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Estimation of juvenile striped bass relative abundance in the Virginia portion of Chesapeake Bay, January 1995-December 1995 : annual progress report

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ANNUAL PROGRESS REPORT

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U. S. Fish and Wildlife Service

Sportfish Restoration Project F87R4

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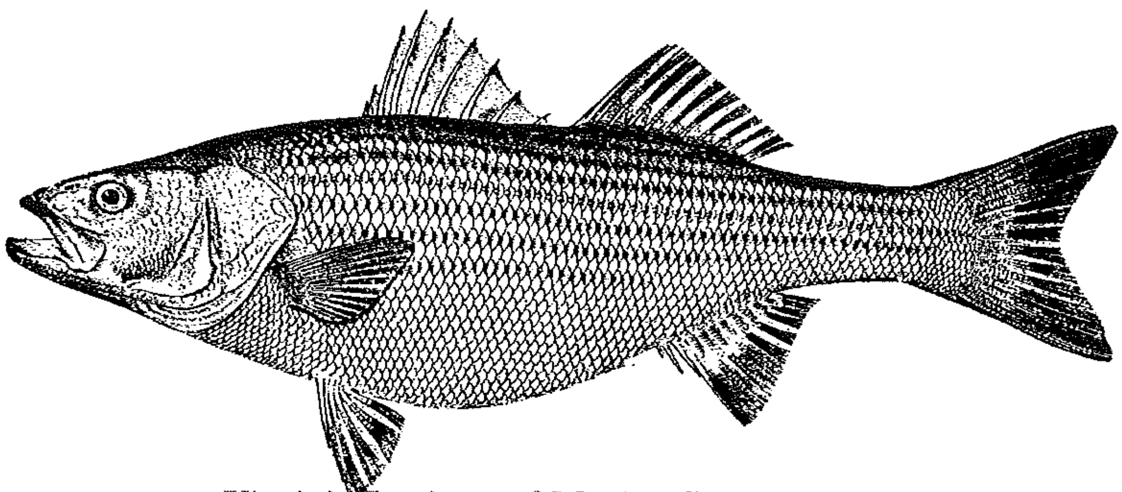

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PREFACE

The Virginia Institute of Marine Science (VIMS) has conducted a juvenile striped bass seine survey from 1967 through 1973 and from 1980 through the present. The primary objective has been the monitoring of the relative annual recruitment success of juvenile striped bass in the spawning and to the nursery areas of Lower Chesapeake Bay. The survey was funded in it's initial period by the U.S. Fish and Wildlife Service and then reinstated in 1980 with funding from the National Marine Fisheries Service under the Emergency Striped Bass Study program. Commencing with the 1988 annual survey, support of the program has been made jointly through the Sportfish Restoration Program (Wallop-Breaux Act), administered through the U.S. Fish and Wildlife Service and the Virginia Marine Resources Commission. This report summarizes the results of the 1995 sampling period and compares these results with the previous work.

Specific objectives planned for the 1995 program were to:

1. Measure the relative abundance of the 1995 year class of striped bass from the James, York and Rappahannock river systems.
2. Quantify environmental conditions at the time of collection.
3. Examine relationships between juvenile striped bass abundance and measured or proxy environmental and biological data.

INTRODUCTION

The estimation of juvenile striped bass abundance in Virginia waters, funded by the U.S. Fish and Wildlife Service, is part of a coast-wide sampling program of striped bass recruitment conducted from New England to North Carolina under the coordination of the Atlantic States Marine Fisheries Commission (ASMFC). Virginia'a efforts started in 1967 with funding from the Commercial Fisheries Development Act of 1965 (PL88-309) and continued until 1973 when the program was terminated. It was instituted in 1980 with Emergency Striped Bass Study funds (PL 96-118, 16 U.S.C. 767g, the "Chafee Amendment"), and since 1989 has been funded by the Wallop-Breaux expansion of the Sportfish Restoration and Enhancement Act of 1988 (PL 100-448 known as the Dingle-Johnson Act).

