

FINAL REPORT
BIOMONITORING OF JUVENILE ALOSIDS BY HAUL
SEINE IN THE LOWER SUSQUEHANNA RIVER IN 2015

Task 1

December 2015

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Prepared for

PENNSYLVANIA FISH AND BOAT COMMISSION

Benner Spring Fish Production Services
1735 Shiloh Road
State College, Pennsylvania 16801-8495

Prepared by

NORMANDEAU ASSOCIATES, INC.

1921 River Road
Drumore, Pennsylvania 17518

Normandeau Associates' Project Number 23618

December 2015

1.0 INTRODUCTION

The Pennsylvania Fish and Boat Commission (PFBC) contracted Normandeau Associates, Inc. to monitor the occurrence and abundance of juvenile American shad and river herring in the Susquehanna River. This is a continuation of an ongoing effort to monitor abundance, species composition, growth, and out-migration of juvenile alosines in the lower Susquehanna River, and to provide specimens to the PFBC for otolith analysis, which serves to differentiate naturally produced from hatchery-reared American shad (*Alosa sapidissima*).

2.0 METHODS AND MATERIALS

Fifteen sampling events beginning in mid-September were planned for 2015. Sampling occurred twice a week for the first five weeks and then once a week for the remaining five weeks with sampling concluding in mid-November. Once initiated, we were able to complete all fifteen events without interruption from high river flow.

A haul seine measuring 400 feet by 6 feet, with 3/8-inch stretch mesh, was deployed to collect juvenile alosids. Sampling was conducted by anchoring one end of the seine to shore and maneuvering the unattached end by boat, out into the current then back to shore forming a semicircle. A crew of three biologists was utilized to deploy and retrieve the net throughout the study.

Each sampling event consisted of six seine hauls beginning after sunset. After each seine haul, the catch was identified, enumerated, and all species were returned alive to the river. Other information collected included water temperature (°C), and water clarity measured in inches with a secchi disk. River flow in cubic feet per second (cfs) was obtained from the USGS Marietta Gauge Station.

2.1 Sampling Locations

Samples were taken from the mainstem of the Susquehanna River in the vicinity of Columbia, (Lancaster County), Pennsylvania (Table 1 and Figure 1). Samples were principally collected from six sites (Stations 1 through 6) around the PFBC's Columbia Boat Launch.

Water depth at each sample location varied, depending upon river flow and the hydroelectric generation of the Safe Harbor Station. The bottom substrate consisted of exposed bedrock, boulders, gravel, sand and concrete at the boat ramp; aquatic vegetation was sparse. Riparian vegetation at most sites consisted primarily of water willow (*Justicia Americana*) and purple loosestrife (*Lythrum salicaria*).

2.2 Disposition of Samples

Per the monitoring design, when available, the first 30 American shad collected on a sampling date are measured to the nearest millimeter total length (TL) and retained for otolith analysis. Specimens are placed in labeled zip-lock freezer bags, covered with water, and frozen. Two waterproof labels containing the sample time, date of capture, sample site, and the number of American shad are affixed to each bag. One label is placed outside of the bag and the other is placed inside the bag. American shad are transported frozen to the PFBC's Benner Spring Fish Production Services Facility, State College, Pennsylvania for otolith analysis.

2.3 Data Analyses

A summary of the number and percent composition of the catch by sample date was tabulated. The American shad catch by seine haul, date, and the catch per unit effort (CPUE – number per seine haul) was tabulated. A comparison of the 2015 catch with that collected from this section of the river between 1989 and 2014 is also presented.

3.0 RESULTS

Haul seining in the lower Susquehanna River occurred between 14 September and 18 November 2015 (Table 2). A total of 2,211 fish of 15 species was collected during the 15 sampling events. Three species comprised 93.0% of the total catch. The comely shiner (*Notropis amoenus*), was the most abundant species comprising 33.4% of the catch followed by spotfin shiner (*Cyprinella spiloptera*) 29.9%, and spottail shiner (*Notropis hudsonius*) 29.7%. Other common species were gizzard shad (*Dorosoma cepedianum*) 3.2% and rock bass (*Ambloplites rupestris*) 1.1%. All other species were collected in low numbers (< 20 specimens) each comprising less than 1.0% of the catch.

