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Age Composition Of Striped Bass Catches In Virginia Rivers, 1967-1971, And A Description Of Fishery

George C. Grant
Virginia Institute of Marine Science.

THE AGE COMPOSITION OF STRIPED BASS CATCHES IN VIRGINIA RIVERS, 1967-1971, AND A DESCRIPTION OF THE FISHERY[1]

GEORGE C. GRANT[2]

ABSTRACT

The age composition of Virginia catches of the striped bass, *Morone saxatilis*, is being monitored as one of the parameters important in rational management of the species. Catches of pound nets and fyke nets, relatively nonselective gear types used in estimates of age structure, were sampled semimonthly in three Virginia rivers from July 1967 through June 1971.

Seasonal changes in age composition are slight with older, migratory striped bass occurring more frequently in winter and spring catches. Young fish are not caught by these nets in significant numbers until the spring following the year of their hatch. An age group that is dominant in summer usually continues its dominance through the spring of the following year.

Differences in age composition of striped bass catches among rivers and years occur as a result of variable year class strength. Although one-year-olds normally dominate catches, two-year-olds may predominate either through local failure of a year class or by continued dominance of a relatively strong year class.

A brief description of the striped bass fishery in Virginia is included.

Closer management of anadromous fish stocks may become necessary as a protective response to increasing human populations along the Atlantic coast of the United States. Because of their reproductive migrations into river systems, these anadromous fishes may be most directly affected by the expanding megalopolis of the east coast and the increased pollution of coastal waters.

One valuable anadromous species is the striped bass, *Morone saxatilis* (Walbaum). Although the biology and habits of striped bass are fairly well studied (Raney, 1952), effective management of the stocks has been hampered by the absence of data on population parameters such as age composition and mortality.

An investigation of striped bass in Virginia[3] was initiated in 1967 after a review of results from the Chesapeake Bay Cooperative Striped Bass Program (Lewis, 1961; Mansueti, 1961; Massmann and Pacheco, 1961) and follows the suggestions of Sykes (1961) for further research on striped bass. This paper considers the age composition of striped bass catches in Virginia and briefly describes the fishery.

DESCRIPTION OF THE FISHERY

The coastal Virginia fishery for striped bass is scattered and diverse. It includes trawlers, pound nets, fyke nets, haul seines, gill nets and sport fishing gear.

In the commercial fishery, pound nets are fished at permanent locations and are most consistently in use. They are lifted only during brief periods for cleaning, to prevent possible ice damage, or because of nuisance factors such as abundant jellyfish. Fyke nets, hung and fished much like small pound nets in Virginia waters, are usually located farther upriver than the pound nets. Catches are relatively small and the gear is employed more sporadically than pound nets. Trawlers are limited to offshore fishing by law. Therefore striped bass are available to this gear only in winter months, when they are migrating along the coast. Striped bass availability to trawlers increases during severe winters when the river populations migrate to the warmer coastal waters (Grant et al., 1970). Gill net mesh size and manner of fishing vary with the season in the striped bass fishery. Small mesh "spot and perch nets"

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[2] Virginia Institute of Marine Science, Gloucester Pt., VA 23062.

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(2⅞ - 3½" stretch mesh) are anchored in the summer and staked from late fall to winter. Large mesh "shad nets" (5½" stretch mesh) are staked or drifted in late winter and spring. Haul seines are used sporadically throughout the warmer months, but most effectively in the spring.

Sport fishing for striped bass is intensive in the lower Chesapeake Bay, especially along the Chesapeake Bay Bridge-Tunnel in spring and fall. The sport fishery extends from the mouth of the Bay to the freshwater regions of major river systems from March through December. Attraction of small striped bass to the numerous lighted piers extends sport fishing well beyond daylight hours.

Commercial landings of striped bass in Virginia[4] for the 40-yr period 1930-1969 show a ninefold increase from a low of 0.3 million pounds in 1934 to 2.8 million pounds in 1966 (Figure 1). The overall trend in landings (and striped bass populations) has been rising during this period. Two definite peaks of abundance are evident, one in the late 1940's and the other in the 1960's. Not included in these landings are sport catches, which have increased to as much as 50 percent of the total catch in certain areas (Grant, unpublished data). Averaged commercial landings in the most recent years have declined; continuation or reversal of this decline depends on contributions to subsequent catches by successful year classes such as those of 1966 and 1970 (Grant and Joseph, 1969; Grant, Burrell, and Kriete, 1971).