The Atlantic Coast Striped Bass Interstate Fisheries Management Plan was adopted by ASMFC, in 1981, then adopted by the Virginia Marine Resources Commission (VMRC) in March 1982 (Regulation 450-01-0034). Amendment IV to the plan requires "producing states" (e.g. Virginia, Maryland, Delaware and New York) to develop and support monitoring programs of recruitment levels. This became a mandate when Congress passed the Atlantic Striped Bass Conservation Act in 1984 (reauthorization 1991, PL102-130). To remain in compliance with the Act, each state must adhere to all provisions in the interstate FMP (ESBS 1993). Virginia has done this through December 1995.

Originally, the Virginia program used a 6' x 100' (2m x 30.5m) x 0.25" (6.4mm) mesh bag seine,2 but after comparison tows with Maryland gear , 4' x 100' x 0.25" mesh (1.2m x 30.5m x 6.4mm) showed virtually no statistical differences in catch, Virginia adopted the "Maryland seine" (Colvocoresses 1984). The original purpose of the gear comparison studies was to standardize methods thereby allowing a Bay-wide examination of recruitment success (Colvocoresses and Austin 1987). This was never realized however, for various differences in data handling (MD: arithmetic index, VA: geometric index) and state politics. A Bay-wide index using a weighted (by river spawning area) geometric mean was finally developed in 1993 (Austin, Colvocoresses and Mosca 1993).

METHODS

Field sampling was conducted during five approximately biweekly sampling periods from July through mid-September of 1995. During each sampling period beach seine hauls were conducted at eighteen historically sampled sites (index stations) and 22 auxiliary stations along the shores of the James, York and Rappahannock river systems (Fig. 1). Addition of the auxiliary sites was made to provide better geographic coverage and, once a sufficient time series of data is developed, create larger within-river-system sample sizes so that trends in juvenile abundance can be meaningfully monitored on a system by system basis.

One seine haul was made at each auxiliary station, and two replicate hauls made at each index station during each sampling round. Collections were made by deploying a 100' (30.5m) long, 4' (1.22m) deep, 1/4" (0.64cm) bar mesh minnow seine perpendicular to the shoreline (either until the net was fully extended or a depth of approximately four feet was encountered) and then leaving the onshore brail in a fixed position while pulling the offshore end downcurrent and back to the shore, resulting in the sweeping of a quarter circle quadrant. In the case of index stations, all fish taken during the first tow were removed from the net and held in water-filled buckets until after the second tow. All fish collected were identified and counted, and all striped bass and all individuals or a subsample of at least 25 individuals of other species measured to the nearest mm fork length (or total length if appropriate). Salinity, water temperature, pH and dissolved oxygen concentrations were measured after the first haul using a Hydrolab Reporter® water quality instrument. Sampling time, tidal stage and weather conditions were recorded at the time of each haul. When two hauls were made, the first sample was processed in the period between the two hauls and an intervening period of 30 minutes was allowed between hauls. All fishes captured, excepting those preserved for life history studies, were returned to the water at the conclusion of sampling.

In the present report, comparisons with prior years will be made on the basis of the 'primary nursery' standardized data set (Colvocoresses 1984), i.e. only the data collected from the months and areas covered during all surveys will be included in the analyses. Data from the auxiliary stations will not be included since there is no direct basis for comparison. Since the frequency distribution of catch size of these collections is extremely skewed and approximates a negative binomial distribution (Colvocoresses 1984), a logarithmic transformation ($\ln(x+1)$) was applied in order to normalize the data (Sokal and Rohlf 1981) prior to analyses. Subsequently computed mean values were retransformed (i.e. the geometric mean), but because the geometric means of such a strongly skewed distribution are much smaller than the arithmetic means, for comparative purposes (particularly with respect to the results of the Maryland survey, wherein arithmetic means are reported) the geometric means have been scaled up to the arithmetic means by multiplication by the ratio of the overall arithmetic to geometric means to give adjusted means as of the 1984 survey (2.28).

Mean catch rates are contrasted by comparing 95% confidence intervals as estimated by $\pm$ two standard errors (square root of the variance divided by n) of the mean. Reference to "significant" differences between means in this context will be restricted to cases of non-overlap by these confidence intervals. Because the standard errors are calculated using the transformed (logarithmic) values, confidence intervals on the retransformed and adjusted scale are non-symmetrical.

