JOB IV. ABUNDANCE AND DISTRIBUTION OF JUVENILE AMERICAN SHAD IN THE SUSQUEHANNA RIVER, 2011

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INTRODUCTION

This report summarizes the results of bio-monitoring activities for juvenile alosines conducted in the Susquehanna River and its tributaries in 2011.

The Conowingo West Fish Lift continued to be used as a source of adult American shad and river herring to support monitoring activities and tank spawning. A total of 3,074 adult shad were collected at the Conowingo West Lift. The majority were released back into the Conowingo tailrace, with 936 retained for tank spawning.

Since the completion of fish passage facilities at Holtwood and Safe Harbor in 1997, the Conowingo East Lift has operated in fish passage mode. American shad had access to the Inflatable Dam at Sunbury on the Susquehanna main stem, and Warrior Ridge or Raystown Dams on the Juniata. Portions of large tributaries including Muddy Creek, West Conewago Creek, Conestoga River, Conodoguinet Creek, and Swatara Creek were also accessible to American shad.

During the 2011 spring migration, Conowingo East Lift passed 20,571 American shad while fishways at Holtwood, Safe Harbor, and York Haven passed 21, 8, and 0 American shad, respectively. Some 17 blueback herring and 2 alewife were passed at Conowingo Dam. No river herring were passed at Holtwood or York Haven Dams. The five alewife passed at Safe Harbor Dam were likely fish from landlocked populations in freshwater lakes such as Raystown Dam. Some 20 hickory shad were passed at Conowingo, but none passed any of the other dams.

Juvenile American shad in the Susquehanna River above Conowingo Dam are derived from two sources, natural reproduction of adults passed at the lower river hydroelectric projects, and hatchery produced, marked larvae from Pennsylvania Fish and Boat Commission's (PFBC) Van Dyke Hatchery in Pennsylvania. Juveniles occurring in the river below Conowingo and the upper Chesapeake Bay may result from natural spawning below or above dams and hatchery fry stockings either in Maryland or from upstream releases in Pennsylvania.

During the 2011 production season, the PFBC Van Dyke Research Station for Anadromous Fish produced 3.1 million shad larvae which were released in the Susquehanna Basin in Pennsylvania. Larval releases occurred from 1 June to 15 June during a period of steadily decreasing flows. Larvae were released in the following locations and numbers:

Juniata River	1,304,405
North Branch Susquehanna River (PA)	83,693
West Branch Susquehanna River	1,473,182
Bald Eagle Creek	191,590

The production goal of 10 million larvae was not met, primarily due to the loss of the Hudson River as an egg source.

METHODS

Sampling for juvenile American shad was conducted at locations in the Susquehanna River Basin during the summer and fall in an effort to document in-stream movement, out-migration, abundance, growth, and stock composition/mark analysis. Juvenile recoveries from all sources were provided to the PFBC for otolith analysis. Otoliths were analyzed for tetracycline marks to

determine hatchery versus wild composition of the samples.

After 2009, Lift net collections in the forebay at Holtwood were permanently discontinued due to construction of the new powerhouse and the associated reconfiguration of the forebay. An additional haul seine site at City Island in Harrisburg was added in 2010 to compensate for the loss of the lift netting. Geometric mean catch-per-unit effort (GM CPUE) was calculated as an index of juvenile abundance for haul seine collections. Ideally, CPUE would be calculated using data from individual lifts or seine hauls. Unfortunately, this data is not available prior to 1995 for lift netting and prior to 1997 for haul seining. As a result, geometric means could not be computed in the usual way for those years. Combined daily catch for each gear is available and was used as a surrogate to compute GM means. ASMFC stock assessment (ASMFC 2007) recommends use of area-under-the-curve (AUC) methods in cases where sampling is targeted at migrants moving through an area. Because the Holtwood dam lift net collected juvenile shad during the directed outmigration, AUC measures of juvenile abundance were calculated for lift net collections.

Haul Seining - Main Stem

Haul seining in the lower Susquehanna River was scheduled once each week beginning mid-July and continuing through October. Extremely high flows were experienced in the river due to storms and hurricanes and many sampling dates were cancelled. As a result, only fifteen sampling events were conducted in 2011. Sampling was concentrated near the Columbia Borough boat launch (8 events) and City Island in Harrisburg (7 events). Sampling consisted of 6 hauls per date beginning at sunset and continuing into the evening with a net measuring 400 ft x 6 ft with 3/8 in stretch mesh.

