AGE COMPOSITION AND MAGNITUDE OF STRIPED BASS WINTER GILL-NET CATCHES IN THE RAPPAHANNOCK RIVER, 1967-1970[1] [2]

by

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ABSTRACT

The dependence of commercial fishing success on strong yearclasses of striped bass is demonstrated, using four years of catch records from a small group of cooperating gill-net fishermen. Age analysis of these Rappahannock River catches during 1969 and 1970 revealed that an approximate tripling of landings in 1970 was a result of selection for the dominant 1966 year-class.

INTRODUCTION

The occasional appearance of unusually successful, or "dominant", year-classes of certain fish species has been well-documented by fishery biologists. One such species is the striped bass, *Morone saxatilis* (Walbaum), an anadromous species of considerable commercial and recreational importance along the Atlantic coast. In recent history, the best known strong year-classes of striped bass were those of 1934 and 1958, both of which resulted in waves of heavy landings proceeding northward along the coast from Chesapeake Bay (Merriman, 1941; Raney, 1952; Shearer, Ritchie, and Frisbie, 1962; Schaefer, 1968).

The impact of dominant year-classes is clearly reflected in increased commercial landings. Koo (1970) has shown an apparent six-year cycle of abundance for the Chesapeake-spawned population from analysis of the 1930-1966 catch records. Heavy landings were attributed to the periodic appearances of dominant year-classes. A longer-term increase in abundance is also evident, with landings increasing nine-fold from 1934 to 1966.

The direct effect of strong year-classes of striped bass on the fortunes of individual fishermen or segments of the fishery is less well-known than is their effect on total landings. Vladykov and Wallace (1952) provided a detailed analysis of the catches of two pound-netters from 1930 to 1937. Compared with 1935 catches, landings tripled and quadrupled in 1936 and 1937, respectively. These increases were attributed to the dominant 1934 year-class. Similarly, a doubling of pound net catches in Maryland from 1941 to 1942 was caused by the dominant 1940 year-class (Tiller, 1950). Murphy (1960) found that haul seine catches doubled in the summer of 1959, coincident with a slight reduction in effort, and consisted largely of 1956 and 1957 year-classes. Continuance of that study for an additional year or two would have been interesting in view of the known abundance of the 1958 year-class.

This paper will examine the effect of a strong year-class of striped bass on the landings recorded by four gill-net fishermen on the Rappahannock River, Virginia. Their cooperation in providing confidential records and allowing sampling of their catches is gratefully acknowledged.

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METHODS AND MATERIALS

Catch Data and Fishery Description

Data for landings utilized in this paper were obtained from log-books maintained by four stake gill-netters from March 1967 to April 1970. Daily entries, in pounds by species, were made by each fisherman.

Catch data have not been converted to a per-unit-effort base, because total effort within this segment of the fishery has remained essentially constant over the period being considered. The location of nets have also remained the same, extending along seven nautical miles of the Rappahannock River where the average river width is 1.6 nautical miles.

This fishery employs, for the most part, two different classes of gill-nets: 1) a "perch" net (3 ¼"-3½" stretch mesh) used early in the season, December- February, primarily for white perch, *Morone americanus*, but catching significant numbers of striped bass, and 2) so-called "shad nets" (4"-5" mesh) that are substituted beginning in late February or early March, in anticipation of the spring run of American shad, *Alosa sapidissima*. The constant location of nets eliminates most of the bias indicated by Craig (1930) who found that catches of shad were inversely correlated with catches of striped bass, because California fishermen changed their location and habits of fishing when shad were abundant.

Catch Sampling

Catches from this gill-net fishery were sampled semi-monthly while nets were in operation during the winters of 1969 and 1970. Samples of approximately 50 striped bass were measured. Age was determined from scales removed from the region above the lateral line and below the gap between the two dorsal fins (Merriman, 1941).

