	29	37	24	18	16	5	3	2	-	-	-	212

the same locality as O-group fish, it is necessary to compare samples of the O-group fish with samples of I-group fish taken one year later. Because such fish will be from the same year class, valid comparisons of the circuli widths in the first growth zone can be made. Tables 26 and 27 show that the 140 O-group fish were sampled in 1931 at Montauk, N.Y.; in 1932 139 I-group fish were sampled. A comparison of the circuli widths yields the following analysis of variance:

Source	Degrees of Freedom	Sum of Squares	Mean Squares
Total	279	248,848	
Mean	1	247,275	
Years	1	5	5
Within Years	277	1,568	5.66
	$F \sim 1$	$P > 0.05$	

The analysis of variance indicates no significant difference. From this comparison, it can be concluded that the measurements are from the same population of weakfish. Hence, northern I-group fish spent their first summer in the same locality as O-group fish.

The latter observation suggests that all I-group weakfish in the Northern area completed their first summer's growth there, so that data drawn from the first growth zone of their scales is the equivalent of data from the scales of Northern O-group fish. The samples for the Northern I-group were taken in the course of routine data collection from many catches over extended periods of time. The O-group samples were taken over short periods of time at the end of the season. A few large samples, especially collected when opportunities presented themselves, account for a considerable part of the data. Since such large collections may over-represent sub-groups, such as have frequently been observed among juveniles, it was concluded that the I-group data are probably more representative of the typical O-group spacing in the northern area than are data drawn directly from the O-group samples. Consequently, in subsequent analysis, normal distributions computed from the I-group data have been used to represent the Northern area.

Parenthetically, it may be noted that the differences in spacing appear to be virtually independent of the differences in growth which are also characteristic of the areas or of locality subdivisions within the Northern area. Within each area, the larger, hence presumably faster growing individuals do not show materially coarser spacing.

With the sole exception of the instance noted above, in which Northern I-group and Northern O-group fish agree with respect to circulus spacing of the growth zone, adult distributions are significantly different from the juvenile distributions characteristic of the areas in which the adults were taken. The differences are such as to suggest that the adults in each area represent a mixing of weakfish from two or more nursery areas.

Origin of Northern Juveniles

The foregoing analysis of the origin composition of stocks of adult weakfish is based on a scale character which is not formed until the end of the juvenile summer. This provides no direct evidence of the actual origin of the juvenile weakfish in each locality, for it is possible that extensive migrations may occur in the period between spawning and the end of the juvenile summer. A number of facts bearing on this possibility are available, but on the whole the evidence is so conflicting as to be inconclusive. The information available is presented below.

As shown by the following reports, eggs and/or larvae are present in various localities: Beaufort, N. C., Hildebrand and Cable, 1934; entrance to Chesapeake Bay, Pearson (1941); vicinity of Cape May, N. J., Welsh and Breder, 1923; various localities from Bay Head, N. J., to Cape Henlopen, Del., Prof. A. E. Parr (unpublished manuscript). Eggs were also found by the writer in May, 1931, in Peconic Bay, L. I., N. Y. Tracy, 1908, reports larvae from Wickford, R. I.

There is, however, considerable uncertainty as to whether reproduction is actually successful in all of the localities where eggs have been reported, for with the exception of the few larvae found by Tracy in lobster-rearing pools at Wickford, intensive search has not disclosed weakfish larvae north of the entrance to Chesapeake Bay. This is in marked contrast to the observations of Hildebrand and Cable (1934) in the vicinity of Beaufort and of Pearson (1941) in lower Chesapeake Bay, for the former report taking more than 300 larvae less than 10 millimeters in length and the latter more than 4,000 less than 7 millimeters in length.

