

AMERICAN SHAD AND RIVER HERRING MONITORING PROGRAMS IN THE TAR RIVER, NORTH CAROLINA – 2015



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Abstract.—American Shad *Alosa sapidissima* in the Tar River were sampled with boat electrofishing in coastal North Carolina during spring 2015. Overall catch per unit effort (CPUE) was 54.7 fish/h. Catch rates were highest for males. The age structure of this population was comprised of 3–6 year-old males and 4–6 year-old females. Electrofishing was also used to sample anadromous Alewife *A. pseudoharengus* and Blueback Herring *A. aestivalis*, collectively known as river herring, in the Tar River in 2015. Only three Blueback Herring were collected during the survey. Relative abundance of river herring remains low and suggests the need for continued protection through the current harvest moratorium.

The North Carolina Wildlife Resources Commission (Commission) is responsible for the spawning stock assessment of American Shad *Alosa sapidissima* populations in North Carolina's coastal rivers, specifically the inland waters of the Roanoke, Tar, Neuse, and Cape Fear rivers. Population characteristics from these rivers are summarized each spring, and then submitted to the North Carolina Division of Marine Fisheries (NCDMF) for stock assessment models and inclusion in North Carolina's annual American Shad compliance report to the Atlantic States Marine Fisheries Commission (ASMFC). This information is required from the state of North Carolina as mandated under conditions set forth within the fishery management plan for alosine species established for the eastern United States (ASMFC 1985) and associated addendum (ASMFC 2002; ASMFC 2010). Compliance with this plan is necessary to support the enhancement of American Shad populations within coastal North Carolina for the benefit of recreational and commercial fishermen. As part of this compliance, a Sustainable Fishery Plan

was created to identify and implement management efforts that would rebuild and maintain American Shad populations in North Carolina (NCDMF and NCWRC 2012).

This report includes an assessment of the spawning stock characteristics of the American Shad population within the Tar River, and in response to rising concerns over the status of river herring populations, as described in Amendment 2 to the Interstate Fishery Management Plan for American Shad and River Herring (ASMFC 2009), the Commission also includes within this report information on Alewife *A. pseudoharengus* and Blueback Herring *A. aestivalis* collected from inland waters in the Tar River Basin. A moratorium on anadromous river herring harvest was enacted in North Carolina inland waters in July 2006 and statewide in September 2007.

To satisfy compliance requirements of the Atlantic States Marine Fisheries Commission Amendment 3 to the Shad and River Herring Interstate Fishery Management Plan, NCDMF has conducted a creel survey on the Tar/Pamlico River, which includes two zones (upper and lower), since 2012. The upper Tar River creel survey is conducted in the spring and timed to intercept anglers primarily targeting American Shad, Hickory Shad *A. mediocris*, and Striped Bass *Morone saxatilis*. Results related to shad anglers surveyed during the creel survey conducted in the upper zone of the Tar River are also included in this report.

Methods

Anadromous Alosine Spawning Stock Assessments

Commission fisheries biologists sampled American Shad from the Tar River on nine occasions between 24 March and 5 May 2015 (Table 1). Sample sites traditionally are within one of three approximate 15-km segments within spawning areas for American Shad. The upper most access area at Battle Park downstream to the Dunbar access area comprised segment 1, while the Dunbar access area downstream to the Bell's Bridge access area comprised segment 2, with the Bell's Bridge access area downstream to the Tarboro town ramp comprising segment 3 (Figure 1). Normally, one sample of approximately 30 minutes was conducted in a particular segment in a sample day in areas that appeared to have preferred American Shad habitat while avoiding bank and boat angling activity. Flows and water temperature were the major factors in determining which segment would be sampled in a particular day. Moderate to high flows and warmer water temperatures tend to cause American Shad to move further upstream and into segment 1. There are certain minimum river levels required to allow access to the river for electrofishing (Table 2), yet as flows approach moderate levels (> 300 cfs), we tend to concentrate the majority of American Shad sampling in segment 1. A boat-mounted electrofishing unit (Smith-Root 7.5 GPP) with one dip netter was used to capture fish during daylight hours, and electrofishing effort was recorded in seconds. To minimize size selection during sampling, American Shad were netted as they were encountered. Relative abundance of each year class was indexed by catch-per-unit-effort (CPUE) and expressed as number of fish captured per hour of electrofishing. These sampling techniques have remained unchanged since Tar River American Shad sampling by the Commission began in 2000.