RESULTS

Landings, 1967-1970

Striped bass landings for the selected Rappahannock River fishery are summarized in Table 1. Differences between catches of individual fishermen within months are largely due to the number of nets fished, so that relative success from month to month is quite consistent. Records were not obtained before March 1967, therefore data for winter 1967 are incomplete. Because ice frequently prevents fishing during January and February, the best months for consistent fishing and for comparison of striped bass abundance are March and April. Total landings for these two months in the years of record were as follows: 1967-14,434 lbs., 1968-29,432 lbs., 1969-17,508 lbs., and 1970-66,543 lbs. Reduced catches in March and April 1969 followed large landings early in the season. Total catches in winter 1970 were approximately triple those of the previous two fishing seasons.

Age and Size Composition, 1969-1970

Sampling of this fishery was initiated in January 1969. Figure 1 shows the magnitude of catches during the two seasons of sampling and the age composition of the catch within semi-monthly sampling periods. The 1966 year-class contributed over 80% of the total number of striped bass during the period of maximum landings (March 1970), as it did throughout the last half of the preceding fishing season.

Younger year-classes (primarily the 1967 year-class) contributed most to catches during the first half of the 1970 season, when small-mesh "perch nets" were in use. Replacement of these nets with "shad nets" coincided with the heavy catches of 1966 year-class striped bass. The final sample, conversely, contained a large percentage of fish from the year-classes 1965 and older (oldest 1957), resulting from an experimental employment of two large-mesh gill-nets (8" and 9" stretch mesh).

Size selection by the various nets employed is evident from the change in mean length of striped bass caught through the season (Table 2). In 1969, the mean length increased from about 350 mm to nearly 430 mm when shad nets (4″-5″) were substituted for perch nets (3 ¼″-3½″), and in 1970 from 390 mm to 476 mm. A similar jump in mean length of the 1966 year-class component of catches occurred in 1969. These lengths increased from about 360 mm to 420 mm. Shad nets caught faster-growing members of the 1966 year-class than did smaller-mesh nets, as is evidenced by the mean back-calculated lengths at Age I. This effect, however, was not as evident in the 1970 season after a further year's growth by the 1966 year-class. "Perch nets" simply caught fewer of these now larger striped bass.

Estimated Contribution by Weight of the 1966 Year-class to Total Landings

Since landings are reported only in pounds and our age and size data are in numbers of individuals, some conversion from numbers to weight is necessary before attributing change in total landings to abundance of any particular year-class. Table 3 lists the mean lengths of striped bass within year-classes throughout the sampling period and their calculated mean weights. The length-weight relationship of male striped bass published by Mansueti (1961) for Maryland-caught fish has been used for these fish of unknown sex, since his equation for females and striped bass of unknown sex somewhat overestimates weights of striped bass (unknown sex) in Virginia waters. Length-weight relationships for Virginia populations have not yet been published.

During the winter 1969 season, including only those semi-monthly periods in which samples were taken, the 1966 year-class accounted for an estimated 22,446 pounds, or over 70% of the total landings of 31,326 pounds reported during those periods. Landings of the 1966 year-class more than doubled in the following season. An estimated 49,834 pounds, or nearly 60% of a total 85,351 pounds, was landed in the periods sampled.

DISCUSSION

Strong year-classes of striped bass increase the catch of selective-gear fisheries, as they have been shown to do for landings as a whole (Koo, 1970) and for non-selective gear, such as pound nets (Tiller, 1950; Vladykov and Wallace, 1952) and haul seines (Murphy, 1960). The 1966 year-class contributed over 80% by numbers and by weight to peak catches in March 1970 by four gill-net fishermen in the Rappahannock River. Contribution of the 1966 year-class to landings in winter 1970, when landing were nearly triple those of the previous year, was nearly 60% by weight.

