Neuse River American Shad Survey, 2019–2020

NEED

Historical evidence suggests American Shad were abundant and extensively distributed in the Neuse River. Before the construction of instream impediments on the Neuse River, spawning American Shad could migrate as far upstream as the Eno River near Hillsborough. The construction of Milburnie Dam in the early 1800s at river-kilometer (rkm) 351 restricted fish passage. In 1879, however, it was speculated that the proliferation of commercial fishing in the Neuse River had a greater impact on the decline of American Shad than dam construction. Dams continued to be built in the 1900s with Quaker Neck Dam constructed at rkm 225 in 1952 and Falls of the Neuse Dam at rkm 379 in 1981. While opportunities for fish passage improved with the removal of Quaker Neck Dam in 1998 and Milburnie Dam in 2018, the Falls of the Neuse Dam remains a blockage to fish passage.

Since 2000, fisheries staff with the North Carolina Wildlife Resources Commission (NCWRC) have conducted spawning stock assessments of Neuse River American Shad as part of North Carolina's compliance requirements with the Atlantic States Marine Fisheries Commission (ASMFC). From 2012 to 2018, NCWRC partnered with the Edenton National Fish Hatchery (ENFH) to annually stock American Shad fry to supplement the American Shad population. However, in 2018, American shad fry stocking was suspended due to a low hatchery contribution to the Neuse River American Shad population.

Annual spawning ground electrofishing surveys are valuable for monitoring American Shad population trends, assessing population changes over time, documenting potential population recovery for a sustainable fishery, and improving opportunities for anglers during anadromous fish migrations in the Neuse River.

OBJECTIVES

1. Document American Shad population trends and assess changes over time.
2. Maintain a long-term data set for ASMFC compliance.

METHODS

Personnel: Ben Ricks, Todd VanMiddlesworth, District 2 Fisheries Biologists.
Waterbody: Neuse River – 49 sites in 2019 and 4 sites in 2020 – each site was 1-km.
Fish Sampling Gear: Boat-Mounted Electrofishing, High Frequency, 7.5 GPP, 120 PPS, 6 A
Other Gear Utilized: YSI water quality meter for water temperature (°C), dissolved oxygen (mg/L), % saturation, conductivity (µS/cm), salinity (ppt).
Species of Primary Interest: American Shad
Sample Date(s): March 24 – May 18, 2019 and March 15 – 28, 2020
Project Name in BIODE Fish: Neuse River Anadromous Spawning Stock Survey
Funding Source: Federal Aid in Sport Fish Restoration and agency license receipts

Citation: Ricks, B. and T. VanMiddlesworth. 2020. Neuse River American Shad survey 2019-
2020. North Carolina Wildlife Resources Commission, Federal Aid in Sport Fish
Restoration, survey summary, Raleigh.