Sex was determined for each captured American Shad by applying directional pressure to the abdomen toward the vent and observing the presence of milt or eggs. Each fish was measured for total length (TL mm). Proportions of each age class within each 10-mm length bin were

computed and expanded to the total number of American Shad collected within each length bin by sex, based on historical age data obtained using otoliths (Rundle 2015). Age distributions and CPUE by age-class were then calculated. Mean lengths at age were calculated for the entire sample following methods described by Bettoli and Miranda (2001).

To address concerns related to declines in river herring abundance, all river herring observed while sampling American Shad or Striped Bass were collected. Due to extremely low catch rates during Commission sampling from 2006 through 2014 in creeks known to have historically supported spawning migrations in the lower Tar River Basin (Rundle 2015), a shift was made to collect river herring while sampling other anadromous species. Targeted river herring collections are planned to resume in the lower river sites on three to five-year intervals. Daily and overall CPUE, sex ratios, and length frequencies (TL mm) for river herring were reported in 2015.

Recreational Harvest Regulations and Monitoring

Current regulations in the Tar River allow for a 10 fish daily creel limit of American Shad and Hickory Shad in aggregate with no closed season. The creel survey conducted in the upper Tar River by NCDMF consisted of a non-uniform probability based access point creel survey (Pollock et al. 1994). The creel area surveyed encompassed nine access points from Battle Park to Falkland (NCDMF Unpublished Data). In 2015, angler surveys were conducted in the upper Tar River from 15 February through 30 May. Preliminary results of the 2015 creel survey were summarized including angler effort, harvest, and releases of American Shad in the Tar River.

Results

American Shad Surveys

A total of 246 American Shad was collected from the Tar River during the spring of 2015, with an overall CPUE value of 54.7 fish/h. American Shad collections began as water temperatures approached 11°C, with CPUE values peaking at 15°C (Table 1). In 2015, males comprised 57% (N=141), while females accounted for 43% (N=105; Figure 2). Age was assigned for all fish sampled using age-length keys from prior collection years, with four male cohorts and three female cohorts represented during the 2015 assessment. Mean length at age analysis for Tar River American Shad indicated that males between ages 4 and 6 had growth rates that ranged from approximately 6 to 52 mm per year, whereas female American Shad were consistently larger than males of the same cohort (Table 3). The majority of the total catch for males and females was accounted for by the 2010–2011 (age 4 and 5) year classes (Figure 2). Male American Shad ranged in age from 3–6 years, while females ranged in age from 4–6 years. American Shad collected in the 2015 sample ranged in total length from 339 to 545 mm. The length-frequency distribution for males showed most individuals occurred between 390 and 489 mm in length, while the majority of females were between 490 and 559 mm in length (Figure 3).

River Herring Surveys

Three Blueback Herring were collected during 2015 spring American Shad and Striped Bass sampling on the main stem of the Tar River. One fish (299 mm female) was collected in the vicinity of Battle Park on March 25, while two male fish (254 and 267 mm) were collected in the vicinity of Swift Creek on April 2 (Table 4). Alewives have not been collected during any sample year.

2015 Tar River Creel Survey Preliminary Results

Tar River anglers caught an estimated 3,790 American Shad on the upper Tar River in spring 2015, and harvested 1,006, or approximately 27% (NCDMF unpublished data; Table 5). A total of 9,287 angler-hours of effort was directed towards shad in general (American and Hickory Shad) in the upper Tar River. Bank fishing is highly popular for American Shad and accounted for approximately 85% of all effort at the Battle Park access area and approximately 8% of all effort at the Old Sparta access area (NCDMF unpublished data). The Battle Park area offers several accommodations for bank anglers ranging from cleared bank areas and trails to wooden fishing platforms. The Old Sparta area has limited bank fishing opportunities and would benefit from a safe and permanent fishing platform.

