T. aurea easier, but they appear to be competing for space and spawning areas with centrarchids. This was made evident when 266 pounds of the species were collected in a 125 yard trammel net, comprising 84 per cent by number and weight of the sample. The juveniles of this species are in competition with young centrarchids for available food. Invertebrates are utilized extensively by the smaller representatives of both groups (McBay, 1961). The length-weight relationship is indicative of the large sizes obtained by Florida tilapia. Their short food chain, plus a favorable climate, enables *T. aurea* to contriubte tremendously to the biomass of the aquatic environment.

Commercial exploitation is possible but even native fisheries, under present Florida law, are not fully utilized.

It is evident from what has happened in South Central Florida that control of both experimental species and news media is needed. If tilapia present problems similar to the introduced carp (Hubbs, 1968) it is already too late to stop the problem with known methods of control. Tilapia will continue to spread throughout Florida and may invade other southeastern states. What effects they may have on native sport fisheries is unknown. Hopefully, the problems experienced with *T. aurea* will stimulate more caution and better control of non-native species.

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COMPARATIVE STRENGTH OF THE 1966 YEAR CLASS OF STRIPED BASS, *ROCCUS SAXATILIS* (WALBAUM), IN THREE VIRGINIA RIVERS[1]

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ABSTRACT

The age composition, as determined from scale impressions, of striped bass stocks in the James, York, and Rappahannock Rivers during the period June 1967 – March 1968 indicates a relative deficiency of the 1966 year class in the James River. Similar results are shown in samples from non-selective gear (pound nets, fyke nets), selective gear (gill nets, haul seines, hook-and-line), and routine surveys using a 30-foot semi-balloon trawl.

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The immediate effect of this apparent deficiency on a planned winter tagging program, and the more general implications for evaluation of year-class strength, are briefly discussed.

INTRODUCTION

Research directed toward the estimation of those parameters essential to an understanding of local striped bass population dynamics was initiated in mid-1967 by the Virginia Institute of Marine Science, in cooperation with the federal Bureau of Sport Fisheries and Wildlife.[2] Some of the primary objectives of this research are 1) an estimation of the age composition of Virginian striped bass stocks, 2) an estimation of individual year class abundance during river residence, and 3) an estimate of annual fishing mortality rates. The first objective may be reached by sampling non-selective commercial fishing gear, whereas the latter two require catch-per-unit-effort and tagging data. This report, while directly concerned with individual year class abundance, is based on data collected for the estimation of age composition and will demonstrate the effect of river stock differences on a planned winter tagging program.

Raney (1952, p. 64) indicated that striped bass abundance may be expected to differ depending on the part of the species' range under consideration. Since the neighboring James, York and Rappahannock Rivers might be considered by some to be a single "part of the range", the purpose of this paper is to refine and stress the observation of Raney.

Methods and Materials

Scale samples were obtained at landings for sport and commercial catches, the latter including pound nets, fyke nets, gill nets, and haul seines. Trawl data are from routine, monthly surveys of the James, York, and Rappahannock Rivers with a 30-foot semi-balloon trawl.

Age analysis is based on scales removed from the locale specified for striped bass by Merriman (1941), i.e. midway between the lateral line and the dorsal fins and below the gap separating the dorsals. Plastic scale impressions were made with a Carver hydraulic press and read on a microprojector.

Two types of tags were used during the winter of 1968: 1) streamer disc tags, tied with either nylon or dacron fishing line, and 2) the Floy Dart Tag 6-B, having a double barb. All fish tagged in this period (Jan. 29-March 6, 1968) were obtained with a 30-foot semi-balloon trawl. Ages for tagged fish are taken from scales removed from the region of tag insertion, below the first dorsal in the case of dart-tagged fish and below the second dorsal of those tagged with streamer discs. These scales are suitable for aging, but not for back-calculation of lengths.

Results of Age Composition Sampling

Non-selective Gear

Pound nets and fyke nets have been chosen as gear types that catch striped bass essentially in proportion to their actual age composition. Although some culling of the catch may occur before landing, this has little effect on fish older than one year. Any selection by these nets is due to concentration of gear in parts of the river systems (and subsequent fishing on a portion of the stock) rather than any mechanical or purposeful selection by size. Pound nets were employed at some period in all three rivers, fyke nets only in the James River. The age composition of striped bass catches in non-selective gear beginning in June 1967 and summarized by river and quarterly periods, is presented in Table 1.