Study Area:
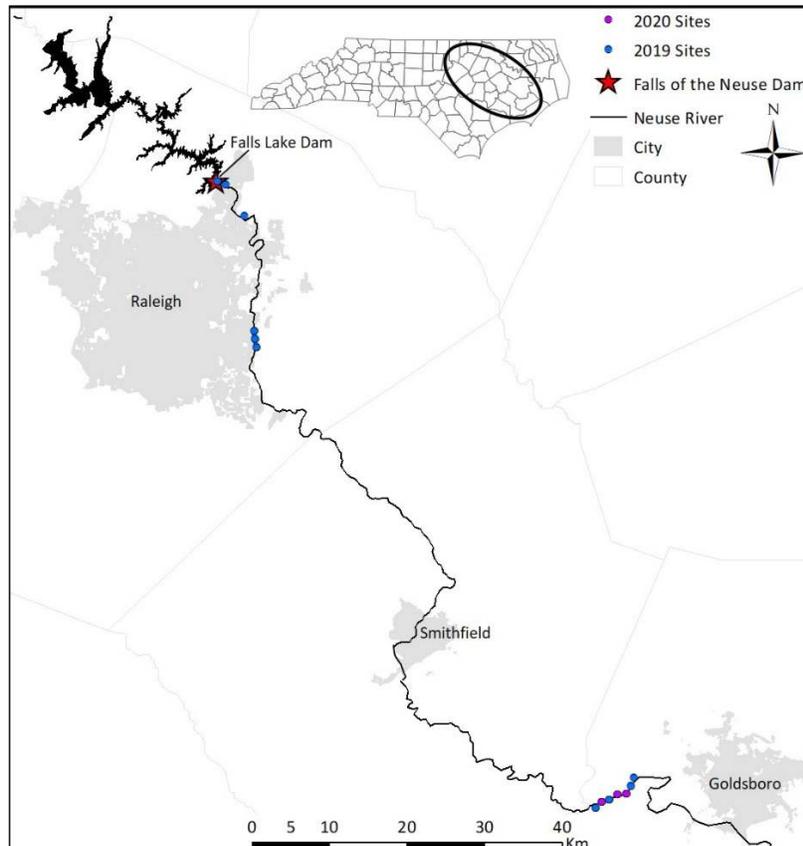
BIOLOGICAL OBSERVATIONS

2019 Neuse River American Shad survey. American Shad (N=469) were collected during weekly spring sampling on the Neuse River at annual sample sites near Goldsboro, NC, and when flows allowed near Raleigh between March 27 and May 13 (Table 1). Mean CPUE of all sites was 28.7 fish/h, which was similar to 2018 (Figure 1), and the peak weekly CPUE (57.4 fish/h) occurred during the week of May 5, 2019 at 22.3°C (Table 2). Overall CPUE (total catch/total effort) was 30.3 fish/h. Male American Shad comprised 65% of the catch (N=303), while female American Shad contributed 35% (N = 166). American Shad ranged 341–531 mm TL. Both males and females exhibited unimodal size distributions (Figure 2). Males ranged 341–483 mm, with the peak occurring in the 490–419 mm size-class. Females ranged 397–531 mm, with the peak occurring in the 480–589 mm size-class. Otolith annular ring counts were used to assign ages to 58 female and 60 male American Shad. Sex specific age-length keys were developed from the 2019 otolith data and used to assign ages to 99 females and 216 males. Males were represented by four year-classes (ages 3–6), with the 2014, 2015, and 2016 year-

classes (age 3, 4, and 5) contributing similarly to the electrofishing catch and comprising 86% of males (Table 3). Females also were represented by five year-classes (ages 3–7), with the 2013 and 2014 year-classes (age 5 and 6) comprising 78% of the female sample. Age-7 females accounted for 8% of the female sample (Figure 3). Population metrics for American Shad collected in the Neuse River during 2019 were consistent with previous observations since 2000 (Table 4).

2020 Neuse River American Shad Survey. Only two weekly samples were completed in the Goldsboro area as a result of the Covid-19 pandemic and the associated North Carolina stay-at-home orders. In the two sampling days, 135 American Shad were collected with a total CPUE of 87.1 fish/h). Male American Shad ranged 381–514 mm, and female American Shad ranged 420–559 mm. The 2020 sample is not comparable to other years due to inflated CPUE estimates.

MANAGEMENT RECOMMENDATIONS

1. Maintain current creel limits to allow no more than one American Shad within the daily creel limit of 10 shad in combination (American Shad and Hickory Shad).
2. Maintain current American Shad sampling efforts and monitor for changes in spawning stock metrics as a response to hatchery stockings. Develop new biological reference points using the available time series data.
3. Develop NCWRC boating access areas on the Neuse River upstream of Smithfield, NC. NCWRC should support and facilitate operation of these access areas whenever possible.

TABLE 2. American Shad weekly electrofishing effort, total catch, male to female ratio, mean CPUE, standard error, number of sites, and mean daily water temperature for Neuse River, 2019–2020. Logistical limitations introduced variability in the number of sites each week. The 2020 sample was suspended due to Covid-19 restrictions.