Peach Bottom Atomic Power Station (PBAPS) and Conowingo Dam

Intake screens were monitored for impinged alosines at Peach Bottom APS in 2011. Intake screen sampling was conducted from 2 November to 2 December, 2011. Eight sampling events

were conducted during the outmigration period. Nine sampling events were cancelled due to maintenance activities at the site. Conowingo Hydroelectric Station's cooling water intake strainer sampling was conducted twice weekly (Monday and Friday) from 3 October through 21 November 2011. Sampling occurred twice weekly during this period for a total of 15 sampling events.

Susquehanna River Mouth and Flats

Maryland DNR sampled the upper Chesapeake Bay using haul seines in the summer and fall.

Disposition of Samples

Sub-samples of up to 30 juveniles per day were used for otolith analysis. Samples of shad from most collections were returned to the PFBC's Benner Spring Fish Research Station for analysis of tetracycline marks on otoliths. Otoliths were surgically removed from the fish, cleaned and mounted on slides, ground to the focus on the sagittal plane on both sides, and viewed under ultraviolet light to detect fluorescent rings indicating tetracycline immersion treatments.

RESULTS

Haul Seining - Main Stem

Five juvenile American shad were captured by haul seine; three at the Columbia boat launch (Figure 1, Table 1) and two at City Island (Figure 2, Table 4). The Geometric Mean Catch-Per-Unit-Effort (GM CPUE, individual haul) for the Columbia site was 0.03 (Tables 2 and 5). Table 3 lists weekly catches of American shad by haul seine at Columbia from 1989 to 2011. Catches generally peaked in August and September, except in 1989 and 1992 when catches peaked in July, in 2010 when catches peaked in October and in 2005 -2011 when there was no peak. The Geometric Mean Catch-Per-Unit-Effort (GM CPUE, individual haul) for the City Island site was 0.03 (Tables 4 and 5). Table 6 lists weekly catches of American shad by haul seine at City Island in 2010 and 2011.

Lift Netting at Holtwood

Lift netting did not occur in 2011 due to construction activities in the Holtwood forebay. Geometric Mean CPUE (individual lift), GM CPUE (combined daily) and Area under the curve (AUC) for collections from 1985 to 2009 are listed in Table 7. Historical weekly catches peaked in October, except in 1985, 1997, 2000, and 2001 when catches peaked in November (Table 8).

Peach Bottom APS, and Conowingo Dam

Peach Bottom intake screens produced no juvenile American shad and 25 alewife between 2 November and 2 December (Tables 9 and 10).

Cooling water intake strainers at Conowingo produced one American shad collected on October 21 (Tables 11 and 12). One alewife and one unidentified *Alosa sp*. were collected in strainer samples in 2011.

Electrofishing

Electrofishing collections were made at numerous sites by Normandeau Associates as part of FERC re-licensing studies. One juvenile shad was collected by electrofishing gear in Conowingo Pond on 23 September and one in Lake Aldred on 28 September.

Susquehanna River Mouth and Flats

In 2011, 118 juvenile American shad were captured at seven permanent sites and 57 at seven auxiliary sites (Table 13).

Otolith Mark Analysis

Results of otolith analysis are presented in Table 14. (see Job III, Appendix 1 for a discussion of relative survival). All seven of the specimens evaluated for otolith marks were hatchery.

DISCUSSION

River conditions for the Susquehanna River Basin during 2011 could be characterized as

unusually high except for the period from early June through late August (Figure 3). High water events began in late August and resulted in higher than average flows through November.

Fish passage at Conowingo Dam was suspended on May 20 due to maintenance issues with the fish lift at Holtwood. SRAFRC partners agreed that passing fish into Conowingo Pool, with little chance of them passing Holtwood, was counter-productive. Fish passage efficiency at Holtwood (21) was less than one percent, the worst in the time-series. The fish lift at Safe Harbor passed 8 shad while the vertical slot ladder at York Haven did not pass any shad. Production of wild juvenile shad was, no doubt, negatively impacted by the low numbers of shad passed into spawning habitat above York Haven Dam.