The 1966 year class did not appear in non-selective samples until October 1967 in the James River, while it predominated in catches from the York and Rappahannock throughout the period of sampling. During summer months these one-year-old fish contributed over 90 percent of the numbers caught in the latter rivers, while absent from James River samples. In fall months, 2-year-old fish continued to dominate James River catches, while the 1966 year class contributed over 80 percent of York and Rappahannock samples. Small sample sizes during the sparsely-fished winter months preclude similar comparisons, although it is evident that immigrating older fish generally lowered the predominance of the 1966 year class.

TABLE 1

Percent age composition of seasonal pound and fyke net samples (non-selective gear) in the James, York, and Rappahannock Rivers, Virginia, during the period June 1967 – March 1968.

Sampling Period	*River*	*Percent of Catch in Year Class*											
		1967	*1966*	*1965*	*1964*	*1963*	*1962*	*1961*	*1960*	*1959*	*1958*	*Older*	*N*
June	James	0	0	38.5	40.4	15.4	3.8	0	1.9	0	0	0	52
1967	York	0	50.0	0	50.0	0	0	0	0	0	0	0	4
July-Sept.	James	0	0	55.6	38.1	1.6	1.6	1.6	1.6	0	0	0	63
1967	York	0	92.4	6.4	1.2	0	0	0	0	0	0	0	343
	Rappahannock	0	90.5	8.0	1.5	0	0	0	0	0	0	0	137
Oct.-Dec.	James	0.6	12.1	77.7	6.4	1.3	0	1.9	0	0	0	0	157
1967	York	0	84.2	15.0	0.8	0	0	0	0	0	0	0	133
	Rappahannock	0.6	81.4	14.0	3.2	0.6	0	0	0	0	0.3	0	344
Jan.-Mar.	James	0	34.6	30.8	15.4	0	3.8	0	0	3.8	7.7	3.8	26
1968	York	0	40.0	32.5	27.5	0	0	0	0	0	0	0	40
	Rappahannock	0	47.2	14.0	9.6	2.2	3.4	10.7	3.4	0.6	7.9	1.1	178

These data for the ten-month period June 1967 through March 1968 are combined in Figure 1. The 1966 year class, dominant in non-selective catches from both the York and the Rappahannock Rivers, contributed less than ten percent to the catches sampled in the James River. Here, the 1965 year class was dominant, with the 1964 year class appearing in twice the abundance of the 1966 year class. Noteworthy are the small peaks representing the 1961 and 1958 year classes. Treatment of these data by weight rather than numbers would show the truly outstanding contribution of the 1958 year class to the Atlantic coast fishery, already well-documented. The relative strength of the 1961 year class confirms the recent report of Schaefer (1968) concerning Long Island striped bass studies.

