

SPAWNING OF THE STRIPED BASS IN THE TAR RIVER, NORTH CAROLINA

by

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ABSTRACT

Spawning of striped bass in the Tar River was studied in 1975 and results were compared with a similar study done in 1965. Egg samples indicated a significant increase in spawning activity probably due in part to an increased population established by stocking. More favorable temperatures in 1975 also resulted in an extended period of peak spawning. The location of major spawning grounds based on egg samples was found to cover a 25 mile span of river between River Mile 60 and 85.

INTRODUCTION

The striped bass or rockfish, *Morone saxatilis* (Walbaum), is an important anadromous fish which has a native range along the Atlantic Coast from the St. Lawrence River in Canada to the St. Johns River in Florida and along the Gulf Coast from western Florida to Lake Ponchartrain, Louisiana. The range on the Pacific Coast, where it was introduced in 1897, now extends from Grays Harbor, Washington, to Los Angeles County, California.

Following an upstream migration in the spring, the striped bass spawns in fresh or virtually fresh water. The time of spawning varies with latitude, local temperature conditions and physiological factors. Spawning normally occurs in North Carolina from mid-April until late May or early June when water temperatures range from 14.4 to 22.2°C (McCoy, 1959). At the onset of spawning, a single female is usually surrounded by several males. Vigorous spawning activity then occurs during which the eggs and milt are released.

Striped bass eggs are spherical, transparent and non-adhesive. After fertilization, they water harden and increase in size from 1.3mm to 3.4mm in diameter (Mansueti, 1958). The buoyant eggs are then carried downstream with the current. Hatching time varies with water temperature with 48 hours being required at an average temperature of 17.8°C (Pearson, 1938).

The Roanoke River in North Carolina has long been known as an outstanding spawning area for striped bass. In 1965, a study was made to determine whether spawning also occurred in the Tar River which is adjacent to the Roanoke (Humphries, 1965). From the results of this study, it was apparent that significant spawning did occur and an estimate of the location of the spawning grounds was made.

The purpose of the 1975 investigation was to determine whether spawning of striped bass still occurs in the Tar River, and if so, to compare the results of the two studies to determine any significant changes in numbers of eggs spawned, the period of spawning, location of spawning grounds and conditions under which spawning occurs.

METHODS AND MATERIALS

Study Area

The Tar River Basin, draining an area of approximately 3,080 square miles, lies wholly within the State of North Carolina (Figure 1). It arises in the Piedmont Plateau near the village of Mill Creek in Person County and follows a southeasterly course through the Piedmont and Coastal Plain regions until it empties into the Pamlico River at Washington, approximately 195 miles from the headwaters. The river falls vertically 27 feet after passing through a dam at Rocky Mount. This is the natural fall line between the Piedmont and Coastal Plain regions. Below this point, the river falls only 58 feet to its mouth at Washington.