Week	Effort (h)	Total Catch	M:F Ratio	Mean CPUE	Mean CPUE Standard Error	Number of Sites	Mean Water Temp (°C)
March 24 – March 30, 2019	0.6	25	2.3:1	38.9	7.1	2	13.0
March 31 – April 6, 2019	1.0	52	2.7:1	54.4	16.8	3	11.7
April 7 – April 13, 2019	2.2	44	2.1:1	19.2	4.2	8	18.0
April 14 – April 20, 2019	2.2	13	1.2:1	7.4	3.0	7	18.0
April 21 – April 27, 2019	2.8	47	2.4:1	16.5	5.2	10	18.4
April 28 – May 4, 2019	2.9	91	2.6:1	28.4	9.0	9	20.4
May 5 – May 11, 2019	2.4	138	1.9:1	60.9	13.1	6	22.3
May 12 – May 18, 2019	1.3	59	0.7:1	44.0	10.5	4	22.8
2019 Total	15.5	469	1.8:1	28.7	3.7	49	
March 15 – March 21, 2020	0.7	91	2.3:1	125.4	8.7	2	18.0
March 22 – March 28, 2020	0.8	44	1.9:1	54.6	18.7	2	15.5
2020 Total	1.6	135	2.1:1	90.0	22.1	4	

TABLE 3. Mean total length (mm) at age by sex for Neuse River American Shad year-classes collected in 2019. Data include broodfish and fish collected from the spawning grounds.

Year Class	Age	Males				Females			
		N	Mean	Min	Max	N	Mean	Min	Max
2016	3	83	402	363	447	13	424	409	441
2015	4	80	409	341	447	7	436	424	448
2014	5	76	437	348	483	55	481	422	524
2013	6	37	446	402	476	69	491	452	531
2012	7					13	500	477	513

TABLE 4. Long-term dataset of the Neuse River American Shad spawning stock characteristics and mean discharge, 2000–2020. The 2020 sample was suspended due to Covid-19 restrictions and is not comparable to other sampling years.