Gill-net fishermen are in the best position to maximize catches of such dominant year-classes, providing they have knowledge of year-class abundance, average length at different ages, expected growth from one year to the next, and the relation between gill-net mesh size and mean length of striped bass caught. Trent and Hassler (1968) have shown a linear relationship between gill-net mesh size and length of male striped bass. Mean lengths expected to be caught in the nets commonly employed in the Rappahannock fishery are as follows: 3¼″-338 mm, 4″-403 mm, 5″-490 mm. Comparison of these expected lengths with mean lengths of our samples in Table 2 shows close agreement. Furthermore, it is apparent that peak catches occurred when the 1966 year-class approached a mean length close to that expected to be optimally caught in 5″-mesh nets. A further year's growth will reduce catches of 1966 year-class striped bass if 5″ gill-nets are again employed in 1971. Assuming a significant return of the 1966 year-class in the winter of 1971 and growth to a mean fork length of approximately 550 mm, catches would be maximized by use of gill-nets with 5¾″ stretch mesh.

TABLE 1
LOG-BOOK RECORDS OF LANDINGS BY MONTHS FOR INDIVIDUAL GILL-NET FISHERMEN, RAPPAHANNOCK RIVER, 1967-1970. STRIPED BASS CATCHES IN POUNDS.

Month and Year	Fisherman A	B	C	D	Totals
Mar 1967	2,340	2,391	2,691	1,925	9,275
Apr	1,383	1,234	1,549	993	5,159
					14,434*
Jan 1968	1,294	---	---	1,625	2,919
Feb	---	---	---	935	935
Mar	2,316	6,776	7,291	7,518	23,901
Apr	780	1,378	1,656	1,717	5,531
					33,286
Jan 1969	2,442	2,458	5,263	2,952	13,115
Feb	---	654	522	647	1,823
Mar	771	3,286	3,010	4,943	12,010
Apr	1,179	739	1,621	1,959	5,498
					32,446
Dec 1969	---	---	2,287	1,997	4,284
Jan 1970	530	1,003	2,003	1,478	5,014
Feb	---	5,927	8,307	6,237	20,471
Mar	5,344	11,009	12,475	15,853	44,681
Apr	1,713	5,887	6,960	7,302	21,862
					96,312

*incomplete - no records for early winter months.