No American shad were collected in 2015 (Table 3). The ambient river temperature ranged from 10.0°C (50.0°F) to 23.5°C (74.3°F). Ambient water temperature was lower in 2015 than previous years because sampling occurred from mid-September through mid-November instead of the typical mid-July through October sampling period. Water clarity as measured by secchi disk ranged from 28 to 90 inches.

4.0 DISCUSSION

The 2015 catch of juvenile American shad from the lower Susquehanna River was the same as in previous years (2002, 2008, and 2009) (Table 4). This continues a trend of deeply depressed numbers of juvenile shad observed since 2002. In the last ten years (2006 to 2015) the catch of juvenile shad has ranged from 0 and 7 fish annually, with a combined total of 18 American shad collected.

Physical parameters collected during sampling since 1998 were reviewed for trends in the low numbers of American shad (Table 5). River flow, which had averaged 6,000 to 7,000 cfs in 2001 and 2002, resulted in 377 juveniles collected in 2001 yet no shad were collected in 2002. The average river flow in 2015 during sampling days was 12,103 cfs and within the range recorded since 1998. Daily average river flow during the 66 days between the first and last sampling event in 2015 ranged from 5,020 to 25,500 cfs, except for 4 days in October and eight days in November. This allowed for consistent sampling over the 15 scheduled events. Reports of juvenile shad sightings at upriver locations (Juniata River sites) were not evident in haul seine results from the lower river site. Of the other parameters examined, water clarity and water temperature did not provide any useful trends to explain the lack of juvenile shad in the catch.

We reviewed the catch of adult American shad at the lower Susquehanna River hydroelectric facilities (chiefly Holtwood and Safe Harbor) over the 1998 through 2015 period. This showed a general trend of increased catches of adult American shad from 1998 through 2001, which for the most part resulted in a corresponding increase in the numbers juvenile shad collected (Table 5). Beginning in 2002 the catch of adult American shad at these facilities fluctuated based on the number of adult American shad passing the Conowingo East Fish Lift Facility, the lowermost facility on the Susquehanna River. The decline in the adult catch appears to mirror the decline in catches of juvenile shad as well. The shad passage numbers at Holtwood (n= 5,299) and Safe Harbor (n= 3,896) in 2015 were greater than those observed in 2014, but still below historical values. The continued trend in low numbers of adult shad passed to upstream spawning habitat areas needs to be reversed in order to increase juvenile shad production in the Susquehanna River.

However, the lack of juvenile American shad caught in 2015 may be unexplainable. The low and fairly stable river flow experienced throughout the early and late fall should have allowed the juvenile shad to grow and survive without being flushed out by a high water event. Further, the success of hatchery production and timing of stockings from the Van Dyke Hatchery should have affected the catch, but was not noted. During a juvenile American shad outmigration study at Peach Bottom Atomic Power Station (PBAPS), a total of 62 juvenile American shad were collected from 2 to 25 November. It's possible the juvenile American shad may have left the Columbia sampling area prior

to commencement of the project and settled out in the Conowingo Pond near PBAPS. Also, other unidentified environmental parameters could have influenced the juvenile American shad catch.

Table 1

Location of haul seine stations sampled in the Susquehanna River near Columbia, PA in 2015.

Station	GPS Coordinates	Description
1	40° 2.072'N, 76° 30.791'W	Susquehanna River - East shore upstream and across from "Tire" island.
2	40° 2.048'N, 76° 30.773'W	Susquehanna River - East shore about 50 m below Station #1.
3	40° 1.963'N, 76° 30.931'W	Susquehanna River - at "Tire" island, east shoreline.
4	40° 1.880'N, 76° 30.621'W	Susquehanna River - East shore of sandbar just below first old bridge pier.
5	40° 1.877'N, 76° 30.627'W	Susquehanna River - West shore of sandbar just below first old bridge pier.
6	40° 1.840'N, 76° 30.547'W	Susquehanna River - at PFBC Columbia, PA boat launch.