Discussion

American Shad

American Shad abundance in the Tar River appears to be relatively stable during more recent annual sampling. Catch rates were the greatest in 2000, which was the first year of sampling, with considerable variability through the 2009 sample year, which had the lowest catch rates, followed by moderate and comparatively steady catch rates over the past six sample seasons (Figure 4). There is some concern related to sampling only three female cohorts of American Shad during 2015, yet traditionally this has been normal with only three female cohorts observed in 2011, 2012, 2013, and 2014 (Wynne et al. 2012; Ricks et al. 2013; Ricks et al. 2014; Rundle 2015). Although four female cohorts were documented in 2009 and 2010, only a single age-3 fish was collected in 2010 and only one age-7 fish was sampled in 2009 (Wynne et al. 2010; Wynne et al. 2011). For the majority of sampling in the Tar River, females aged 4, 5, and 6 consistently comprised the greatest abundance of female American Shad.

Catch rates for American Shad in 2015 were highest within segment one and could be partially attributed to periods of higher than normal flows (Figure 5); this is the uppermost area accessible by American Shad to their preferred spawning habitat. There are certain minimum river levels required to allow access to the river for boat electrofishing (Table 2). Conversely, although access is possible during exceptionally high flows, sampling is very difficult; therefore, sampling is often delayed until river flows have moderated somewhat. It is likely that moderate to high flows attract American Shad further upstream where they tend to remain for a period of time even as the river subsides, coinciding with high catch rates following high flows in segment one. After high catch rates in early May (104 American Shad/h), flows dropped considerably by

mid-May and precluded additional sampling in 2015. Variation in catch rates occur naturally due to variability in mortality and recruitment rates in all systems; however, on the Tar River variation in catch rates can also be attributed to sampling logistics and limitations due to fluctuating flows. Therefore, caution should be used when relating catch rates to abundance.

River Herring

Sampling in 2015 was the tenth season of river herring investigations by Commission staff in the Tar River Basin. Prior to 2015, weekly surveys were conducted in tributaries of the lower Tar River near Grimesland. However, consistently low catch rates since sampling began in 2006, justified a shift to monitoring river herring during routine American Shad and Striped Bass sampling in the upper reaches of the Tar River. Similar to American Shad, river herring abundances can vary widely among sampling trips. Weather-related factors like water temperature, precipitation, and stream flow contribute substantially to this variability. However, at low population levels, there is added variability associated with the reduced likelihood of electrofishing gear even encountering river herring. Therefore, caution should be exercised when interpreting these data. Catch per unit effort information has the potential to become more meaningful once river herring populations begin to expand and gross increases in abundance are measured. Although 2015 was the first year for sampling river herring in the upper reaches of the Tar River, observations of river herring while sampling American Shad and Striped Bass in previous years have also been low. Therefore, with continued low relative abundances of river herring, the need remains for continued protection through the current harvest moratorium.

Management Recommendations

1. Maintain the current regulation on the Tar River to allow a daily creel limit of 10 shad (American Shad and Hickory Shad) in aggregate.
2. Continue the harvest moratorium on Alewife and Blueback Herring.
3. Maintain the current sampling methods for American Shad in the Tar River.
4. Explore the development of a fishing platform (public fishing area) adjacent to the Commission's Old Sparta boating access area.

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TABLE 1.— American Shad daily electrofishing effort, catch, male to female ratio, daily CPUE, sample segment, and mean daily water temperatures for the Tar River, 2015.