Abundance – Main Stem

Comparison of relative abundance of juvenile alosines in the Susquehanna River from year to year is difficult due to the opportunistic nature of sampling and wide variation in river conditions, which may influence catches. In 2011, 5 juvenile shad were collected by haul seine. This is well below the numbers captured during 1990 to 2001 when an average of 330 juvenile shad was captured by haul seine.

GM CPUE for haul seine at Columbia for individual hauls and combined daily hauls was 0.04 and 0.06, respectively (Table 2). GM CPUE for haul seine at City Island for individual hauls and combined daily hauls was 0.03 and 0.04, respectively (Table 5). Juvenile shad abundance has been well below normal for seven consecutive years (Figure 4), a disturbing trend that will impact upstream fish passage counts until at least 2016. In 2002, problems at the Van Dyke Hatchery resulted in release of comparatively few healthy larvae. In 2003 and 2004, high river flows had a negative impact on survival of stocked hatchery larvae and on fish passage efficiency. Poor catch rates for juvenile shad in 2005 may have been due, in part, to fewer larvae stocked. In 2006, poor catch rates were attributed to fewer larvae stocked (compared to the decade of the 1990's) and the late June flood which, undoubtedly, impacted survival. In 2007,

flows were low and decreased steadily during the entire season. Poor catch rates in 2007 were attributed to decreased egg deliveries, poor survival in the hatchery (see Job III), and poor fish passage. The poor catch rates in 2008 to 2011 are troubling. The number of larvae stocked during those years averaged 3.2 million. This represents 41% of the average number of larvae stocked during 1993 to 2001. In comparison, CPUE for 2008 to 2011 was less than 1% of the CPUE for 1993 to 2001. It is clear that survival of hatchery-reared American shad larvae in the Susquehanna River Basin has plummeted in recent years. The cause of this phenomenon is unknown. We do know that YOY smallmouth bass have suffered outbreaks of *Columnaris* bacterial infections which have caused high mortalities and resulted in poor year classes for 2005 to 2011. The suspected cause of this is low dissolved oxygen in shallow water habitats where smallmouth bass YOY are found. American shad larvae and juveniles are generally not found in these shallow water habitats, preferring deeper water. No *Columnaris* symptoms have been noted on juvenile American shad and it is unknown if smallmouth bass and shad survival are in any way related.

Stock Composition and Mark Analysis

For all sites combined, hatchery contribution was 100% (7 of 7 successfully processed shad). Juvenile shad were captured from releases at a number of sites including the Juniata R. (day 3 mark, 2 specimens), the Juniata R. (Susquehanna source eggs; day 3,6,9 mark, 3 specimens), the North Branch Susquehanna River (1 specimen), and Bald Eagle Creek (1 specimen). The only stocking site not represented in the recaptures was the North Branch Susquehanna River.

SUMMARY

- Juvenile American shad were collected by haul seine at City Island and Columbia, in strainers at Conowingo Dam and by electrofishing in Lake Aldred and Conowingo pond.
- Haul seine GM CPUE at Columbia (combined daily lifts) of 0.06 was among the lowest recorded for that gear type since 1990 and continues a disturbing trend since 2002.
- Lift-net collections in the Holtwood Dam forebay were permanently discontinued due to

construction associated with Holtwood re-development.

- Otoliths from all sites combined were 100% hatchery origin.
- Production of hatchery larvae from the Van Dyke Hatchery was 3.1 million. Adult shad passage was the worst recorded due to high flows and maintenance issues at Holtwood.
- **Based on haul seine CPUE at Columbia, survival of hatchery-reared American shad larvae was 106 times lower during 2008 to 2011 than during 1993 to 2001 indicating that survival of hatchery-reared larvae has plummeted in recent years. The cause of this is not known.**

ACKNOWLEDGMENTS

Normandeau Associates (Drumore, PA) was contracted by the PFBC to perform juvenile collections. Many individuals supplied information for this report. John Cingolani and Brant Hoover processed shad otoliths.

LITERATURE CITED

ASMFC 2007. American Shad Stock Assessment Report for Peer Review. Volume I. Stock Assessment Report No. 07-01 (Supplement) of the Atlantic States Marine Fisheries Commission. Atlantic States Marine Fisheries Commission, Bethesda, MD.