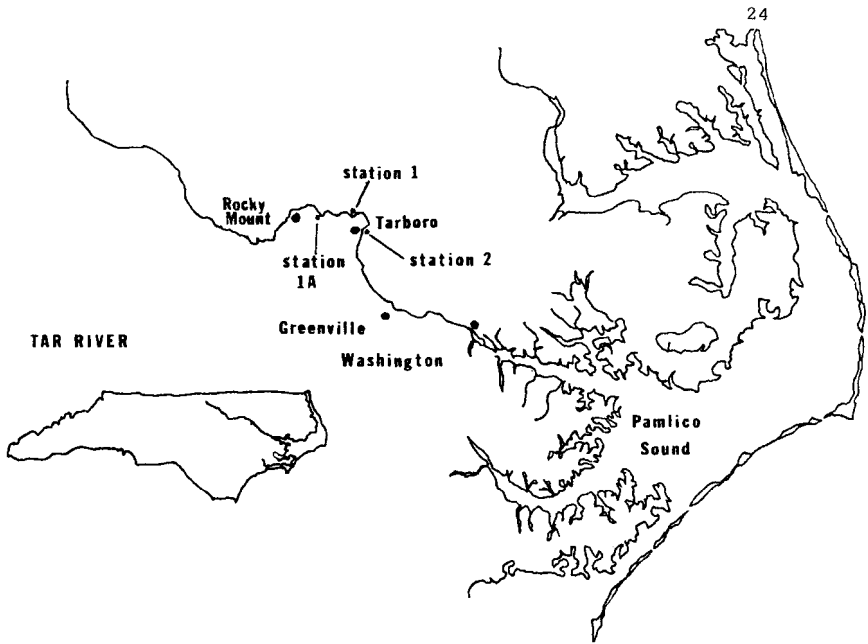


Figure 1. Location of Tar River and Egg Sampling Stations.

Collecting Stations

During the 1965 investigation, seven stations were established which covered 52 miles of the Tar River. The stations ranged from Grimesland at River Mile 5.5 upstream to Bell's Bridge at River Mile 57.0 near Tarboro. In the 1975 study, three collecting stations were established in the vicinity of the area previously determined to be the spawning grounds of the striped bass. Station 1A was located at Dunbar's Bridge at River Mile 67.8. Station 1 was located at Bell's Bridge at River Mile 57.0 near Tarboro. Station 2 was located at the Highway 64 Bridge at River Mile 46.2 in Tarboro. Stations 1 and 2 were used in both studies. Station 1A was established for the 1975 study to increase accuracy of the delineation of spawning activity. Flow data during both studies was available from a U. S. Geological Survey Gaging Station located at Station 2.

Sample Collections

Sampling in both investigations was done by using cone shaped plankton nets having approximately 76 meshes per centimeter. The collecting net in the 1965 study had a mouth diameter of 38cm and a length of 91cm. The collecting net in the 1975 study had a mouth diameter of 46cm and a length of 137cm. Collecting bottles were attached to the ends of the nets. In both studies, the nets were set just below the water surface in the midstream channel. Sets were made either from a bridge or an anchored boat. In the 1965 study, 30 minute sets were used until May 4, and 15 minute sets were used thereafter. In the 1975 study, 15 minute sets were used throughout. In both studies, water temperatures were monitored with a Taylor pocket thermometer. Stations were sampled on a regular basis throughout both investigations.

Sorting Samples and Preserving Eggs

The samples taken in both studies were placed in containers and sorted shortly thereafter. Striped bass eggs were separated from debris by pouring a shallow layer of the sample water into a flat pan. A bright lamp placed above the pan made the protruding eggs readily visible. Eggs were removed with a large bore pipette and stored in vials containing a 7% buffered formalin solution.

Staging Eggs

In both studies, the preserved eggs were examined individually under a dissecting microscope. When possible, the eggs were classified as to their approximate stage of development by comparing them with figures and descriptions of eggs given by Mansueti (1958); and with a set of color slides of developing striped bass eggs prepared by the North Carolina Wildlife Resources Commission.

RESULTS AND DISCUSSION

Sampling and Egg Collections

Sampling for striped bass eggs in both studies began in late March since observations and available literature indicated that striped bass may be present at any time afterward. The sampling records for Stations 1 and 2 during both studies are summarized in Tables 1, 2, 4 and 5. Table 3 summarizes the sampling records for Station 1A which was used only in 1975. Generally, more eggs were collected in 1975, partially because the collecting net had a larger diameter. The extreme right column of each table indicates the number of eggs collected per minute of sampling which provides a rough index to the relative abundance of striped bass eggs at different times during the sampling periods.

Table 1. Record of sampling and striped bass egg collections from Station 1 in 1965.