Date	Effort (h)	Catch	M:F Ratio	Daily CPUE	Sample Segment	Mean Water Temp °C
3/24/2015	0.5	2	0	4.0	2	11
3/25/2015	0.5	42	0.7:1	84.0	1	13
4/2/2015	0.5	9	0.1:1	18.0	2	9
4/7/2015	0.5	63	1.4:1	126.0	1	15
4/8/2015	1	23	1.5:1	23.0	2	18
4/9/2015	0.5	36	1.6:1	72.0	1	18
4/22/2015	0.5	19	2.2:1	38.0	1	17
5/5/2015	0.5	52	2.5:1	104.0	1	20
Total	4.5	246		54.7		

TABLE 2.— Access areas, sampling segments, and minimum requirements for access on the Tar River for spring American Shad sampling.

Access Ramp	Segment	USGS Gage Station	Min Discharge (ft ³ /s)	Min Gage (ft)
Battle Park City Ramp	1	2082585	175	4.3
Dunbar WRC Ramp	2	2082585	175	4.3
Bells Bridge WRC Ramp	3	2083500	470	3.8

TABLE 3.— Mean total length (mm) at age for American Shad males and females collected from the Tar River, spring 2015.

Year Class	Age	Males		Females	
		N	Mean	N	Mean
2012	3	18	435	0	n/a
2011	4	53	433	20	516
2010	5	61	439	56	526
2009	6	3	491	10	513

TABLE 4.— Blueback Herring daily electrofishing effort, catch, CPUE, sample segment, and daily water temperatures for the Tar River 2015. Data only shown for dates when Blueback Herring were encountered. Alewife were not collected in 2015.

Date	Effort (h)	Catch Blueback	CPUE Blueback	Sample Segment	Water Temp (C)
3/25/2015	0.5	1	2.0	1	13
4/2/2015	0.5	2	4.0	2	9
Totals	1.0	3	3.0		

TABLE 5.— Estimated effort, harvest, and discard statistics of the Tar River recreational American Shad fishery. Statistics are preliminary and estimated using data collected by the NCDMF creel survey in the upper zone of the Tar River between 15 Feb 2015 and 30 May 2015.

Month	Effort		Harvest	Discard
	Trips	Hours	Number	Number
Feb	134	335	0	0
Mar	2,298	6,047	618	458
Apr	1,106	2,545	363	188
May	50	360	25	2,138
Total	3,588	9,287	1,006	2,784