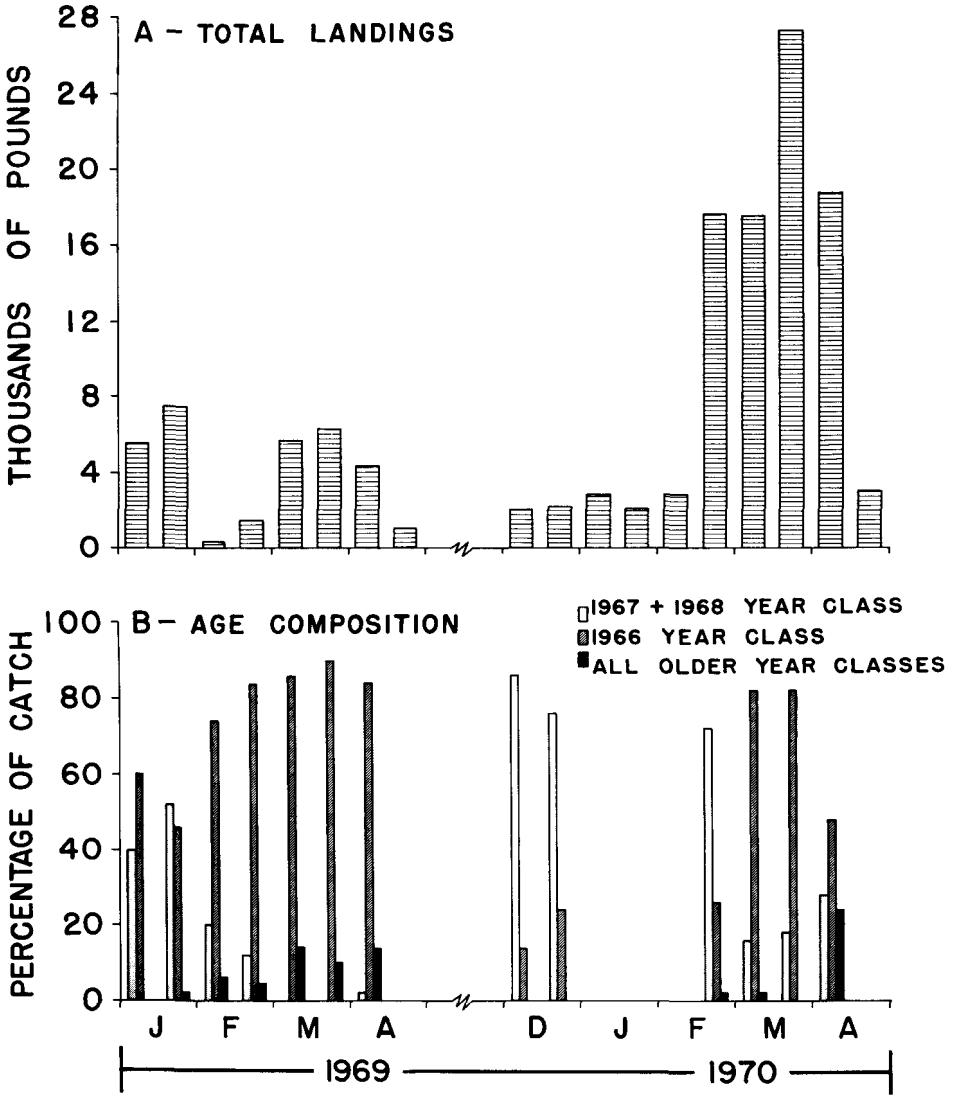

FIGURE 1. Total landings (A) and age composition (B) of striped bass in the sampled gill-net fishery, Rappahannock River, Virginia, during the winters of 1969 and 1970.

TABLE 2

MEAN FORK LENGTHS (IN MILLIMETERS) OF ENTIRE SAMPLES AND THEIR 1966 YEAR-CLASS COMPONENT, WITH BACK-CALCULATED LENGTHS AT AGE I FOR THE 1966 YEAR-CLASS

Sample Date	Entire Sample			1966 Year Class				
				At capture			At Age I	
	N	$\bar{x}$	(t.05)S.E.	N	$\bar{x}$	t.05(S.E.)	$\bar{x}$	t.05(S.E.)
3 Jan 69	50	339.8	± 8.8	30	355.9	± 10.0	118.7	± 8.7
17 Jan 69	50	322.9	± 8.9	23	340.9	± 12.8	106.2	± 9.6
11 Feb 69	50	373.6	± 14.2	37	381.8	± 11.4	130.4	± 12.1
21 Feb 69	49	356.0	± 11.0	41	357.7	± 8.0	118.3	± 7.9
6 Mar 69	49	429.6	± 11.8	42	420.4	± 10.3	151.9	± 9.1
19 Mar 69	49	421.2	± 12.0	44	412.6	± 10.2	148.9	± 9.6
2 Apr 69	50	429.1	± 15.4	42	416.9	± 11.3	136.8	± 8.9
8 Dec 69	50	358.7	± 14.4	7	434.0	± 40.2	110.3	± 28.0
17 Dec 69	50	390.3	± 19.2	12	487.0	± 15.2	130.0	± 14.7
16 Feb 70	50	390.0	± 13.9	13	442.3	± 22.3	122.2	± 14.0
4 Mar 70	50	476.6	± 15.8	41	477.7	± 10.1	135.1	± 8.1
16 Mar 70	50	463.3	± 11.0	41	470.5	± 11.6	123.0	± 7.6
10 Apr 70	50	544.4	± 48.2	24	484.5	± 13.1	134.9	± 11.9