Date	Sample Duration Min.	Surface Water Temp. °C	Striped Bass Eggs	
			Number	No./Min.
3/29	30	12.8	0	0
3/31	30	13.9	0	0
4/2	30	11.6	0	0
4/4	30	11.6	0	0
4/6	30	13.9	0	0
4/8	30	15.6	0	0
4/11	30	16.7	0	0
4/13	30	18.4	0	0
4/15	30	16.1	1	0.03
4/18	30	18.4	17	0.57
4/20	30	16.7	1	0.03
4/22	30	16.7	0	0
4/24	30	17.8	5	0.17
4/26	30	17.2	0	0
4/28	30	15.6	10	0.33
4/29	30	15.6	29	0.97
5/1	30	15.0	8	0.27
5/3	30	18.4	2230	74.33
5/5	15	21.1	274	18.37
5/7	15	18.9	43	2.87
5/8	15	21.1	15	1.00
5/11	15	21.1	64	4.27
5/13	15	21.7	1	0.07
5/15	15	20.0	2	0.13
5/17	15	21.1	0	0
5/19	15	22.8	0	0
5/21	15	23.4	0	0

Table 2. Record of sampling and striped bass egg collections from Station 2 in 1965.

<i>Date</i>	<i>Sample Duration Min.</i>	<i>Surface Water Temp. °C</i>	<i>Striped Bass Eggs</i>	
			<i>Number</i>	<i>No./Min.</i>
4/15	30	16.1	1	0.03
4/20	30	16.7	4	0.13
4/22	30	17.2	0	0
4/24	30	17.8	53	1.77
4/26	30	17.2	2	0.07
4/28	30	15.6	52	1.73
4/29	30	15.6	67	2.23
5/1	30	15.0	12	0.40
5/3	30	18.4	232	7.73
5/5	15	21.1	128	8.53
5/7	15	18.9	28	1.87
5/9	15	21.1	50	3.33
5/11	15	21.1	5	0.33
5/13	15	21.7	4	0.27
5/15	15	20.0	5	0.33
5/17	15	21.7	0	0
5/19	15	22.8	0	0
5/21	15	23.4	0	0

Table 3. Record of sampling and striped bass egg collections from Station 1A in 1975.

<i>Date</i>	<i>Sample Duration Min.</i>	<i>Surface Water Temp. °C</i>	<i>Striped Bass Eggs</i>	
			<i>Number</i>	<i>No./Min.</i>
4/4	15	12.2	0	0
4/5	15	11.1	0	0
4/7	15	11.1	0	0
4/13	15	11.1	0	0
4/14	15	11.6	0	0
4/18	15	13.9	0	0
4/19	15	14.5	0	0
4/21	15	14.5	124	8.27
4/23	15	15.0	0	0
4/25	15	16.7	534	35.60
4/27	15	17.8	87	5.80
4/29	15	16.7	0	0
5/1	15	15.6	0	0
5/3	15	17.2	4	0.27
5/5	15	16.7	0	0
5/7	15	17.8	320	21.33
5/9	15	17.8	500	33.33
5/12	15	18.9	201	13.40
5/14	15	18.9	406	27.07
5/17	15	20.6	0	0
5/20	15	21.1	0	0

Quantitative estimates of the flow of striped bass eggs past Station 2 are presented in Tables 6 and 7. This was the only station for which flow data and cross sectional area measurements were available. Since previous work in the Roanoke River, North Carolina, had indicated that there was no significant difference in samples from nets set at different vertical and horizontal positions (McCoy, 1959), the matter of differential distribution of eggs was not considered when the estimates were made. The estimates were determined by expanding the mean number of eggs collected each minute by the ratio of the river area to net area. These estimates were then expanded to number of eggs flowing past Station 2 per hour. As indicated in Tables 6 and 7, estimates ranged up to 444,960 eggs per hour in 1965 and 1,036,560 eggs per hour in 1975. It was assumed in deriving these estimates that water was strained by the nets as rapidly as it was passing down the river and that all eggs survived the netting and were found. These assumptions are probable sources of error. However, since the estimates would only have increased because of the error involved, they were considered to be minimal. The estimates are of interest since there is little doubt that at least this many eggs flowed past Station 2.