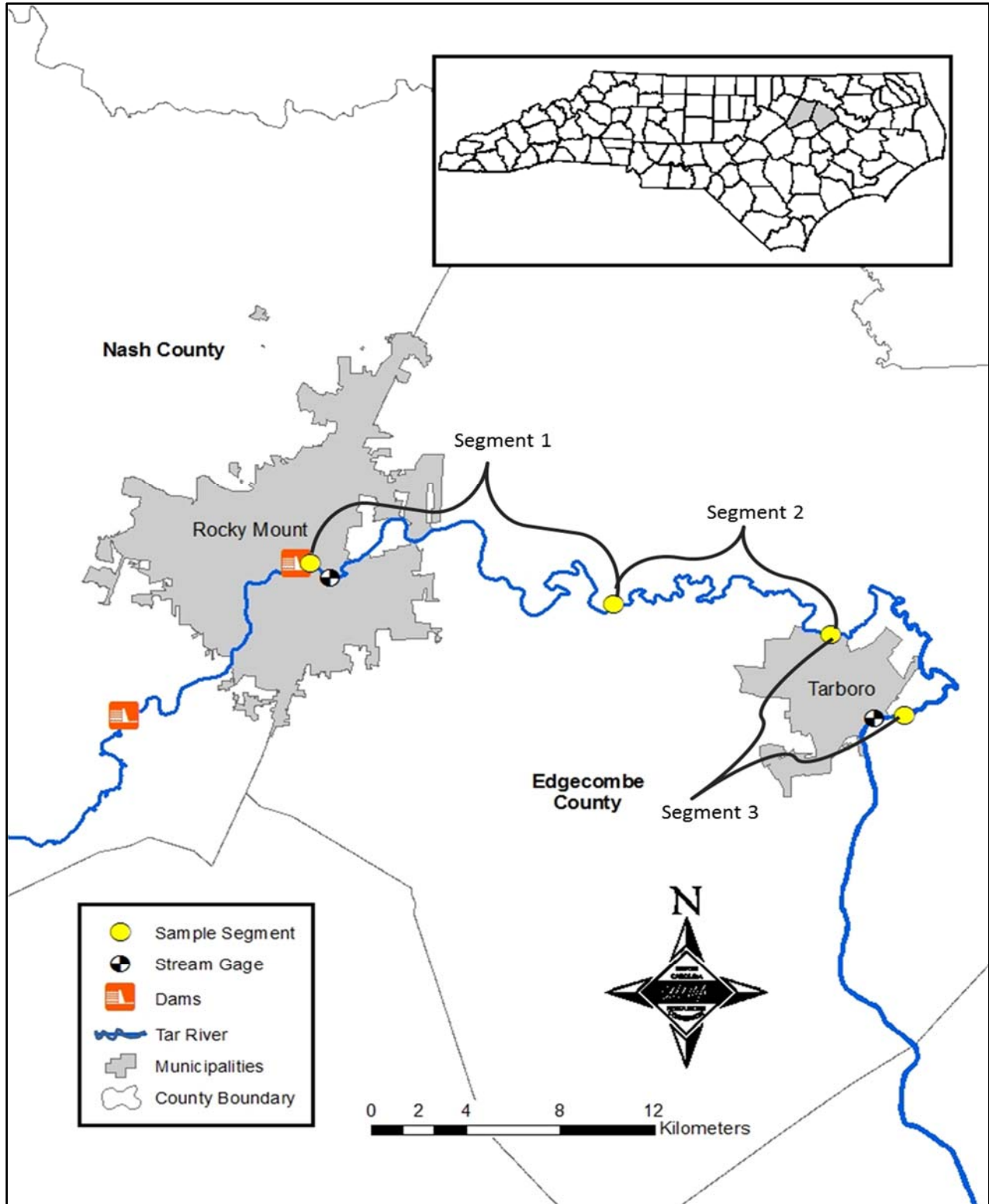


FIGURE 1.—American Shad sampling sites on the Tar River, spring 2015.

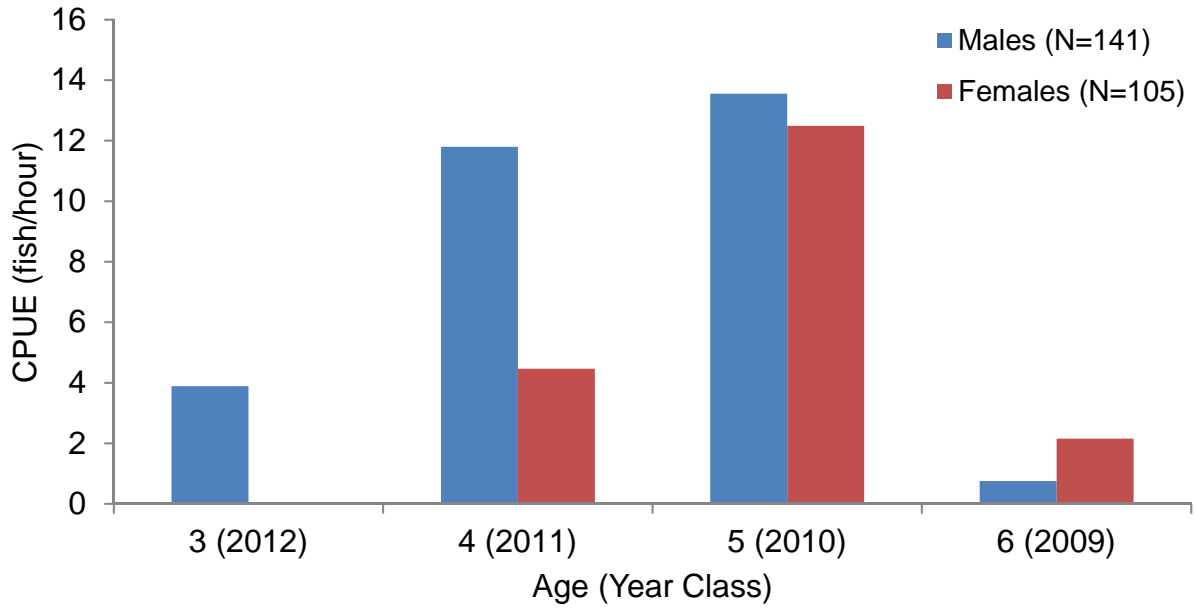


FIGURE 2.—Relative abundance (electrofishing CPUE) of American Shad collected from the Tar River, spring 2015.