Table 2

Number and percent composition of the fish collected by haul seine from the lower Susquehanna River near Columbia, PA in 2015.

Date	14-Sep	15-Sep	22-Sep	23-Sep	28-Sep	29-Sep	6-Oct	7-Oct	12-Oct	13-Oct	20-Oct	27-Oct	3-Nov	9-Nov	18-Nov	Total	%
Daily Mean River Flow (cfs)	8,580	7,620	5,630	5,480	5,170	5,070	21,300	18,600	10,900	9,940	8,230	6,930	26,100	13,400	28,600		
Water Temperature (°C)	23.5	23.0	22.0	22.0	22.0	22.5	17.0	17.1	17.5	17.0	13.0	13.5	13.0	12.0	10.0		
Secchi Disk (in)	28	30	55	65	84	90	34	42	55	55	43	75	33	60	28		
American shad																0	0.0%
Alewife																0	0.0%
Gizzard shad	18	4					30	16		1			1			70	3.2%
Common carp	1															1	0.0%
Spotfin shiner	39	20	23	1	37	25	38	4	149	37	11	64	106	73	33	660	29.9%
Comely shiner	30	21	26	40	81	11	39	8	18	36	24	96	72	114	123	739	33.4%
Spottail shiner	9	9	10	2	21	16	53	4	34	36	106	48	155	128	26	657	29.7%
Bluntnose minnow			4			4							2	2	5	17	0.8%
Fallfish	1	1						1								3	0.1%
Channel catfish	3															3	0.1%
Banded killifish					1							4				5	0.2%
Rock bass	12	6	4				1					1			1	25	1.1%
Green sunfish	1															1	0.0%
Bluegill			3				1	1	1				6	2		14	0.6%
Smallmouth bass	1		1			2		1								5	0.2%
Tessellated darter	1		2		1		1					1	2		1	9	0.4%
Walleye	1													1		2	0.1%
Total	117	61	73	43	141	58	163	35	202	110	141	214	344	320	189	2,211	100.0%
No. of Species	12	6	8	3	5	5	7	7	4	4	3	6	7	6	6		

Table 3

Summary of juvenile American shad collected by haul seine from the lower Susquehanna River near Columbia, PA in 2015.

Station Number			1	2	3	4	5	6		
Date	No. Hauls	Time (h)	East Shore upstream & across from "Tire" island	East Shore about 50 m below Station 1	"Tire" Island, east shoreline	East shore of sandbar just below first old bridge pier	West shore of sandbar just below first old bridge pier	Columbia, PA Boat Ramp	No. American Shad	CPUE*
14-Sep	6	1906-2017							0	0.00
15-Sep	6	1905-1957							0	0.00
22-Sep	6	1850-1955							0	0.00
23-Sep	6	1858-1956							0	0.00
28-Sep	6	1857-1955							0	0.00
29-Sep	6	1820-1912							0	0.00
6-Oct	6	1815-1917							0	0.00
7-Oct	6	1822-1935							0	0.00
12-Oct	6	1811-1919							0	0.00
13-Oct	6	1810-1930							0	0.00
20-Oct	6	1825-1914							0	0.00
27-Oct	6	1745-1851							0	0.00
3-Nov	6	1650-1753							0	0.00
9-Nov	6	1645-1744							0	0.00
18-Nov	6	1652-1745							0	0.00
TOTAL	90		0	0	0	0	0	0	0	
MEAN										0.00

* Catch per seine haul.

Table 4

Weekly catch of juvenile American shad by haul seine from the lower Susquehanna River near Columbia, PA 1989 through 2015.