Assuming that the number of eggs recovered in the samples (Tables 1-5) and that the estimated flow of eggs past Station 2 (Tables 6 and 7) are indices of spawning intensity, it is evident that significant striped bass spawning occurred in the Tar River in 1965 with a considerable increase of spawning activity in 1975. This indicates an increase in the spawning population which can be attributed in part to periodic extensive stocking of striped bass in the Tar River by the North Carolina Wildlife Resources Commission

Table 4. Record of sampling and striped bass egg collections from Station 1 in 1975.

<i>Date</i>	<i>Sample Duration Min.</i>	<i>Surface Water Temp. °C</i>	<i>Striped Bass Eggs</i>	
			<i>Number</i>	<i>No./Min.</i>
4/4	15	12.8	0	0
4/5	15	11.1	0	0
4/7	15	11.6	0	0
4/13	15	11.6	0	0
4/14	15	11.1	0	0
4/18	15	14.5	0	0
4/19	15	14.5	0	0
4/21	15	15.6	172	11.47
4/23	15	15.6	0	0
4/25	15	17.2	1780	118.67
4/27	15	17.8	30	2.00
4/29	15	16.1	8	0.53
5/1	15	15.6	5	0.33
5/3	15	17.2	38	2.53
5/5	15	16.7	32	2.13
5/7	15	17.8	2755	183.66
5/9	15	17.2	161	10.73
5/12	15	18.4	75	5.00
5/14	15	18.4	63	4.20
5/17	15	20.0	932	62.13
5/20	15	20.6	0	0

Table 5. Record of sampling and striped bass egg collections from Station 2 in 1975.

<i>Date</i>	<i>Sample Duration Min.</i>	<i>Surface Water Temp. °C</i>	<i>Striped Bass Eggs</i>	
			<i>Number</i>	<i>No./Min.</i>
4/4	15	12.2	0	0
4/5	15	10.6	0	0
4/7	15	11.1	0	0
4/13	15	11.6	0	0
4/14	15	11.1	0	0
4/18	15	13.9	0	0
4/19	15	14.5	0	0
4/21	15	15.6	23	1.53
4/23	15	15.6	2	0.13
4/25	15	17.2	140	9.33
4/27	15	17.8	10	0.67
4/29	15	16.1	20	1.33
5/1	15	15.6	0	0
5/3	15	16.1	2	0.13
5/5	15	16.7	27	1.80
5/7	15	17.2	727	48.46
5/9	15	17.2	23	1.53
5/12	15	17.8	168	11.20
5/14	15	18.4	48	3.20
5/17	15	20.0	36	2.40
5/20	15	21.1	0	0

Table 6. Estimated flow of striped bass eggs down the Tar River past Station 2 in 1965.

<i>Date</i>	<i>River Dsch cfs</i>	<i>River XS Area Sq. Ft.</i>	<i>Vel mph</i>	<i>Eggs/Min. Sampling</i>	<i>Estimated Flow of Eggs</i>	
					<i>Per Min.</i>	<i>Per Hour</i>
4/14	1460	835	1.2	0.03	20	1200
4/20	1200	715	1.1	0.13	77	4620
4/24	1330	775	1.2	1.77	1113	66780
4/26	1200	720	1.1	0.07	39	2340
4/28	1760	975	1.2	1.73	1375	82500
4/29	2200	1195	1.3	2.23	2171	130260
5/1	4080	1910	1.5	0.40	621	37260
5/3	2160	1180	1.2	7.73	7416	444960
5/5	1490	835	1.2	8.53	5794	347640
5/7	1100	665	1.1	1.87	1010	60600
5/9	898	580	1.1	3.33	1573	94380
5/11	902	580	1.1	0.33	157	9420
5/13	906	585	1.1	0.27	127	7620
5/15	770	510	1.0	0.33	138	8280

Table 7. Estimated flow of striped bass eggs down the Tar River past Station 2 in 1975.