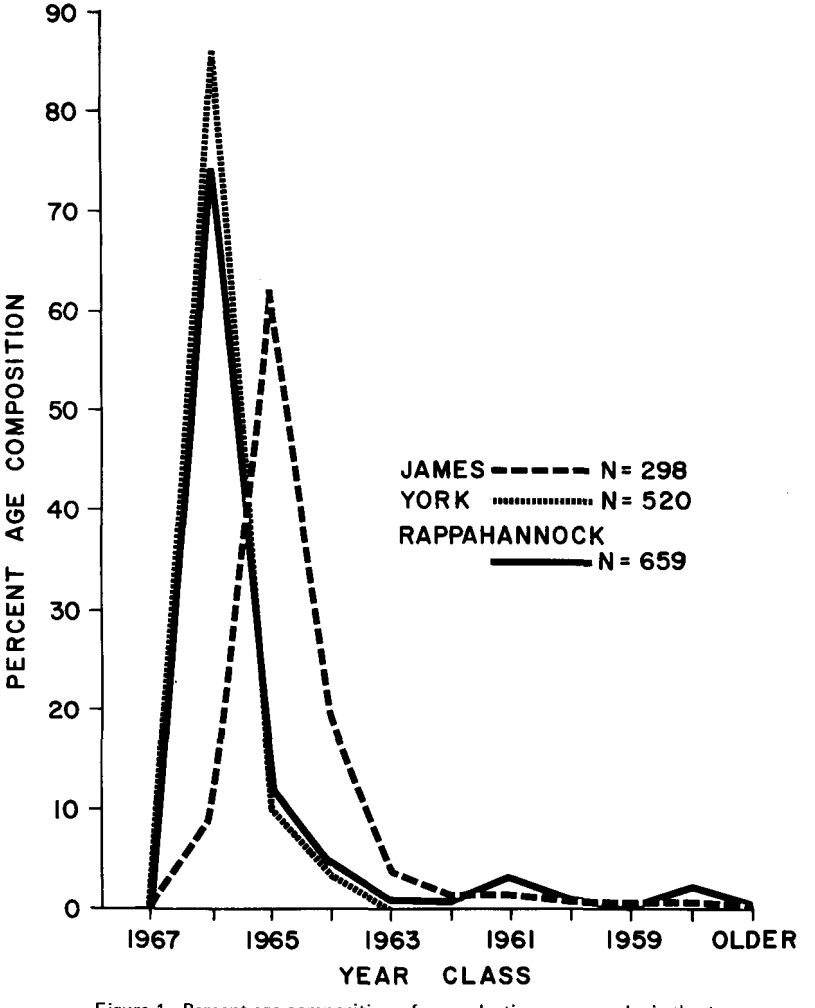

Figure 1. Percent age composition of non-selective gear samples in the James, York, and Rappahannock Rivers. All data from the period June 1967 – March 1968 combined.

Selective Gear

Age composition data collected from selective gear catches may be used in a similar comparison between rivers, providing a seasonal approach is followed. These data are more limited due both to seasonality of usage and to lack of coincident effort in the three river systems. The available comparisons are given in Tables 2-4.

Haul seines have here been treated as selective gear because of the season of fishing, rather than any mechanical selection by size. Summer catches of haul seines consist of somewhat smaller individuals than do non-selective catches for the same period. This is due to the presence and vulnerability of young, schooling striped bass in shoal areas during these months. The percentages in Table 2 show a large difference in the relative catch of year classes 1966 and 1965 in the James River compared with the York and Rappahannock Rivers. A similar, but less pronounced, distribution of year classes is evident in Table 3, based on the limited gill net samples available for the same period. Again, the predominant year class in James River catches is the 1965 rather than the 1966 year class.

Samples of sport catches in the James and York Rivers (Table 4) show a seasonal increase in predominance of a single year class. These are, again, the 1965 and 1966 year classes, respectively, in the James and York Rivers, despite a selection for somewhat larger fish by hook-and-line methods. These data, combined for the period July – December 1967, are presented in Fig. 2, where the difference in year class dominance between rivers is evident.

TABLE 2.

Percent age composition of haul seine samples from the James, York, and Rappahannock Rivers during the period July-September 1967.

	Percent of Catch in Year Class			
River	*1966*	*1965*	*1964*	*N*
James	7.2	88.4	4.3	69
York	96.3	2.7	1.1	187
Rappahannock	94.0	6.0	0	67

TABLE 3.

Percent age composition of gill net samples from the James and Rappahannock Rivers during the period July-September 1967.

	Percent of Catch in Year Class								
River	*1966*	*1965*	*1964*	*1963*	*1962*	*1961*	*1960*	*1959*	*N*
James	3.7	70.4	18.5	0	0	3.7	0	3.7	27
Rappahannock	78.1	9.4	12.5	0	0	0	0	0	32

TABLE 4.

Percent age composition of seasonal sport catch samples from the James and York Rivers.