FIGURES AND TABLES

Figure 1. Location of the haul seine stations sampled in the lower Susquehanna River near Columbia, Pennsylvania in 2011

Figure 2. Location of the haul seine stations sampled in the middle Susquehanna River around City Island near Harrisburg, Pennsylvania in 2011.

Figure 3. Discharge (cfs) in the Susquehanna River at Marietta, April 1, 2011 to November 30, 2011.

Figure 4. Annual YOY American shad CPUE for haul seine collections in the Susquehanna River.

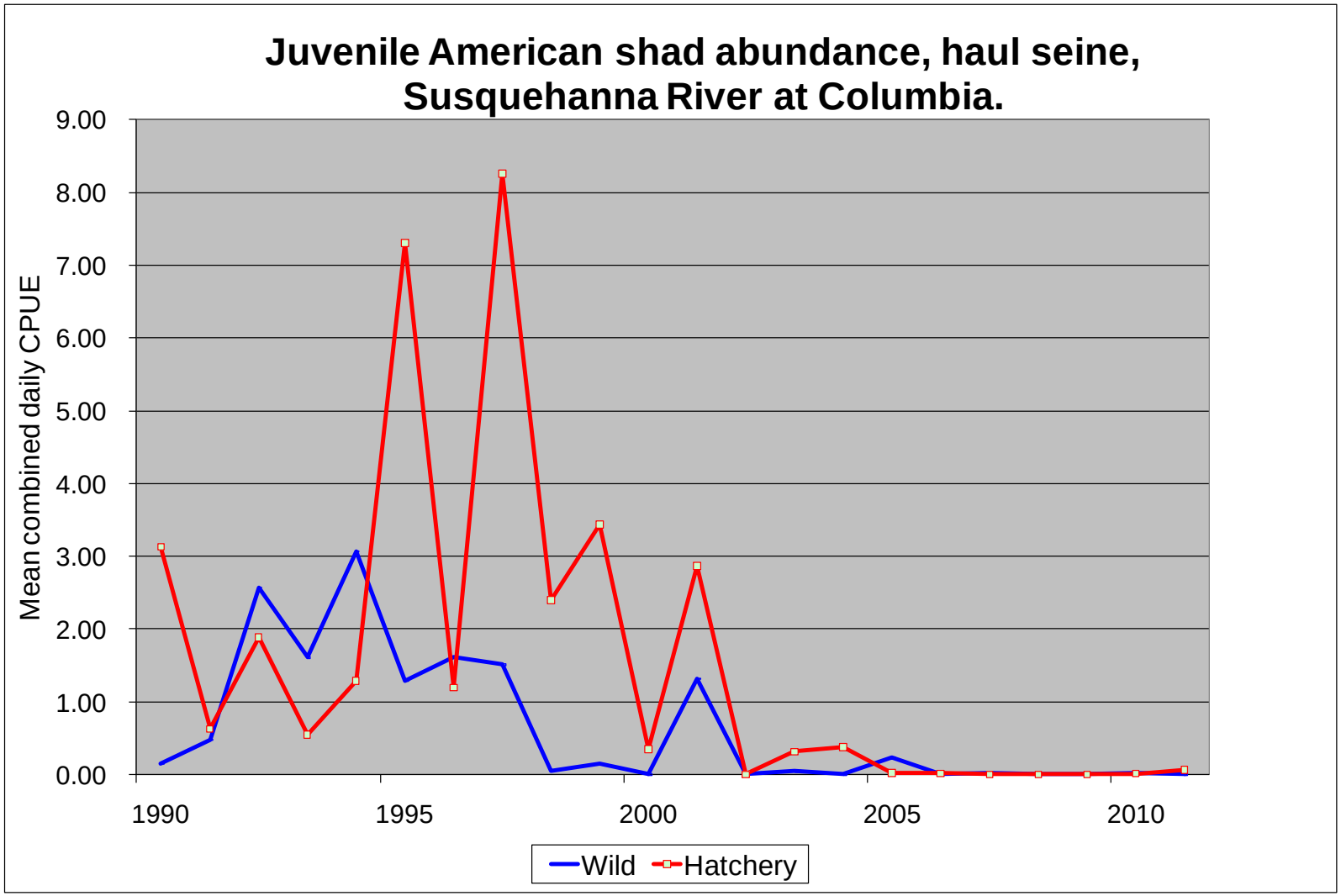

Table 1. Number and percent composition of the fish collected by haul seine from the lower Susquehanna River near Columbia, Pennsylvania in 2011.