Date	River	River	Vel	Eggs/Min.	Estimated Flow of Eggs	
	Dsch cfs	XS Area Sq. Ft.	mph	Sampling	Per Min.	Per Hour
4/21	2480	1174	2.2	1.53	1015	60900
4/23	1909	990	1.8	0.13	73	4380
4/25	1571	877	1.6	9.33	4623	277380
4/27	1340	795	1.5	0.67	301	18060
4/29	797	585	1.0	1.33	440	26400
5/1	1148	720	1.3	0	0	0
5/3	1123	714	1.3	0.13	52	3120
5/5	1228	752	1.4	1.80	765	45900
5/7	916	631	1.2	48.46	17276	1036560
5/9	1072	691	1.3	1.53	597	35820
5/12	985	655	1.2	11.20	4144	248640
5/14	665	524	0.9	3.20	947	56820
5/17	778	570	1.0	2.40	773	46380

Periods of Spawning and Conditions at Spawning

The periods of spawning as indicated by striped bass egg collections are presented in Figure 2. The spawning period extended from April 15 to May 15 in 1965 and from April 21 to May 17 in 1975. Surface water temperatures during both sampling periods are indicated in the third columns of Tables 1-5. The temperatures during the spawning periods ranged from 15.0 to 22.2°C in 1965 and from 14.4 to 20.6°C in 1975. These are in general agreement with temperature ranges found in the Roanoke River by McCoy (1959). He stated that spawning does not begin until temperatures reach approximately 14.4 to 15.6°C. The majority of spawning occurs at temperatures of 17.8 to 20.0°C, with temperatures at the end of the spawning season from 21.1 to 22.2°C.

A definite spawning peak occurred on May 3, 1965. The beginning of this peak was coincident with a sharp rise in water temperature from 15.0 to 18.3°C. After this spawning period ended around May 8, the water temperature leveled off at about 21.1°C and very little spawning activity occurred. During the 1975 study, three spawning peaks were evident which were also correlated with rises in water temperature. These peaks occurred around April 25, May 7 and May 17. The water temperatures in 1975 were generally lower than those in 1965 throughout the spawning period. Thus, the more favorable water temperatures on the spawning grounds probably accounted for the extended spawning peaks in 1975.

Location of Spawning Grounds

Estimates of the distribution and relative intensity of striped bass spawning as related to river location are indicated in Figure 3. These estimates were made by back staging the eggs based on their age and their approximate rate of transport downstream. Aging of eggs was based on an average incubation period of 48 hours. The transport rate was considered to be the same as current velocity which averaged approximately one mile per hour during the sampling periods.

In 1965, estimates indicated that the greatest spawning activity occurred over a 25 mile span of river between River Mile 50 and 75. Results from the 1975 study indicated that the principal spawning activity also occurred over a 25 mile span of river but the area was farther upstream between River Mile 60 and 85. The main difference between conditions during the two studies was in water temperature, with temperatures being higher on the average during 1965. The incubation period of striped bass eggs varies with water temperature. Forty eight hours is required at an average temperature of 17.8°C (Pearson, 1938). At 21.7 to 22.2°C hatching occurs in about 30 hours, while at 14.4 to 15.6°C hatching normally takes place in about 70 to 74 hours (Merriman, 1941). Since the estimates in both studies were based on an average incubation period of 48 hours and the temperature during the spawning peaks in 1975 averaged about 17.8°C, the 1975 estimates of spawning location are probably more reliable. The higher temperatures and accelerated development of eggs in 1965, if taken into account, would place the estimates of spawning location in close proximity to those in 1975.