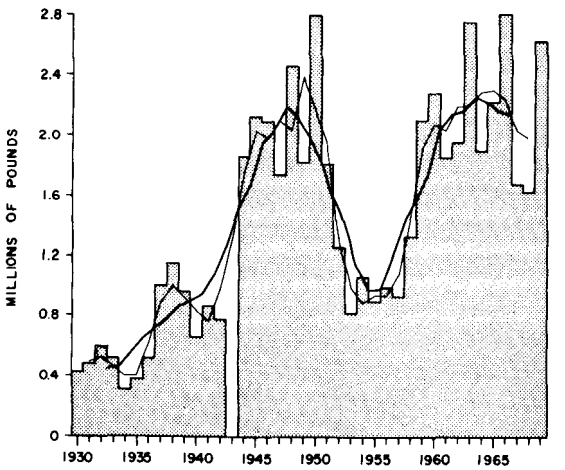

FIGURE 1.—Annual landings of striped bass in Virginia, 1930-69. Moving averages (indicated by heavy line for 6-yr average and light line for 3-yr average) incorporate an interpolated value of 1,321,000 pounds for 1943.

AGE COMPOSITION

Methods and Materials

Pound nets and fyke nets trap striped bass over their entire size range, except for the young-of-the-year which are incompletely recruited to the gear. These two gear types were, therefore, considered to be essentially nonselective (allowing for escapement of Age 0 fish) and were sampled for estimates of the age composition of striped bass stocks residing in the James, York, and Rappahannock rivers. Although differences in the age composition of catches by pound and fyke nets did occur, no consistency was evident in these differences, so catches were pooled for analysis. Rappahannock River samples were taken from pound nets only.

The scale method was used for age determinations. Scales were first used in age analysis of striped bass populations by Scofield (1931); this method was fully developed and validated for striped bass by Merriman (1941). Samples of approximately 50 striped bass were obtained from each river system semimonthly. Scales were removed from individual fish at the site specified by Merriman (1941). Cellulose acetate impressions of scale sculpturing were prepared using five or six scales from each fish. Annuli were counted at a magnification of 15× with all scales being read at least twice and instances of disagreement re-examined.

Annuli on the scales of Virginia striped bass form between April and June, coincident with the spawning season and hatch of a new year class. The growth year of local populations, therefore, may be considered to extend from July to June. Young-of-the-year do not become Age I fish until late spring of the year following their hatch. In this paper, July 1 is designated as the start of each year so that a member of the 1966 year class caught between 1 July 1967 and 30 June 1968 would be called Age I. Seasonal designations are used as follows: winter (Jan.-Mar.), spring (Apr.-June), summer (July-Sept.), fall (Oct.-Dec.); these quarterly periods

[4] Data from Koo (1970) and from annual summaries of regional fisheries statistics published by the Bureau of Commercial Fisheries.

were chosen on the basis of water temperatures and are more meaningful in the present context than terrestrial seasons.

Seasonal Age Composition

James River

Catches in the James River (Table 1) typify the seasonal pattern observed in all three rivers. The age group that dominated July-September catches generally continued to dominate through the following June, i.e., for a complete sampling year that began in July.

Striped bass older than Age III were present throughout the 1967-1968 sampling year and were most abundant in spring. In other years, these mature fish appeared in April; some remained in the river through summer, but none were taken during the fall and winter. Young-of-the-year were generally absent from catches, except for the appearance of the 1969 year class in spring months of 1970.

York River

The general pattern of dominance observed in the James River was repeated in the York (Table 2). An exception occurred in winter months of 1970, when icing of the river severely reduced catches and the small sample consisted mostly of older fish. A more notable exception was the dominance of young-of-the-year striped bass in spring months of 1971.

Mature striped bass older than Age III rarely appeared during warmer months in the York River. Seventy-eight percent of these older individuals were taken in winter and spring months, 7.5% in the summer quarter.