Date	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug	29-Aug	23-Sep	Total	%
Daily Mean River Flow (cfs)	8,330	11,000	7,540	14,500	13,800	10,000	27,100	36,800		
Water Temperature (°C)	32.0	25.5	24.5	24.5	25.0	23.5	19.8	16.5		
Secchi Disk (in)	39	40	42	32	33	33	11	22		
American shad	-	1	1	1	-	-	-	-	3	0.3%
Gizzard shad	-	2	33	46	14	97	49	15	256	26.8%
Common carp	-	-	2	-	2	-	-	-	4	0.4%
Comely shiner	15	9	54	11	13	6	17	7	132	13.8%
Common shiner	-	-	2	-	-	-	-	-	2	0.2%
Spottail shiner	-	1	-	-	-	2	16	18	37	3.9%
Spotfin shiner	38	100	116	15	27	18	32	40	386	40.3%
Mimic shiner	-	-	-	1	1	-	-	-	2	0.2%
Bluntnose minnow	-	3	-	1	1	-	1	1	7	0.7%
Fallfish	1	3	7	4	-	1	2	-	18	1.9%
Quillback	2	2	-	-	-	-	-	1	5	0.5%
White sucker	1	-	-	-	-	-	-	-	1	0.1%
Northern hog sucker	2	-	-	-	-	-	-	-	2	0.2%
Shorthead redhorse	-	-	-	-	-	-	1	1	2	0.2%
Channel catfish	33	3	-	6	2	2	23	2	71	7.4%
Banded killifish	-	2	-	1	1	1	-	-	5	0.5%
Rock bass	-	-	-	-	1	-	2	5	8	0.8%
Bluegill	-	-	-	-	-	-	2	3	5	0.5%
Smallmouth bass	1	2	-	1	-	-	-	-	4	0.4%
Largemouth bass	2	-	-	-	-	-	-	-	2	0.2%
Tessellated darter	-	-	-	2	1	1	-	-	4	0.4%
Walleye	-	-	-	-	-	-	-	1	1	0.1%
Total	**95**	**128**	**215**	**89**	**63**	**128**	**145**	**94**	**957**	**100.0%**
No. of Species	**9**	**11**	**7**	**11**	**10**	**8**	**10**	**11**	**22**	

Table 2. Index of abundance for juvenile American shad collected by haul seine at Marietta, Columbia and Wrightsville, Susquehanna River, 1990-2011.

2011	50	3	0.06	0.06	0.04	0	0	0	3	0	0

Table 3. Weekly catch of juvenile American shad by haul seine from the lower Susquehanna River near Columbia, 1989 through 2011.

Month	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	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	250
24-31 Jul	45	31	-	-	0	60	24	15	22	144	1	0	42	0	0	*	0	*	2	0	0		1	387
1-7 Aug	-	0	0	20	0	24	29	32	14	30	1	2	70	0	*	*	5	0	0	0	*		1	228
8-15 Aug	61	0	0	2	8	13	35	56	20	0	0	6	37	0	*	0	1	0	0	0	0		1	240
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	440
24-31 Aug	-	-	-	-	13	-	42	39	120	10	10	0	36	0	8	16	2	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	*	302
8-15 Sep	-	97	16	-	41	75	65	4	135	3	264	0	31	0	4	4	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	253
24-30 Sep	-	0	73	-	11	5	15	15	32	0	20	1	34	0	*	*	2	0	0	0	0	0	*	208
1-7 Oct	-	0	69	2	22	5	19	10	91	3	1	0	6	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	*	61
16-23 Oct	-	-	5	-	-	10	-	-	14	0	5	0	0	*	*	0	3	1	0	0	0	0	*	38
24-31 Oct	-	-	0	0	-	-	0	0	-	-	-	-	0	0	*	0	*	-	-	-		2		2
1-7 Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-		0		0
8-15 Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-		0		0
16-23 Nov																						0		0
24-30 Nov																								0
1-7 Dec																								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**	**4,922**

* No sampling due to high river flow.

Table 4. Number and percent composition of the fish collected by haul seine from the middle Susquehanna River at City Island, Harrisburg, Pennsylvania in 2011.