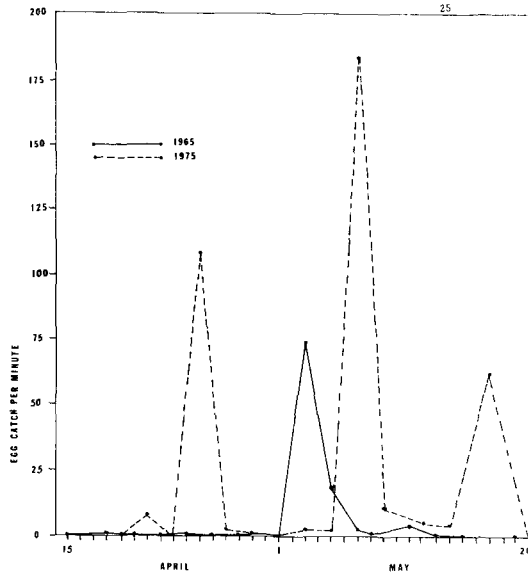


Figure 2. Spawning Periods of the Striped Bass in the Tar River.

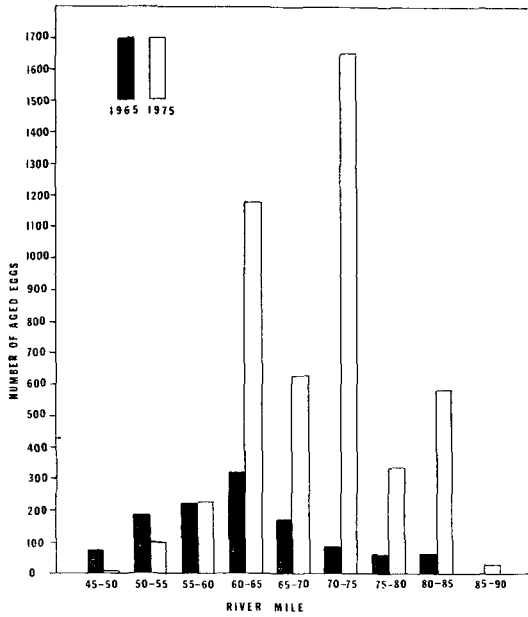


Figure 3. Distribution and Relative Intensity of Striped Bass Spawning Activity as Related to River Location.

Thus, the principal spawning grounds of striped bass in the Tar River apparently occur above Bell's Bridge (Station 1) over about a 25 mile span of river. This stretch of river is characterized by a rocky bottom and a swift current which is very similar to the spawning habitat of striped bass in other rivers such as the Roanoke in North Carolina, the James and Potomac in Virginia and the Hudson in New York (Pearson, 1938).

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MOVEMENTS OF THE REDBREAST SUNFISH IN LITTLE RIVER, NEAR RALEIGH, NORTH CAROLINA¹

by

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ABSTRACT

Recoveries of 189 redbreast sunfish (*Lepomis auritus*) tagged in Little River, North Carolina, indicated that this species is moderately mobile. Upstream movements predominated among fish recaptured within 60 days after their release in April and May. The extent of movement of males and females was about equal. On the basis of measurements at release and recapture, average annual increase in size was 2.4cm in total length and 48.0g in weight. The estimated annual harvest by sport fishermen was 14.7%.

INTRODUCTION

Some species of sunfishes are more mobile than others. On the basis of degree of movement, Funk (1957) classified stream fishes as mobile, semi-mobile, and sedentary. His work, as well as studies by Ball (1947), Gerking (1959), Gunning (1963), and Moody (1960) indicated that Centrarchidae are sedentary and limited to home range areas. However, white crappies (*Pomoxis annularis*) were found to be mobile (Funk 1957; Siefert 1969) and largemouth bass (*Micropterus salmoides*) semi-mobile (Funk 1957). Berra and Gunning (1972) indicated that longear sunfish (*Lepomis megalotis*) are largely limited to home ranges, but travel short distances in the summer and winter.

In North Carolina redbreast sunfish sometimes reach a length of 20cm and a weight of 450g, and occur in most Piedmont and Coastal Plain streams (Shannon 1966a). In 1966, Shannon (1966b), who released tagged, hatchery reared redbreast sunfish into Bones Creek near Fayetteville, North Carolina, and recaptured them in a counting weir, showed that some moved upstream and others downstream. The upstream movements increased during high water levels in the spring.

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