RESULTS

Objective 1: Measure the relative abundance of the 1995 year class of juvenile striped bass from the James, York and Rappahannock river systems.

A total of 926 young-of-the-year striped bass were collected from 180 seine hauls during the 1995 index station sampling, and an additional 358 age 0 striped bass were collected in 104 hauls at the auxiliary sites (Fig. 1, Table 1). The adjusted overall mean catch per seine haul (CPUE) for the index stations was 5.45 which is approximately one-half the 1994 value of 10.48 and represents a significant decrease in the index from the 1994 value (Table 2,Fig. 2). This is the second consecutive year there has been a significant decrease. This value is nearly equal to the overall average index of 5.50. Indices for individual drainages varied with two drainages having indices above their historical averages and one being less than one-half of its historical average.

The 1995 catch rate in the James drainage (8.08) was slightly higher than the historical average (6.37)(Table 3, Fig. 3) and both the mainstem James (6.85) and the Chickahominy (11.09) were slightly higher than their respective historical average.The Chickahominy River index reversed a pattern of below average recruitment for that river observed in four of the last five years. Highest catch rates in the mainstream James were observed at auxiliary station J22 which is immediately downriver from the index area (Table 3, Fig. 4). Within the index area, the lower stations consistently outproduced the two uppermost index sites. The uppermost index site (J56) was especially non-productive as were most of the upriver auxiliary sites.

The 1995 index in the York drainage (6.30) was also slightly higher than the historical average (Table 3, Fig. 3) however, catch rates in the Pamunkey River (3.26) were considerably lower than the historical average (4.74), reversing a two year trend of catches that have been significantly higher than the average (Table 3, Fig. 3). The Mattaponi River index (9.62) was near 1993's record level which is more than double the historical average (4.55) for the second consecutive year (Table 3). On both rivers highest catches were made at the uppermost index sites with a noticeable decrease in catch as sampling sites progressed downstream (Fig.5-6). The two lowermost York stations and the uppermost Pamunkey station (all auxiliary sites) failed to produce a juvenile striped bass during 1995. Catches in the Pamunkey were at low levels during all sampling periods while on the Mattaponi drainage, catches at sites M44 and M47 increased by up to four fold in the last two rounds thereby bolstering the 1995 York index (Table 1, Fig.5-6).

The 1995 index in the Rappahannock River (2.41) was less than half the historical average

(5.60)(Table 3) and only one-fourth the value seen in 1994 (9.71)(Austin et al, 1995).This continues a three year decline since 1992 whereby indices have fallen from near thirty fish per haul to the present level (Fig. 3). Juveniles were caught throughout the index station area even though the uppermost index station was the most productive and was the only site that fish were taken during all five rounds (Fig. 7). Only three juvenile striped bass were captured at the auxiliary sites during 1995 sampling, two at R41 during round four and one at R65 during round five (Table 1, Fig. 7).The auxiliary stations downstream of the historical sampling area (R12 and R21) again produced no juvenile striped bass.

Because the number and precise timing of sampling rounds has varied throughout the history of the sampling program, results by sampling period cannot be directly compared. However, temporal usage of the nursery area can be evaluated by comparing round by round results with historical monthly averages. Generally, catch rates are highest during July and into early-August and taper off in the later rounds of August and September. Results from 1995 indicate a departure from the normally observed pattern. July was still the month of highest abundance but an increase in catch in late August and early September was unusual. In most years sampled, the highest catch rates were seen during the early rounds, followed by a decreased catch rate in later rounds, however in 1995 catch rates were highest in round one, decreased through round three and then increased in rounds four and five (Table 4). Though the first round's numbers were not reached in round five, catch increased by forty-two percent from round three to round five. These increased catches were almost entirely a result of the high catches at the two uppermost index sites on the Mattaponi River (Table 1). These numbers of fish were not seen at any of our sites in earlier rounds.

Objective 2: Quantify environmental conditions at the time of collection.