Date	11-Jul	19-Jul	26-Jul	2-Aug	8-Aug	16-Aug	24-Aug	Total	%
Daily Mean River Flow (cfs)	11,200	7,300	7,300	6,460	17,200	12,500	8,640		
Water Temperature (°C)	28.0	30.5	31.5	29.0	27.0	23.5	23.0		
Secchi Disk (in)	42	48	40	53	45	38	61		
American shad	-	-	-	1	1	-	-	2	0.3%
Central stoneroller	-	-	5	-	-	-	-	5	0.7%
Comely shiner	-	1	3	3	-	1	7	15	2.1%
Spottail shiner	5	-	2	4	-	2	32	45	6.3%
Spotfin shiner	10	84	39	25	31	42	4	235	32.9%
Mimic shiner	-	-	2	7	3	1	-	13	1.8%
Bluntnose minnow	2	2	7	2	1	-	2	16	2.2%
Fallfish	48	11	4	6	3	8	-	80	11.2%
Quillback	24	2	-	-	10	1	-	37	5.2%
White sucker	5	23	-	-	-	-	-	28	3.9%
Northern hog sucker	1	1	-	-	-	3	-	5	0.7%
Shorthead redhorse	-	-	-	-	-	1	1	2	0.3%
Channel catfish	1	1	2	5	-	2	-	11	1.5%
Banded killifish	1	12	23	72	10	41	41	200	28.0%
Rock bass	4	-	-	-	-	1	1	6	0.8%
Redbreast sunfish	1	-	-	-	-	-	-	1	0.1%
Pumpkinseed	1	-	-	-	-	-	-	1	0.1%
Bluegill	-	-	-	-	-	1	1	2	0.3%
Smallmouth bass	-	1	2	2	1	1	1	8	1.1%
White crappie	-	-	-	-	-	-	1	1	0.1%
Walleye	1	-	-	-	-	-	-	1	0.1%
Total	**104**	**138**	**89**	**127**	**60**	**105**	**91**	**714**	**100.0%**
No. of Species	**13**	**10**	**10**	**10**	**8**	**13**	**10**	**21**	

Table 5. Index of abundance for juvenile American shad collected by haul seine from the middle Susquehanna River at City Island, Harrisburg, Pennsylvania in 2011.

Year	No. Hauls	No. Fish	Mean Combined Daily CPUE	GM Combined Daily CPUE	GM Individual Haul CPUE*	No. Wild Fish	Mean Combined Daily CPUE (Wild)	GM Combined Daily CPUE (Wild)	No. Hatchery Fish	Mean Combined Daily CPUE (Hatchery)	GM Combined Daily CPUE (Hatchery)
2010	89	2	0.02	0.02	0.02	0	0.00	0.00	2	0.02	0.02
2011	42	2	0.05	0.04	0.033558	0	0	0	2	0.05	0.05

Table 6. Weekly catch of juvenile American shad by haul seine from the middle Susquehanna River at City Island, Harrisburg, Pennsylvania, 2010-2011.

* No sampling due to high river flow.

Table 7. Index of abundance for juvenile American shad collected by lift net in the forebay of Holtwood Hydroelectric Station, 1985-2009.

***Most of the Holtwood samples processed were from cast net collections.							

Table 8. Historical weekly catch per unit effort (CPUE) of juvenile American shad collected by an 8 x 8 ft lift net at Holtwood Power Station inner forebay*.