Year	Effort (h)	N	Males	Females	M:F Ratio	Peak Site CPUE	Mean CPUE	(SE)	Mean Male TL (mm)	Mean Female TL (mm)	Max TL (mm)	Mean Sample Temp (°C)	March Mean Discharge (cfs)
2000	20.9	197	122	75	1.6:1	72.0	11.7	(3.0)	446	501	551	17.8	1414
2001	15.1	283	168	115	1.4:1	192.0	26.5	(8.8)	443	502	570	18.5	1429
2002	22.0	286	217	69	3.1:1	118.0	15.0	(3.7)	429	502	557	19.7	422
2003	36.4	738	567	233	2.4:1	137.4	26.3	(4.4)	453	511	575	16.3	3366
2004	16.1	247	140	107	1.3:1	96.0	18.9	(3.8)	446	517	603	18.1	776
2005	23.2	519	342	177	1.9:1	58.0	21.5	(3.5)	417	499	582	17.8	2003
2006	12.0	192	121	71	1.7:1	84.0	16.3	(5.3)	430	473	532	18.4	312
2007	20.0	442	291	151	1.9:1	56.5	21.8	(3.5)	435	490	545	17.3	1534
2008	26.0	559	337	222	1.5:1	70.1	23.9	(3.4)	424	487	566	16.2	525
2009	19.0	387	240	147	1.6:1	191.1	31.7	(10.2)	431	486	564	17.0	2527
2010	15.1	463	346	117	2.0:1	135.5	30.7	(6.4)	434	488	536	15.8	1463
2011	17.2	538	394	143	2.8:1	97.8	29.4	(4.5)	438	494	547	16.7	359
2012	20.3	792	540	252	2.1:1	183.5	37.4	(6.3)	443	497	556	17.9	638
2013	20.2	1086	709	377	1.9:1	144.9	53.9	(5.8)	449	507	560	17.9	1138
2014	21.3	667	338	329	1.0:1	189.0	41.2	(8.4)	450	508	568	17.0	2340