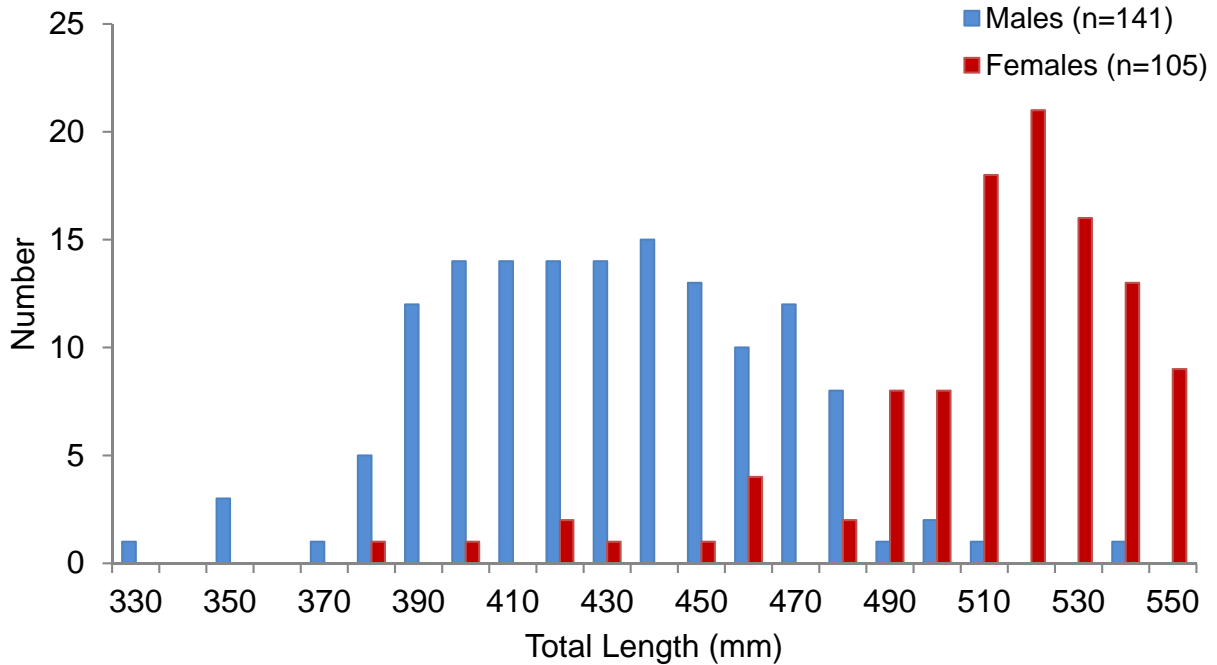


FIGURE 3.—Length-frequency histogram for American Shad collected from the Tar River, spring 2015.