	Historical Years															
Week	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1997**	**1998**	**1999**	**2000**	**2001**
1-7 Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-15 Aug	-	-	-	-	-	-	0.00	-	-	-	0.00	-	-	-	-	-
16-23 Aug	-	-	-	-	-	0.00	0.00	0.00	-	-	0.00	-	-	-	-	-
24-31 Aug	-	-	-	-	-	0.00	0.00	0.00	-	-	0.00	-	-	-	-	-
1-7 Sep	-	-	-	0.00	-	0.00	0.00	0.00	0.00	-	0.00	-	-	-	-	-
8-15 Sep	-	-	1.25	-	-	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00
16-23 Sep	-	-	0.69	-	2.30	0.00	0.00	0.05	0.00	0.00	-	0.00	0.00	6.67	0.00	0.00
24-30 Sep	-	-	0.28	-	-	7.55	0.00	0.00	0.30	0.10	0.00	0.00	0.00	0.30	0.00	0.00
1-7 Oct	-	-	0.89	0.00	1.20	3.87	0.10	0.90	0.20	4.30	0.10	0.00	0.05	4.67	0.00	0.50
8-15 Oct	-	16.67	4.08	0.09	1.20	6.93	0.10	0.03	0.20	3.55	0.00	0.00	0.80	3.65	0.00	0.07
16-23 Oct	0.12	30.29	4.50	0.00	3.22	65.13	0.55	0.45	0.10	0.75	5.05	0.00	2.07	1.87	0.20	0.13
24-31 Oct	1.00	5.40	1.25	9.97	0.50	43.63	0.90	0.50	17.50	0.23	68.90	0.20	2.45	0.50	1.17	0.90
1-7 Nov	41.60	5.29	4.78	19.07	0.00	5.33	1.10	0.00	14.80	0.70	56.05	0.00	1.07	0.00	1.45	1.90
8-15 Nov	28.63	4.09	4.47	2.00	0.00	0.50	2.40	0.00	19.00	0.10	9.30	25.10	0.10	0.00	2.80	7.30
16-23 Nov	10.79	19.52	0.25	0.25	0.00	0.20	0.50	0.00	1.60	0.03	0.00	27.10	0.10	0.00	7.23	6.67
24-30 Nov	36.37	6.31	0.67	0.35	-	0.00	1.18	-	0.10	0.00	0.00	1.46	0.05	0.00	1.85	2.75
1-7 Dec	62.80	14.20	0.00	0.00	-	-	-	-	-	0.00	-	0.00	0.00	0.00	0.00	23.37
8-15 Dec	4.30	0.11	-	-	-	-	1.20	-	-	-	-	-	0.60	0.00	0.00	-
16-23 Dec	0.51	0.00	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-
24-31 Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total shad	3,626	2,926	832	929	556	3,988	208	39	1,095	206	2,100	1,372	180	490	406	1,245
Total lifts	378	404	428	230	286	290	370	240	240	250	230	300	300	300	300	300
CPUE	9.59	7.24	1.94	4.04	1.94	13.75	0.56	0.16	4.56	0.82	9.13	4.57	0.60	1.63	1.35	4.15

* The lift net program was not conducted in 1996 due to flood damage to the platform.

Table 8. Continued.

	Historical Years							Year
Week	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
1-7 Aug	-	-	-	-	-	-	-	-
8-15 Aug	-	-	-	-	-	-	-	**-**
16-23 Aug	-	-	-	-	-	-	-	**-**
24-31 Aug	-	-	-	-	-	-	-	**-**
1-7 Sep	-	-	-	-	-	-	-	**-**
8-15 Sep	-	-	0.00	0.00	0.00	0.00	0.00	**0.00**
16-23 Sep	-	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
24-30 Sep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
1-7 Oct	0.00	1.30	0.00	0.00	0.00	0.00	0.00	**0.00**
8-15 Oct	0.03	0.50	0.00	0.00	0.00	0.00	0.00	**0.00**
16-23 Oct	3.30	0.27	0.00	0.00	0.00	0.00	0.00	**0.00**
24-31 Oct	0.03	0.00	0.00	6.67	0.20	0.00	0.00	**0.00**
1-7 Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
8-15 Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.10	**0.00**
16-23 Nov	0.00	0.00	0.00	0.00	-	0.00	0.00	**0.00**
24-30 Nov	0.00	0.00	0.00	0.00	-	0.00	0.00	**0.00**
1-7 Dec	0.00	0.00	0.00	-	-	0.00	0.00	**0.00**
8-15 Dec	0.00	0.00	-	-	-	-	-	**0.00**
16-23 Dec	-	-	-	-	-	-	-	**-**
24-31 Dec	-	-	-	-	-	-	-	-
Total shad	68	61	0	200	8	0	1	**0**
Total lifts	260	300	240	270	230	300	300	**300**
CPUE	0.26	0.20	0.00	0.74	0.03	0.00	0.003	**0.000**

Table 9. Number of fish collected during intake screen sampling by unit at Peach Bottom Atomic Power Station in fall, 2 November to 2 December, 2011.