2015	11.0	212	219	83	1.6:1	103.3	19.7	(3.8)	429	510	560	17.4	2368
2016	10.3	515	346	169	2:01	177.9	50.0	(7.4)	427	495	558	17.7	1626
2017	11.3	597	361	236	1.5:1	328.1	55.6	(11.0)	441	500	565	17.3	518
2018	15.4	479	276	203	1.4:1	94.3	30.6	(3.4)	436	492	541	16.3	1039
2019	15.9	469	303	166	1.8:1	105.4	28.7	(3.7)	418	478	531	18.8	3396
2020	1.6	135	92	43									995
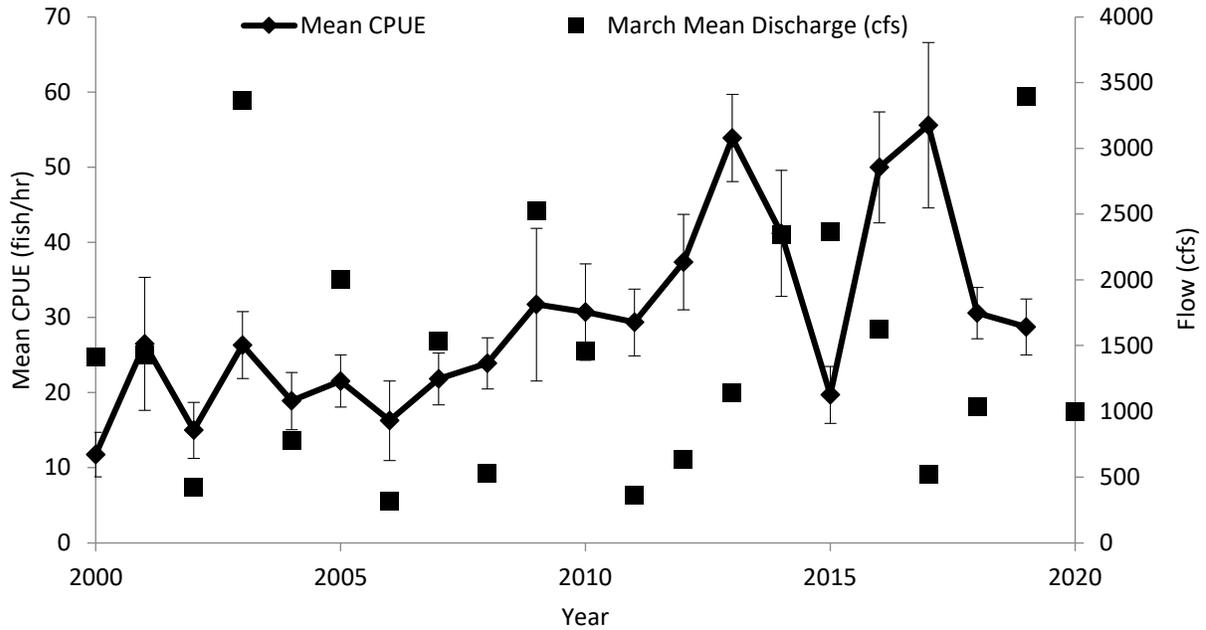
FIGURE 1. Mean CPUE of American Shad and mean March discharge in the Neuse River, 2000–2019. The 2020 sample was incomplete due to Covid-19 restrictions and is not comparable to other years.
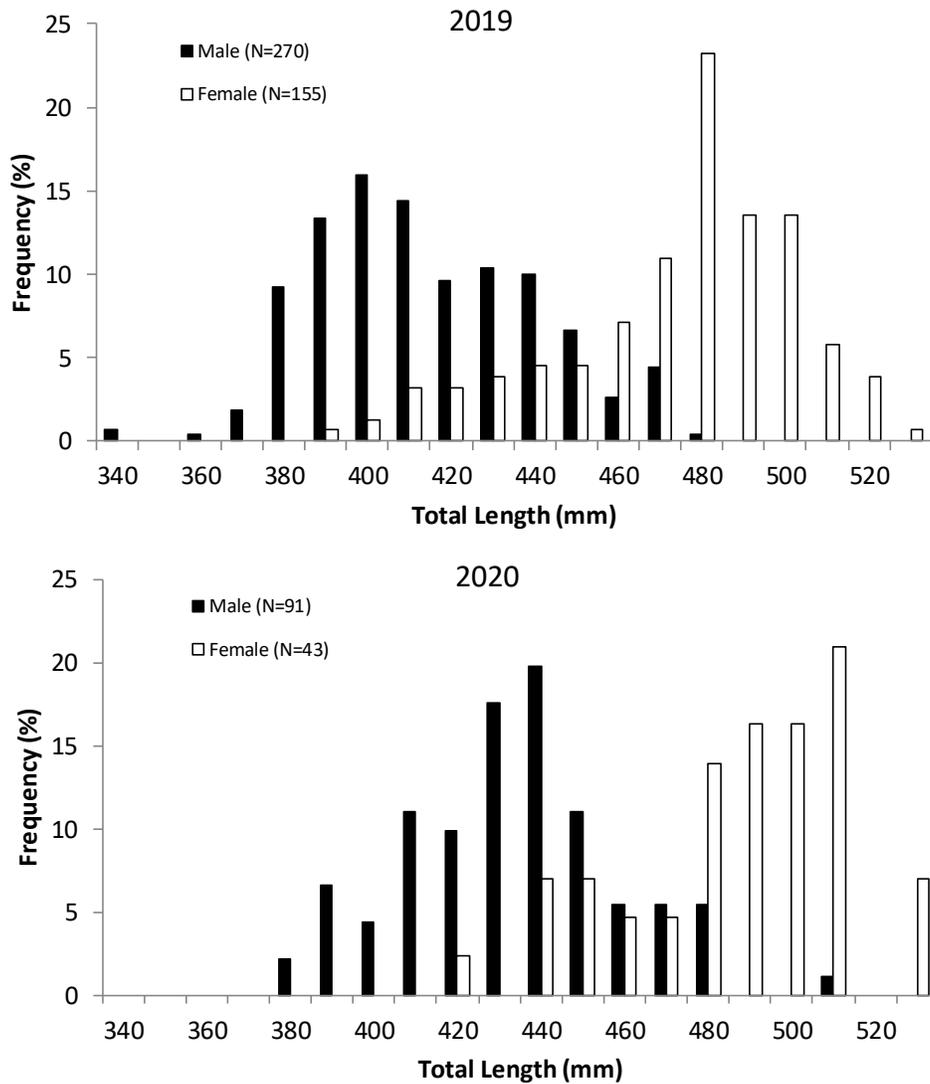
FIGURE 2. Length-frequency distributions for American Shad collected from the Neuse River, spring 2019 and 2020. Male and female plots sum separately to 100%. Total length was not recorded for all fish due to logistical limitations. The 2020 sample was incomplete due to the suspension of sampling due to restrictions associated with the Covid-19 pandemic.
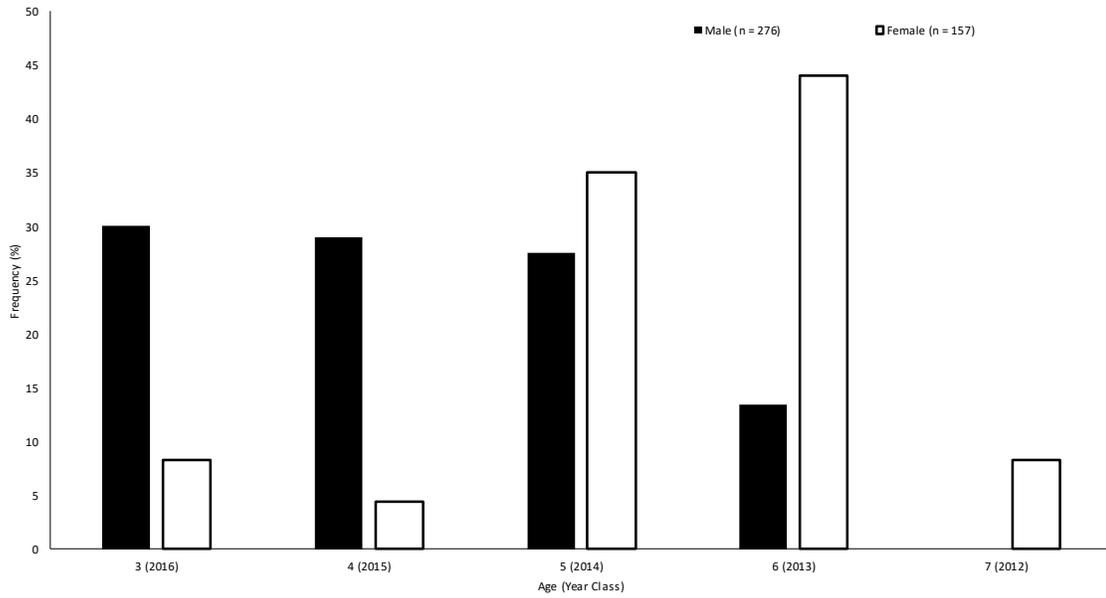
FIGURE 3. Age-frequency distributions for American Shad collected from the Neuse River, spring 2019. Male and female plots sum separately to 100%.