Rappahannock River

Only one seasonal shift in age group dominance occurred in Rappahannock River catches of striped bass during the four-year sampling period. Older fish dominated in winter months of 1970 (Table 3), as observed in the York River.

TABLE 1.—Age composition of striped bass caught by nonselective fishing gear in the James River within quarterly periods, July 1967-June 1971.

	Number in Age Group								
Quarterly Period	0	I	II	III	IV	V	VI	≥VII	*N*
(1967)									
July-Sept	—	—	35	24	1	1	1	1	63
Oct-Dec	1	19	122	10	2	—	3	—	157
(1968)									
Jan-Mar	—	9	8	4	—	1	—	4	26
Apr-June	—	22	39	34	8	2	8	26	139
% Subtotal	0.3	13.0	53.0	18.7	2.9	1.0	3.1	8.1	
July-Sept	—	70	189	94	27	4	1	3	388
Oct-Dec	—	97	89	13	—	—	—	—	199
(1969)									
Jan-Mar	(no samples)								0
Apr-June	—	154	108	16	19	10	8	12	327
% Subtotal	0	35.1	42.2	13.5	5.0	1.5	1.0	1.6	
July-Sept	—	31	235	58	3	4	—	3	334
Oct-Dec	—	8	85	13	—	—	—	—	106
(1970)									
Jan-Mar	—	1	3	2					6
Apr-June	19	33	81	29	10	3	2	14	191
% Subtotal	3.0	11.5	63.4	16.0	2.0	1.1	0.3	2.2	
July-Sept	1	98	57	64	12	1	1	1	235
Oct-Dec	—	33	8	6	—	—	—	—	47
(1971)									
Jan-Mar	(no samples)								0
Apr-June	(no samples)								0
% Subtotal	0.4	46.5	23.0	24.8	4.3	0.4	0.4	0.4	
							Total Number Aged		2,218

TABLE 2.—Age composition of striped bass caught by nonselective fishing gear in the York River within quarterly periods, July 1967-June 1971.

Quarterly Period	Number in Age Goup								
	0	I	II	III	IV	V	VI	≥VII	N
(1967) July-Sept	—	317	22	4	—	—	—	—	343
Oct-Dec	—	112	20	1	—	—	—	—	133
(1968) Jan-Mar	—	16	13	11	—	—	—	—	40
Apr-June	2	119	21	2	—	—	—	2	146
% Subtotal	0.3	85.2	11.5	2.7	0	0	0	0.3	
July-Sept	—	84	126	5	—	1	—	2	218
Oct-Dec	1	274	210	27	4	—	—	—	516
(1969) Jan-Mar	1	178	151	40	14	4	1	1	390
Apr-June	11	191	75	15	3	3	1	6	305
% Subtotal	0.9	50.9	39.3	6.1	1.5	0.6	0.1	0.6	
July-Sept	—	221	149	13	2	2	—	—	387
Oct-Dec	8	225	200	47	11	2	1	3	497
(1970) Jan-Mar	—	1	4	6	1	—	—	—	12
Apr-June	41	84	33	10	2	3	2	—	175
% Subtotal	4.6	49.6	36.0	7.1	1.5	0.7	0.3	0.3	
July-Sept	—	223	48	2	—	—	—	—	273
Oct-Dec	13	425	65	16	6	—	—	—	525
(1971) Jan-Mar	13	82	13	8	1	1	—	3	121
Apr-June	145	131	9	12	7	—	2	2	308
%Subtotal	13.9	70.2	11.0	3.1	1.1	0.1	0.2	0.4	
							Total Number Aged		4,389

Seasonal occurrence of striped bass older than Age III was similar to that observed in the York. Eighty-three percent of these individuals were taken in winter and spring months, 11.2% in the summer months.

Young-of-the-year first appeared in fall catches, but significant numbers were not taken until the following spring. This seasonal pattern was similar to observations from the York River.

Differences in Age Composition between Years and Rivers

Differences between both years and rivers in the age structure of Virginia striped bass catches are shown in Figure 2, where age composition data have been combined into sampling year totals within river systems. James River catches were dominated by Age II striped bass in three of the four sampling years, and by Age I fish (1969 year class) in 1970-1971. Rappahannock River catches, on the other hand, were dominated by Age I striped bass in three of the four years, and by Age II fish in 1968-69. Age I fish dominated York River catches in all four years. Except for the continued domination of Rappahannock River catches by the 1966 year class during the 1968-69 sampling year, age composition in the York and Rappahannock rivers was similar.