TABLE 3
CONVERSION OF AGE FREQUENCY AND MEAN LENGTHS TO WEIGHT WITHIN SEMI-MONTHLY PERIODS OF SAMPLING

Sample Period	Year Class	N	Mean L. in mm.	Calc. Mean Wt. in Pounds*	Total Sample Wt. in Pounds	Percent Total Sample Wt.	Estimated Contribution in Pounds to Total Lndgs.
(1969)							
Jan 1-15	1966	30	355.9	1.252	37.56	68.82	3841
	1967	20	315.6	0.851	17.02	31.18	1740
	Total	50	---	---	54.58	100.00	5581
Jan 16-31	1965	1	375.0	1.492	1.49	3.25	245
	1966	23	340.9	1.089	25.05	54.66	4118
	1967	26	305.0	0.742	19.29	42.09	3171
	Total	50	---	---	45.83	100.00	7534
Feb. 1-15	1965	3	482.7	3.349	10.05	13.19	43
	1966	37	381.8	1.570	58.09	76.22	248
	1967	10	310.7	0.807	8.07	10.59	34
	Total	50	---	---	76.21	100.00	325
Feb 16-28	1965	2	457.5	2.818	5.64	9.02	135
	1966	41	357.7	1.270	52.07	83.26	1247
	1967	6	310.5	0.805	4.83	7.72	116
	Total	49	---	---	62.54	100.00	1498
Mar 1-15	1964	2	482.5	3.349	6.70	5.88	333
	1965	5	485.6	3.419	17.10	15.00	849
	1966	42	420.4	2.148	90.22	79.13	4476
	Total	49	---	---	114.02	100.01	5658
Mar 16-31	1964	1	505.0	3.881	3.88	3.62	230
	1965	4	495.0	3.638	14.55	13.57	862
	1966	44	412.6	2.018	88.79	82.81	5261
	Total	49	---	---	107.22	100.00	6353
Apr 1-15	1962	1	588.0	6.350	6.35	5.38	235
	1964	4	511.8	4.054	16.22	13.75	602
	1965	2	476.0	3.206	6.41	5.43	238
	1966	42	416.9	2.089	87.74	74.36	3255
	1967	1	358.0	1.276	1.28	1.08	47
	Total	50	---	---	118.00	100.00	4377

TABLE 3 (Continued)

Sample Period	Year Class	N	Mean L. in mm.	Calc. Mean Wt. in Pounds*	Total Sample Wt. in Pounds	Percent Total Sample Wt.	Estimated Contribution in Pounds to Total Lndgs.
(1969)							
Dec 1-15	1966	7	434.0	2.382	16.67	24.74	507
	1967	15	387.7	1.651	24.76	36.74	753
	1968	28	324.4	0.927	25.96	38.52	790
	Total	50	---	---	67.39	100.00	2050
Dec. 16-31	1966	12	487.0	3.451	41.41	45.05	1007
	1967	20	387.8	1.655	33.10	36.01	804
	1968	18	328.7	0.968	17.42	18.95	423
	Total	50	---	---	91.93	100.01	2234
(1970)							
Feb 16-28	1965	1	443.0	2.540	2.54	2.92	514
	1966	13	442.3	2.529	32.88	37.75	6643
	1967	26	384.4	1.606	41.76	47.94	8436
	1968	10	331.3	0.993	9.93	11.40	2006
	Total	50	---	---	87.11	100.01	17,599
Mar 1-15	1964	1	765.0	14.89	14.89	8.90	1557
	1966	41	477.7	3.242	132.92	79.45	13,903
	1967	7	446.3	2.606	18.24	10.90	1908
	1968	1	355.0	1.244	1.24	0.74	130
	Total	50	---	---	167.29	99.99	17,498
Mar 16-31	1966	41	470.5	3.089	126.65	85.92	23,356
	1967	9	430.1	2.306	20.75	14.08	3827
	Total	50	---	---	147.40	100.00	27,183
Apr 1-15	1957	1	947.0	29.64	29.64	8.56	1608
	1958	2	940.0	28.96	57.92	16.72	3141
	1960	1	912.0	26.29	26.29	7.59	1426
	1961	3	885.7	23.87	71.61	20.67	3882
	1963	1	840.0	20.13	20.13	5.81	1092
	1964	2	659.0	9.181	18.36	5.30	996
	1965	2	541.0	4.851	9.70	2.80	526
	1966	24	484.5	3.395	81.48	23.52	4418
	1967	13	429.1	2.290	29.77	8.59	1613
	1968	1	380.0	1.548	1.55	0.45	85
	Total	50	---	---	346.45	100.01	18,787

*using l-w relationship by Mansueti (1961). See text.

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