The absence of larvae from Parr's extensive collections (Delaware Bay) is particularly surprising in view of the remarkable concentrations of eggs taken by him (up to 500,000 per 10 to 20 minute surface tow with a meter net). The stations in lower Delaware Bay were occupied so frequently (thrice weekly) and covered so great an area in each of several years that there is no possibility that the tows happened to coincide with peaks of discontinuous spawning and missed the periods when pelagic larvae were present. It is also impossible to account for absence of larvae on the assumption that the eggs drift away from the spawning localities so rapidly as to pass beyond the limits of the area covered by the observations. For eggs taken in tow nets were observed to begin hatching within seven hours of the time of capture when placed in finger bowls at temperatures within the range of those observed in the waters where eggs were taken in abundance. Since the areaobserved extends about 30 miles in each direction along the coast from the center of egg concentration, it is obvious that the moderate drift along the New Jersey coast (certainly not more than 10 miles per day) could not possibly carry the eggs out of the area of observation before hatching.

At times, considerable numbers of small medusae and of a Ctenophore (Mnemeopsis) were observed, but not weakfish larvae were found in them.

In an effort to determine whether hatching can take place at the prevailing temperatures in Delaware Bay, Prof. Parr and the writer found that artificially-fertilized eggs held at controlled temperatures hatched at all temperatures within the range observed in the bay.

On the other hand, juveniles as small as 18 millimeters were taken by Parr in otter trawls in early July and subsequently. Their presence can be explained by either of two hypotheses: 1) They are the result of local spawning and are to be connected with larvae which in some unknown manner escaped the intensive search made for them. 2) They are immigrants from other spawning areas, presumably from southern spawning areas.

With respect to the first hypothesis, the juveniles taken in early July are rather smaller than would be expected if they were produced at the height of spawning observed by Parr in late May and early June. Moreover, the length frequency distributions of the summer and autumn collections suggest that either most of the young fish in Delaware Bay grow very slowly (cf. Hildebrand and Cable, 1934; Pearson 1941); or the young fish taken there are transients for the most part, the stock being added to either by belated spawning in the bay or by immigration of juveniles from elsewhere while losing most of the larger sizes by emigration or mortality.

In addition to these difficulties in connecting the juveniles in Delaware Bay and elsewhere in New Jersey and New York with the egg collections reported, it is also difficult to account for them satisfactorily in any other way. The inshore drift along the coast is southerly so that they cannot be involuntary immigrants from southern spawning. Since both eggs and larvae are absent from the offshore collections, they cannot be carried northward by an offshore drift as appears to be true for mackerel, bluefish, and eel larvae. The only remaining possibility is that after attaining the power of independent locomotion, larvae hatched in the South swim northward. The principal consideration in favor of this suggestion is the presence in the North of large numbers of very small juveniles of at least two other species which, if they spawn at all in the North, must do so sparingly--mullet, Mugil cephalus, and spot, Leiostomus xanthurus. Prof. Parr finds the juveniles of both species abundantly represented in his New Jersey collections and both are common as juveniles as far north and east as Woods Hole. Both are known to be winter spawners. Adult mullet are rare in the North at all seasons and spot disappear from New Jersey in November. A single record indicates the movement of a tagged spot from Delaware Bay to the vicinity of Ocracoke Inlet, N. C., between October, 1930, and December 1930. It is possible, however, that these species may spawn so far offshore that the young are carried northward by the offshore drift.

SUMMARY AND CONCLUSIONS

Little is known concerning the migration of shore fishes which summer in the inshore waters of the Middle Atlantic Bight. Previous tagging experiments suggest that the several species migrate southward as well as offshore in the winter. Foremost among the questions raised by these migrations are those concerning the unity or diversity of the populations. Are populations of weakfish found along the East coast all of one race or do we have a number of races represented? This knowledge is important from both an economic and scientific standpoint.

The complex movements of weakfish have been studied by comparing the stocks of fish at several localities as to abundance, size, age composition, and rate of growth, and by tagging experiments.

Samples selected for study were all obtained from the pound net fishery. Catch records were obtained from the following sources: Fish and Wildlife Service, State of New Jersey Board of Fish and Game Commissioners, and personal records of companies and individuals. Lengths, weights, and scale samples were taken at various localities from 1928-1932. For localities north of Delaware Bay length samples were grouped into periods of varying duration called grouped samples. Size composition was nearly the same for each period. Weighting of length frequencies by the average catch per net for each period gave an estimate of the number of fish at each length caught per net.

Age was determined by examination of scales. The method of age analysis was based on repeated reading of a large number of scales until consistent criteria of interpretation were found. The method was confirmed by a quantitative analysis of the intracircular distance.