Among the 1965-1969 year classes which progressed through the fishery as Age I and II fish during the four-year sampling period, the 1966 year class appears to have contributed most heavily to the York and Rappahannock river catches. The 1967 year class was strongest in the James River. Dominance of year classes in the various years and river systems is summarized in Table 4.

TABLE 3.—Age composition of striped bass caught by nonselective fishing gear in the Rappahannock River within quarterly periods, July 1967-June 1971.

Quarterly Period	Number in Age Group 0	I	II	III	IV	V	VI	≥VII	N
(1967) July-Sept	—	124	11	2	—	—	—	—	137
Oct-Dec	2	280	48	11	2	—	—	1	344
(1968) Jan-Mar	—	84	25	17	4	6	19	23	178
Apr-June	6	217	12	2	—	1	—	1	239
% Subtotal	0.9	78.5	10.7	3.6	0.7	0.8	2.1	2.8	
July-Sept	—	81	220	1	2	—	—	—	304
Oct-Dec	4	124	256	8	1	—	—	—	393
(1969) Jan-Mar	—	36	139	14	4	1	—	3	197
Apr-June	30	121	146	8	—	1	—	11	317
% Subtotal	2.8	29.9	62.8	2.6	0.6	0.2	0	1.2	
July-Sept	—	156	110	47	3	3	—	—	319
Oct-Dec	—	152	113	32	3	—	—	—	300
(1970) Jan-Mar	—	17	35	40	2	1	—	4	99
Apr-June	28	142	20	44	4	5	1	10	254
% Subtotal	2.9	48.0	28.6	16.8	1.2	0.9	0.1	1.4	
July-Sept	—	123	87	7	10	1	—	—	228
Oct-Dec	8	200	86	4	1	—	1	—	300
(1971) Jan-Mar	3	127	64	16	14	1	4	1	230
Apr-June	86	149	30	7	14	1	1	5	293
% Subtotal	9.2	57.0	25.4	3.2	3.7	0.3	0.6	0.6	
								Total Number Aged	4,132

DISCUSSION

Seasonal and Annual Age Composition of River Catches

Seasonal variation in the age composition of striped bass catches is slight (Tables 1-3) when viewed over a sampling year begun in July. Most of the seasonal variation occurs among subdominant age groups, specifically the appearance of young-of-the-year in the fall and the annual return of older, mature stocks in winter and spring. A year class that is dominant in summer tends to remain dominant through the following spring. Changes in year class dominance from one year to another usually occur in summer, so *age group* dominance tends to remain constant.

Annual differences in age composition, on the other hand, can be striking. Although Age I striped bass are expected to predominate in pound net and fyke net catches, strong year classes may continue to dominate catches a second year as Age II individuals. This occurred in the Rappahannock River as a result of the strong 1966 year class (Figure 2).

The predominance of Age II striped bass catches from the James River during three of the four sampling years differs from the age composition observed in the York and Rappahannock rivers. Partial explanations are available for two of these cases: 1) the 1965 year class dominated 1967-68 catches because of the local failure of the 1966 year class (Grant and Joseph, 1969); 2) the 1966 year class dominated 1968-1969 catches after entering the James from other rivers where it was an unusually successful year class.

The Virginia Fishery and Cycles of Abundance

The appearance of a dominant year class of striped bass in Chesapeake Bay waters is reflected in subsequent catches within the Bay