Collection information and pertinent environmental variables recorded at the time of each collection in 1995 are given in Tables 5 through 8. While these data do not show a great deal of deviation from the norm with the possible exception of lower salinities on the Rappahannock and James during round one, and to a small degree the York, there nevertheless was a severe flooding event on the Rapidan River, a headwater of the Rappahannock River immediately prior to round one (27 June) and whose effects were observed through round two. The river was quite turbid with orange silt particles that extended downriver of R37. While no dead or dying striped bass were caught in our samples, dead and dying fish were encountered along the river and many reports from other sources were noted. We did note that juvenile striped bass in our samples did appear to be emaciated and in generally poor condition. These conditions were not evident on the James or the York systems. From all reports, the Rappahannock was the hardest hit of the systems as far as the upriver flooding was concerned.

Higher than normal tides from a coastal storm caused the loss of available beach at J74, J78, R60, R65, and R76 in round three and R41 was not sampled in round two due to a delay from mechanical failure. All index sites were completed without interruption during all five sampling rounds.

Objective 3: Examine relationships between juvenile striped bass abundance and measured or proxy environmental and biological data.

Overall distribution of catch rates with respect to salinity in 1995 followed the normally observed pattern i.e. a definitive trend towards higher catches at lower salinities (Table 9). Overall mean catches were highest in the areas of lowest salinities (0-4.9ppt), however there were some exceptions, notably J22 (Fig. 4) and R28 (Fig.7) where catch rates were generally higher than at stations just upriver from these sites. Both station J22 and R28 are intermediate (5.0-9.9) to higher salinity stations (10.0-14.9ppt).

Catch rates with respect to water temperature in 1995 clearly adhered to the pattern seen in most years, i.e. catch rates varied directly with water temperature (Table 10). As noted in previous reports, this relationship is considered to be largely the result of a coincident downward progression of both catch rates and temperature as the survey season progresses (at least after the second sampling round) rather than any causative effect of water temperature on juvenile distribution. The increased size and thus the increased gear escapement or avoidance usually play a larger role in this trend. As noted earlier, the increase in catch in rounds four and five this year is unusual and though it did not affect the overall trend between catch and water temperature, in the short term it showed a reverse in the trend whereby catches increased while water temperatures were decreasing. This reversal serves to further reinforce the concept that catches within the sampling season are not noticeably governed by water temperatures and the overall relationship between catch and water temperature within the sampling season is probably coincidental..

Data on pH, dissolved oxygen concentrations and secchi disc visibility depth readings have only been recorded with the seine collections since the expansion of the sampling program in 1989. Dissolved oxygen concentrations generally exceed 5 ppm outside of the York system, and should have little or no effect on juvenile striped bass distributions. The lowest dissolved oxygen concentrations observed during 1995 sampling occurred during the second and third sampling rounds at the lowermost Mattaponi station (M33) and at the two lowest Rappahannock stations (R12 and R21) in round two, when concentrations were less than 4 ppm (Table 7). Juvenile striped bass were collected during the two visits on the Mattaponi and R12 has never produced a striped bass while R21 has only produced one since the inception of sampling there so low D.O. should not be a factor. Low pH values (<6.5) were not observed at any sampling sites in 1995 (Table 8). All of these parameters, as well as those previously discussed and undoubtedly others which are not currently measured, probably exert complex and interrelated effects on juvenile striped bass distribution, catchability and survival, and more years of data will be required before meaningful assessments of the effects of the newly measured parameters can be attempted.

DISCUSSION AND CONCLUSIONS

The striped bass juvenile indices recorded in the Virginia Chesapeake Bay nursery areas in 1995 were nearly equal to the historical average and about one-half the 1994 index (Table 2). However this average year class should not necessarily be looked upon as a failure. It follows the fourth highest and the highest year classes on record and spawning success in seven of the last nine years has been superb. An "average" year class will not necessarily adversely affect and should help sustain overall population and spawning stock levels. In addition, the high indices since 1987 have steadily raised the historical average to a level where the historical average is only slightly less than the index for 1970, which was generally accepted as "the" dominant year class. The "average" year class of 1995