Sampling		*Percent of Catch in Year Class*										
Period	*River*	*1967*	*1966*	*1965*	*1964*	*1963*	*1962*	*1961*	*1960*	*1959*	*1958*	*N*
July-Sept.	James	0	2.1	52.8	26.6	6.4	5.2	3.9	1.3	1.3	0.4	233
1967	York	0	74.4	22.2	2.9	0.2	0	0	0.2	0	0	454
Oct.-Dec.	James	0	1.6	64.5	22.6	1.6	1.6	3.2	1.6	3.2	0	62
1967	York	0.8	85.0	12.3	1.6	0.2	0	0	0	0	0	608

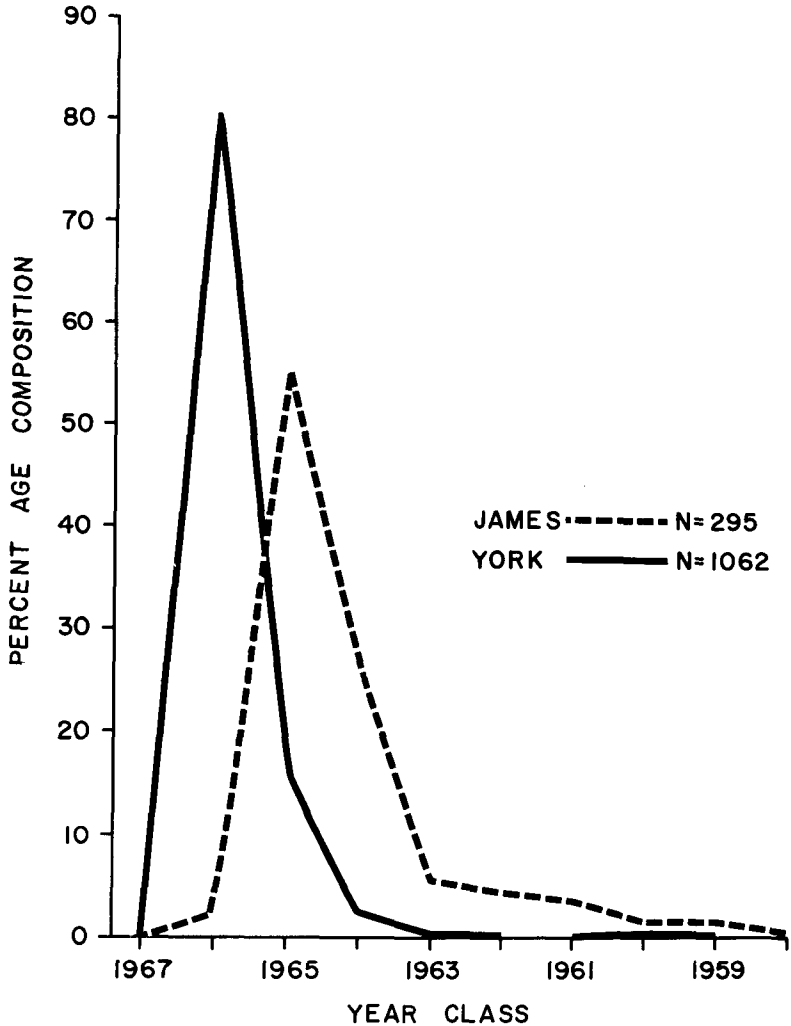

Figure 2. Percent age composition of the sport catch in the James and York Rivers during the Period July – December 1967.

Young Fish Trawl Surveys

The Virginia Institute of Marine Science routinely surveys the three rivers being considered in order to monitor the relative abundance of young fishes of commercial importance. These monthly surveys employ a 30-foot semi-balloon trawl at a number of fixed stations in each river system. This gear is particularly effective for striped bass in cold months when the resident populations are congregated in river channels, and less so for the remainder of the year.

In anticipation of the present project, begun in May 1967, trawl-caught samples of striped bass were frozen for subsequent processing. These samples were available beginning in January 1967, thereby providing an early assessment of the relative

abundance of the 1966 year class. The age composition of trawl-caught striped bass, summarized in quarterly periods, is presented in Table 5. These figures suffer from inadequate sample size during the warmer months, when the populations have moved from the deep trawling stations into shoal areas. However, the first quarter of 1967 shows an age distribution similar to that seen in commercial and sport catches later in the year. Extremely low trawl catches in the James River throughout 1967 are believed due, at least in part, to the scarcity of the 1966 year class. It is evident by the fall sampling period of 1967 that the percent age composition in the James was to be more similar to the York and Rappahannock Rivers in the current year. This was confirmed by the data for the period January-March 1968, which shows the 1967 year class to comprise 70-76 percent of the catch in all three rivers.