It is an open question whether all of the O-group fish were spawned in the localities where they were captured or whether extensive migration had occurred between spawning in June and capture in October. By fall the O-group is distributed all along the coast from Long Island to North Carolina. During November and December they migrate to the warm waters off Virginia and North Carolina where they spend their first winter. Many of the I-group migrate from North Carolina to Virginia and a few to southern New Jersey in midsummer. This migration pattern is repeated each year by all age groups, which return to southern waters in winter and move coastwise and northward in summer. The data suggest that most of the two-year-old fish north of Delaware Bay are immigrants, presumably recruited from stocks of yearlings in localities south of Delaware Bay where such weakfish are regularly present. Weakfish three or more years old constitute the bulk of the catch only in northern New Jersey and some years at Fire Island which leads us to believe that these fish are recruited from the southern New Jersey two-year-old stocks.

In all sampling locations fall caught fish were larger than spring caught fish except in Virginia and southern New Jersey where the reverse was true. This is true because many of the fish caught here in the spring must be enroute to northern waters where they had spent their previous summers and where growth is more rapid.

The above observations led to a hypothesis concerning the movements of the fish during each year of their life:

First to Second Autumn. Young (O-group) fish are distributed from Long Island to North Carolina, but migrate to Virginia and North Carolina for their first winter. In the following spring these fish (now I-group) move inshore along North Carolina, most migrating to Virginia by mid-August.

Second to Third Autumn. Yearlings move to warmer water off North Carolina and Virginia to spend their second winter. In spring they return inshore from North Carolina to New York, and in summer there is a general northward movement.

Third to Succeeding Autumns. The II-group fish winter off Virginia and North Carolina. Depending on their previous history, they migrate as far north as New York or remain off Virginia and South Carolina. Movements are repeated during each succeeding year of life.

The hypothesis was tested by tagging experiments and analysis of scale measurements:

Weakfish of the O-group were tagged at Montauk, N. Y. in 1932. The returns in 1933 consisted of 18 from southern waters and the remainder predominantly from Delaware Bay and southern New Jersey. In 1934 most of the returns were in northern New Jersey or New York. Later returns were mostly from New York waters.

A tagging experiment in lower Chesapeake Bay in 1931 indicated no northward migration, while 30 percent of the returns of fish tagged off Exmore, Virginia, in 1933 were from northern localities.

Tagging experiments with I-group weakfish in Pamlico Sound, North Carolina seem to indicate that the North Carolina sounds do not contribute materially to northern stocks. The majority of recaptures were made in Virginia and North Carolina waters.

Declines in percentage recovery of tags from the various experiments indicated that the stocks were declining at the rate of 50 to 75 percent per year.

Frequency distributions of the mean spacing between the ten marginal circuli of the lateral field of the first growth zone were constructed.

A statistical analysis of the measurements indicated that year classes should be treated separately. Comparison of the 1934 O-group measurements from North Carolina, Virginia, and Northern area discloses the existence of separate southern and northern populations. To determine whether northern I-groups spend their first summer in the northern area, 1931 O-group measurements from Montauk, N. Y. were compared with 1932 I-group measurements from the same locality. Analysis of variance indicated no significant difference. suggesting that northern I-group fish spend their first summer in the same locality as O-group fish.

Adult distributions are significantly different from the juvenile distributions characteristic of the areas in which the adults were taken. The difference is such as to suggest that the adults in each area represent a mixing of the weakfish from two or more nursery areas.

Weakfish eggs and larvae are abundant in Chesapeake Bay and southward, but larvae have never been found north of the entrance to Chesapeake Bay. Numerous eggs have been found in Delaware Bay in spring, but extensive sampling has revealed no larvae. Juveniles found there in the spring probably have moved northward from southern spawning areas.

The hypothesis concerning the movements of the weakfish is supported by an analysis of age, size, rate of growth, and scale circuli measurements. Tagging experiments partially support the hypothesis and in addition indicate that North Carolina sounds do not contribute materially to the northern stocks.