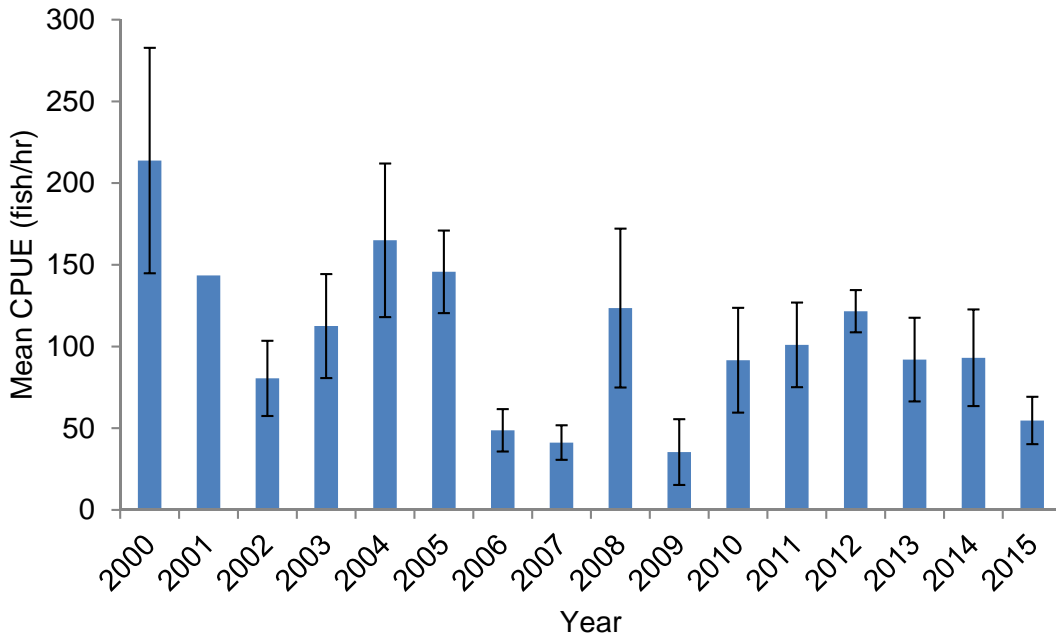


FIGURE 4.—Mean relative abundance (electrofishing CPUE) of American Shad collected from the Tar River, 2000–2015. Error bars represent standard error. Standard error is not available for 2001.

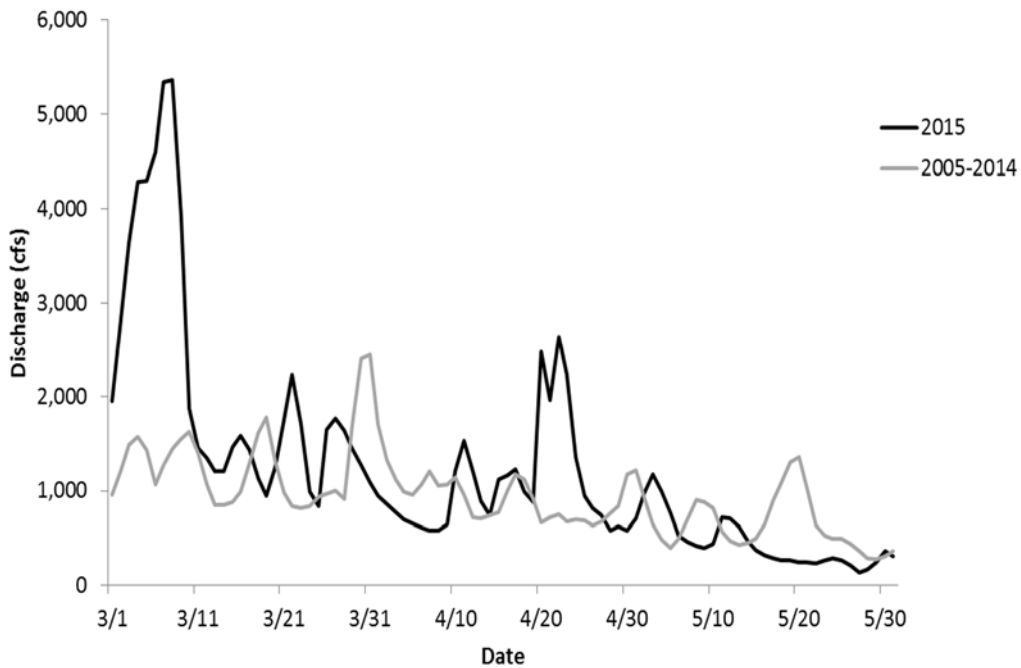


FIGURE 5.—Mean daily discharge from March–May 2005–2014 and 2015 in the Tar River, Rocky Mount, NC. Discharge measurements from USGS gage number 2082585.