The age distribution of trawl catches in the three rivers during the winter months of 1967 and 1968 is compared in Figure 3. The expected decrease in numbers of fish from successive year classes, evident in all three rivers in 1968 and in the York and Rappahannock in 1967, is not found in the James River in 1967. The distorted age composition in the James River in 1967 could be caused by an exceptional abundance of the 1965 year class, but catch-per-unit-effort data do not support this hypothesis. Catches of the 1965 year class per hour of trawling in the York and Rappahannock were two to three times those in the James River during the winter months of 1967. All available evidence points to a relative deficiency of the 1966 year class in the James River.

Effect of Observed Age Composition on Winter 1968 Tagging Success

Original project plans called for tagging in at least one river system during the winter of 1968, when populations would be concentrated in river channels prior to the spawning season. Striped bass, are, at this time, most vulnerable to capture by trawl. Trawling was carried out with the R/V *Pathfinder* using regular survey 30-foot semi-balloon trawls.

Initial tagging in the York River in late January and early February was sufficiently successful to allow tagging attempts in the other two rivers as well, during this winter period (Table 6). The importance of the 1966 year class to the success of tagging efforts is shown by the percentage of this year class included in tagged fish. The futility of further efforts in the James River at this time became apparent after two days of trawling with only 85 fish tagged.

TABLE 5

Percent age composition of seasonal survey-trawl catches from the James, York, and Rappahannock Rivers during the period January 1967 – March 1968.

Sampling		*Percent of Catch in Year Class*						
Period	*River*	*1967*	*1966*	*1965*	*1964*	*1963*	*Unknown*	*N*
Jan.-Mar.	James	0	25.9	63.8	10.3	0	0	58
1967	York	0	82.9	15.7	0.3	1.0	0	606
	Rappahannock	0	78.7	18.4	2.9	0	0	494
Apr.-June	James	0	0	50.0	0	0	50.0	4
1967	York	0	38.0	62.0	0	0	0	66
	Rappahannock	0	96.4	3.6	0	0	0	28
July-Sept.	James	33.3	66.7	0	0	0	0	6
1967	York	25.8	51.6	22.6	0	0	0	31
	Rappahannock	0	100.0	0	0	0	0	8
Oct.-Dec.	James	80.0	20.0	0	0	0	0	15
1967	York	80.6	16.4	1.5	0	1.5	0	67
	Rappahannock	62.4	37.2	0	0.4	0	0	226
Jan.-Mar.	James	69.8	16.3	7.0	7.0	0	0	43
1968	York	76.0	21.8	2.2	0	0	0	362
	Rappahannock	69.8	23.3	2.3	2.3	2.3	0	43

TABLE 6.
Striped bass tagged in Virginia rivers during the period Jan.-March 1968.

Tagging Dates (1968)	*River*	*Total Number Tagged*	*Percent 1966 Year Class*
Jan. 29—Feb. 7	York	1469	61.9
Feb. 13-20	Rappahannock	1180	85.3
Feb. 27-28	James	85	45.9
Mar. 5-6	York	464	84.7
Jan. 29-Mar. 6	All Rivers	3198	73.4

Discussion and Conclusions

Analyses of the age composition of catches from diverse sources, including pound nets, fyke nets, gill nets, haul seines, sport catches, and Virginia Institute of Marine Science trawl surveys, have shown a relative deficiency in the 1966 year class in the James River. The possibility that this is only an apparent deficiency due to an abnormally large 1965 year class has already been dismissed, on the basis of catch-per-unit-effort data. A second possible explanation lies in an observed difference in growth rates between rivers. Observations not included in this report indicate a much slower growth rate for James River striped bass, compared with rates in the York and Rappahannock Rivers. This could delay the availability of James River striped bass to the gear employed. However, the restoration of the expected distribution of ages in 1968 (Figure 3), given a 1967 year class of more normal strength, is evidence against this explanation. It is concluded that the 1966 year class, apparently quite successful in the York and Rappahannock Rivers, was relatively unsuccessful in the neighboring James River.