The most important conclusion to be derived from this study is that the fishery apparently draws on a common stock which originates chiefly in southern waters. Consequently, any conservation policy for the weakfish industry must consider the effect of fishing intensity on the total yield of the Middle Atlantic Bight.

LITERATURE CITED

Bigelow, H. B.
1928. Physical oceanography of the Gulf of Maine. U. S. Bur. Fish., Bull., Vol. 40, Part II, (Doc. 969) pp. 511-1027.

Bigelow, H. B., and Mary Sears
1935. Studies of the waters on the continental shelf, Cape Cod to Chesapeake Bay. II. Salinity. Pap. Phys. Ocean., Meteor., Mass. Inst. Tech., Woods Hole Ocean. Inst., vol. 4, No. 1, 94 pp.

Bigelow, H. B., and W. W. Welsh
1925. Fishes of the Gulf of Maine. U. S. Bur. Fish., Bull., vol. 40, Part I, (Doc. 965) pp. 270-276.

Crozier, W. J., and Selig Hecht
1914. Correlations of weight, length, and other body measurements in the weakfish, Cynoscion regalis. U.S. Bur. Fish., Bull., vol. 33, (Doc. 800), pp. 141-147.

Gilbert, C. H.
1919. Contributions to the Life History of the sockeye salmon (No. 5). Rept. Comm. Fish., Britich Columbia. 1918 (1919), pp. 26-52.

Higgins, Elmer, and J. C. Pearson
1927. Examination of the summer fisheries of Pamlico and Core Sounds, N.C., with special reference to the destruction of undersized fish and the protection of the gray trout, Cynoscion regalis (Bloch and Schneider). U. S. Bur. Fish., Ann. Rpt., App. II, pp. 29-65.

Hildebrand, S. F., and Louella E. Cable
1934. Reproduction and development of whitings or kingfishes, drums, spot, croaker, and weakfishes or sea trouts, Family Sciaenidae, of the Atlantic Coast of the United States. U. S. Bur. Fish., Bull., No. 16, vol. 48, pp. 41-117.

Lea, Einar
1919. Report on "Age and growth of the herring in Canadian waters", Canadian Fisheries Expedition, 1914-15, Dept. of the Naval Service, pp. 75-164, Ottawa.

Nesbit, R. A., and W. C. Neville
1935. Conditions affecting the southern winter trawl fishery. U. S. Bur. Fish., Fish. Cir. 18, 12 pp.

Parr, A. E.
1933. A geographic ecological analysis of the seasonal changes in temperature conditions in shallow water along the Atlantic Coast of the United States. Bull. Bing. Ocean. Coll., vol. 4, art. 3, 90 pp.

Pearson, J. C.
1932. Winter trawl fishery off the Virginia and North Carolina coasts. U. S. Bur. Fish., Invest. Rpt. 10, 31 pp.

Pearson, J. C.
1941. The young of some marine fishes taken in lower Chesapeake Bay, Virginia, with special reference to the gray trout, Cynoscion regalis. U. S. Fish and Wildlife Serv., Fish. Bull. No. 36, vol. 50, pp. 79-102.

Rathbun, Richard
1887. "Ocean temperatures of the Eastern Coast of the United States", The Fisheries and Fishery Industries of the United States, Sec. III, pp. 155-177.

Runnstrom, Sven
1936. A study on the life history and migrations of the Norwegian spring herring based on the analysis of the winter rings and summer zones of the scale. Rpt. Norw. Fish. Mar. Inv., vol 5, No. 2, 104 pp.

Schroeder, W. C.
1930. Migrations and other phases in the life history of the cod off southern New England. U. S. Bur. Fish., Bull., vol. 46 (Doc. 1081) pp. 132-136.

Tracy, H. C.
1908. The fishes of Rhode Island. VI. A description of two young specimens of the squeteague, Cynoscion regalis, with notes on their rate of growth. Comm. Inland Fish. Rhode Island, 39th Ann. Rpt., pp. 85-91.

Welsh, W. W., and C. M. Breder, Jr.
1923. Contributions to life histories of Sciaenidae of the eastern United States coast. U. S. Bur. Fish., Bull., vol. 39, (Doc. 945) pp. 141-201.

56961 Interior-Duplicating Section-Washington