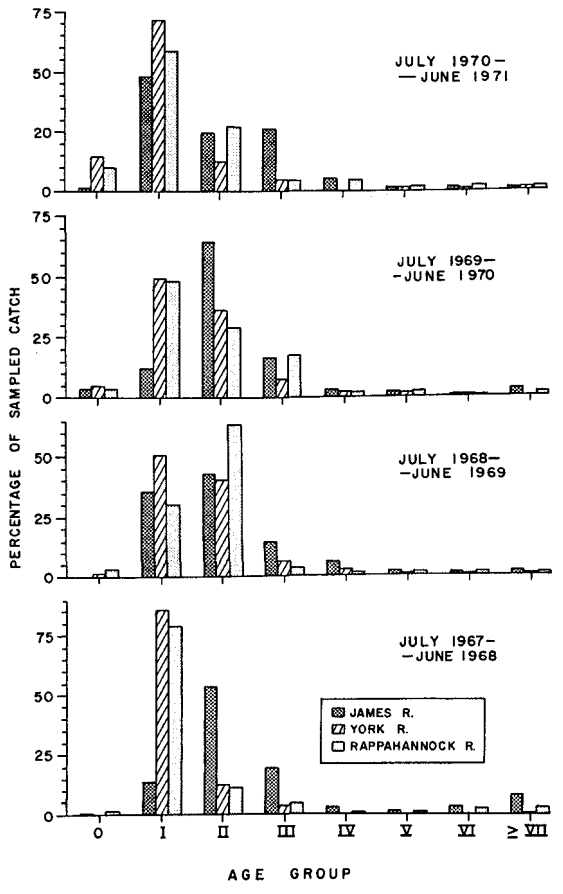

FIGURE 2.—Age composition of sampled pound and fyke net catches in the James, York, and Rappahannock rivers, July 1967-June 1971.

(Tiller, 1950; Vladykov and Wallace, 1952; Murphy, 1960; Shearer, Ritchie, and Frisbie, 1962) and along the migration route in coastal states from Virginia to New England (Merriman, 1941; Schaefer, 1968). Schaefer (1968) concluded that Chesapeake Bay is the primary source of striped bass caught in the surf of Long Island, and that Hudson River stocks may significantly contribute to these populations only when dominant year classes from Chesapeake Bay are unavailable. Yet it is generally believed, although still debatable, that only a small proportion of those striped bass originating in Chesapeake Bay enter the coastal migration (Vladykov and Wallace, 1952; Mansueti, 1961; Massmann and Pacheco, 1961; Grant et al., 1970).

Koo (1970) has shown an apparent six-year

TABLE 4.—Summary of the year classes of striped bass that dominated catches in Virginia rivers, 1967-1971.

River	Sampling Year (July through June)			
	1967-68	1968-69	1969-70	1970-71
James	1965	1966	1967	1969
York	1966	1967	1968	1969
Rappahannock	1966	1966	1968	1969

TABLE 5—Contribution of age groups I-III to pound net and fyke net catches of striped bass in three Virginia rivers, 1967-1971.

Sampling Year (July-June)	Percentage of Sampled Catch in Age Groups I-III		
	James	York	Rappahannock
1967-1968	84.7	99.4	92.8
1968-1969	90.8	96.3	95.3
1969-1970	90.9	92.7	93.4
1970-1971	94.3	84.3	85.6

cycle of abundance in Maryland. Such a cycle could result from the appearance of a dominant year class every six years, followed by three years of high catches (Ages I-III), then three of relatively low catches. The younger age groups (I to III) contribute most to Virginia pound net and fyke net catches of striped bass (Table 5), as expected for nonselective fishing gear. Over 90% of sampled individuals were from age groups I to III, except: 1) 84.7% in the James River during the first year of sampling due to catches of large numbers of older fish, particularly the 1958 year class; 2) 84.3% in the York River in the 1970-1971 sampling year; and 3) 85.6% in the Rappahannock River in the same year. The last two exceptions occurred because of contributions by the latest dominant year class (1970—then Age 0).

Although the age composition of Virginia catches would seem to conform to Koo's (1970) six-year cycle, no such cycle is apparent in Virginia landings (Figure 1), even though the dominant year classes mentioned by Koo (1970) were also successful ones in Virginia. The difference between Maryland and Virginia landings, relative to this six-year cycle, might stem from local successes of year classes interspersed among those appearing at six-year intervals. In addition to the 1958, 1964 and 1970 cyclically dominant year classes, certain Virginia rivers have produced large hatches of striped bass in 1961 and 1966 (Grant and Joseph, 1969; Grant, Burrell, and Kriete, 1971). Catches of these aperiodically strong year clas-

es tend to obscure, or even eliminate, peaks in landings contributed by Koo's Chesapeake-wide dominant year classes. Thus only long-term trends in abundance remain evident (Figure 1).

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