The importance of such great differences in the strength of a given year class between neighboring rivers should be stressed. Outstanding success in spawning and survival of striped bass in one river system may be balanced or even nullified by poor survival in a neighboring nursery ground. Chadwick (1964) has indicated the need for region-wide estimates of abundance due to unexplained annual differences in horizontal distribution of California populations. Obviously, no predictions of year-class abundance of benefit to the Atlantic coast fishery should be made from data obtained in a single river system.

Causes of the observed difference in strength of the 1966 year class in the James River, compared with the York and Rappahannock Rivers, are unknown. The closeness of river systems would seem to rule out climatic factors. Local conditions over the spawning grounds could have been unfavorable in the James River system in 1966, or there may have been behavioral differences in the spawning population that diverted migrating adults from the James. Our present project does not provide for any intensive effort toward solving this problem, allowing only conjecture on the above points. However, the distinct difference in the James River striped bass shown here recalls earlier work on the racial structure of Atlantic Coast populations. Vladykov and Wallace (1952) concluded that three stocks of striped bass within Chesapeake Bay were separable: James River, Potomac River, and Upper Bay populations. Raney (1957) was able to define three somewhat different sub-populations: James River, York and Rappahannock Rivers, and the Upper Bay. The James River sub-population was the best defined. Both studies based on meristics agree on the distinctiveness of the James River striped bass from neighboring populations. It is possible that further study would reveal morphometric, physiological, and behavioral differences, as well as meristic ones, between these river stocks. These might have been sufficient, even with similar environmental conditions, to produce the observed difference in the strength of the 1966 year class.

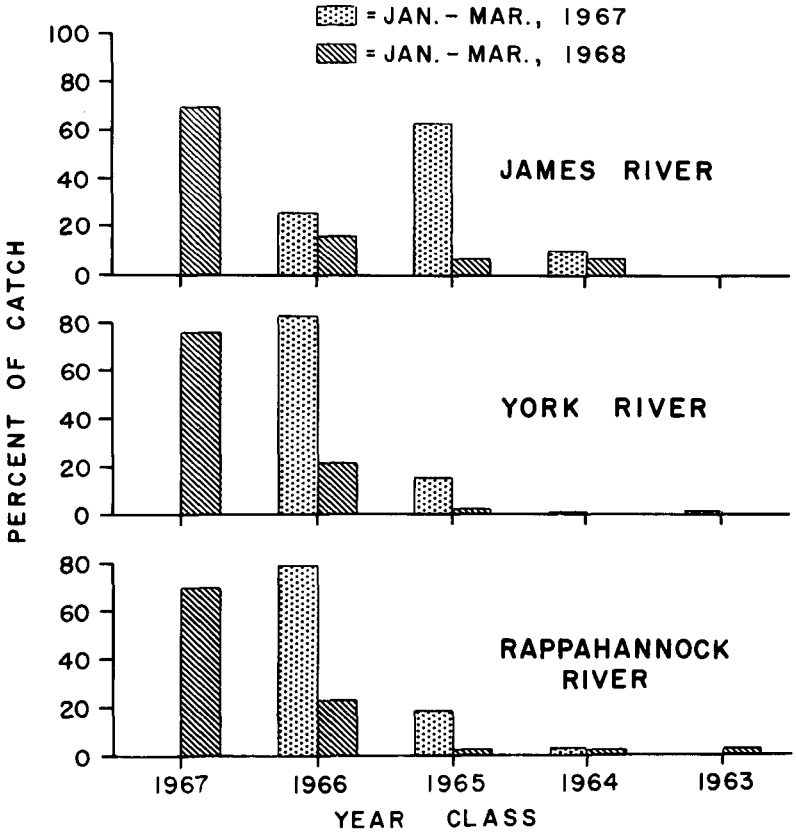

Figure 3. Percent age compositions of survey-trawl catches in the James, York, and Rappahannock Rivers during the periods January – March of 1967 and 1968.

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