Month	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015**	Total	
1-7 Jul				0		2																						2	
8-15 Jul	1,048		0	120	0	27		2	44		0	7			0													1,248	
16-23 Jul			0	6		70	53	18	28	24	0	3	46	0	0	0	2	*	0	0	0		0	0	0	2		252	
24-31 Jul	45	31			0	60	24	15	22	144	1	0	42	0	0	*	0	*	2	0	0		1	0	0	3		390	
1-7 Aug		0	0	20	0	24	29	32	14	30	1	2	70	0	*	*	5	0	0	0	*		1	1	0	0		229	
8-15 Aug	61	0	0	2	8	13	35	56	20	0	0	6	37	0	*	0	1	0	0	0	0		1	0	1	0		241	
16-23 Aug	7	69	0	16	0	46	40	43	171	9	0	1	36	0	0	*	2	0	0	0	0	0	0	0	0	0		440	
24-31 Aug					13		42	39	120	10	10	0	36	0	8	16	2	0	0	0	0	0	0	0	0	0		296	
1-7 Sep	25		12		20		43	34	129	3	*	0	23	0	5	5	3	*	0	0	0	0	*	0	0	0		302	
8-15 Sep	97		16		41	75	65	4	135	3	264	0	31	0	4	4	0	0	0	0	0	0	*	0	0	0	0		739
16-23 Sep	28		30		27	14	46	12	59	4	17	0	15	0	0	*	1	0	0	0	0	0	0	0	0	1	0		254
24-30 Sep	0		73		11	5	15	15	32	0	20	1	34	0	*	*	2	0	0	0	0	0	*	0	0	1	0		209
1-7 Oct	0		69	2	22	5	19	10	91	3	1	0	6	0	*	0	0	0	0	0	0	*	*	0	0	0	0		228
8-15 Oct	0		7		0	2	31	3	0	0	3	11	1	0	0	0	2	0	0	0	0	1	*	0	0	0	0		61
16-23 Oct			5			10				14	0	0	0	*	*	0	3	1	0	0	0	0	*	0	0	0	0		38
24-31 Oct			0	0			0	0					0	0	*	0	*					2		*	0	0	0		2
1-7 Nov																	*				0		*				0		0
8-15 Nov																	0				0			0			0		0
16-23 Nov																					0						0		0
24-30 Nov																											0		0
TOTAL	1,161	250	212	166	142	353	442	283	879	230	322	31	377	0	17	25	23	1	2	0	0	3	3	1	1	7	0	4,931	

* No sampling due to high river flow.

** Haul seine efforts were started in September after award of the contract

Table 5

**Summary of information collected during haul seining from the lower Susquehanna River near Columbia, PA
1998 through 2015.**

Year	River Flow (cfs)			Water Temperature (°C)			Water Clarity (inches)			American
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Shad
1998	8,052	4,500	20,000	24.5	15.0	29.5	40.7	28	70	230
1999	10,562	2,600	29,100	23.1	12.5	30.0	30.9	21	48	322
2000	1,154	7,370	20,000	22.7	12.5	27.0	78.7	18	120	31
2001	6,324	4,790	10,900	24.1	15.0	32.0	32.9	12	55	377
2002	7,334	2,650	24,300	23.9	10.0	31.5	64.7	28	100	0
2003	22,006	15,450	28,700	23.6	16.5	27.0	23.4	8	38	17
2004	27,684	20,425	39,450	20.6	11.5	27.0	35.4	6	80	25
2005	9,742	3,150	25,400	24.4	11.5	32.0	45.7	30	78	23
2006	17,572	7,690	25,600	22.0	16.5	31.0	50.8	24	80	1
2007	6,847	4,130	11,500	23.3	16.0	29.5	66.9	25	98	2
2008	8,775	4,400	18,200	23.5	16.0	28.5	57.5	29	90	0
2009	15,816	8,560	24,550	21.7	14.0	28.5	36.8	17	72	0
2010	17,189	4,800	42,800	17.0	6.0	28.5	42.9	12	98	3
2011	16,134	7,540	36,800	23.9	16.5	32.0	31.5	11	42	3
2012	12,342	7,130	31,700	20.8	5.0	28.5	55.3	18	96	1
2013	14,031	7,550	31,220	22.4	12.0	28.0	48.0	8	100	1
2014	12,889	6,000	26,700	22.2	14.5	27.0	35.0	18	48	7
2015	12,103	5,070	28,600	17.7*	10.0*	23.5*	51.8	28	90	0

* Lower river temperatures in 2015 due to timing of sampling events