Species	Unit 2	Unit 3	Total
Alewife	9	16	**25**
American shad	0	0	**0**
Gizzard shad	1,117	1,994	**3,111**
Gold fish	0	1	**1**
Comely shiner	15	22	**37**
Spottail shiner	1	0	**1**
Spotfin shiner	8	5	**13**
Fathead minnow	0	1	**1**
Golden shiner	2	1	**3**
Shorthead redhorse	0	3	**3**
Channel catfish	28	41	**69**
Flathead catfish	8	5	**13**
Tiger muskie	0	1	**1**
Rock bass	1	5	**6**
Green sunfish	1	2	**3**
Pumpkinseed	0	1	**1**
Bluegill	1,394	1,017	**2,411**
Redbreast sunfish	2	4	**6**
Largemouth bass	2	10	**12**
White crappie	2	12	**14**
Black crappie	0	2	**2**
Tessellated darter	1	0	**1**
Yellow perch	0	3	**3**
Logperch	0	1	**1**
TOTAL	***2,591***	***3,147***	***5,738***

Table 10. Number of juvenile American shad collected during intake screen sampling by unit at Peach Bottom Atomic Power Station in fall, 2011.

Date	Unit 2	Unit 3	Total
2 November - 2 December	0	0	**0**
TOTAL	***0***	***0***	***0***

Table 11. Species and number of fish collected during cooling water intake sampling at Conowingo Dam in fall, 2011.

Species	Francis Units (7)	Kaplan Units (4)	Total
American shad	1	0	**1**
Alewife	1	0	**1**
Alosa sp. (Decapitated)	1	0	**1**
Gizzard shad	182	290	**472**
Carp	1	0	**1**
Comely shiner	16	4	**20**
Channel catfish	12	0	**12**
Spotfin shiner	11	0	**11**
Shorthead redhorse	1	0	**1**
Bluegill	14	7	**21**
TOTAL	***240***	***301***	***541***

Table 12. Number of juvenile American shad collected during cooling water intake strainer sampling at Conowingo Dam in fall, 2011.

Date	Francis Units (7)	Kaplan Units (4)	Total
21 Oct	1	0	**1**
TOTAL	***1***	***0***	***1***

Table 13. Catch of juvenile American shad by location from the upper Chesapeake Bay during the 2011 Maryland DNR juvenile finfish haul seine survey.

SITE	AMSHAD Round 1	AM SHAD Round 2	AM SHAD Round 3
UPPER BAY PERM			
HOWELL PT.	0	23	16
TIMS CR	0	2	2
SASSAFRAS NRMA	0	7	2
PARLOR PT.	1	1	1
ELK NECK PARK	21	9	0
WELCH PT.	1	0	2
HYLAND PT.	29	0	1
TOTALS	52	42	24

Table 13. (continued)

HOB (AUX)

CARPENTER PT	0	1	0
POPLAR PT	Not sampled	Not sampled	Not sampled26
PLUM PT	26	20	6
SPOIL ISLAND	0	1	0
TYDINGS ESTATE	1	0	0
TOLCHESTER	0	0	2
TOTALS	27	22	8

Table 14. Analysis of juvenile American shad otoliths collected in the Susquehanna River, 2011.

Collection Site	Coll. Date	Day 3 Jun/ Susq.	Days 3,6,9 Jun/ Susq.	Days 3,6,9,15 N. Br. Susq. (PA)	Days 3,18 W. Br. Susq.	Days 3,6,9,12,15 Bald Eagle Cr.	Days various + sngl feed Raceway	Total Hatchery	Total Wild	Total Processed	Total Collected
City Island	8/2/2011	0	1	0	0	0	0	1	0	1	1
	8/8/2011	0	1	0	0	0	0	1	0	1	1
Columbia	7/28/2011	0	1	0	0	0	0	1	0	1	1
	8/4/2011	1	0	0	0	0	0	1	0	1	1
	8/11/2011	1	0	0	0	0	0	1	0	1	1
Lake Aldred	9/28/2011							0	0	0	1
Conowingo Pond	9/23/2011	0	0	0	1	0	0	1	0	1	1
Conowingo Strainers	10/21/2011	0	0	0	0	1	0	1	0	1	1
Grand Total		2.3	3.4	0.0	1.1	1.1	0.0	8.0	0.0	7.0	8.0
Percent		28.6%	42.9%	0.0%	14.3%	14.3%	0.0%	100%	0.0%		

**When the entire sample collected was not processed, the shad successfully processed were weighted to ensure that row totals equalled the total number collected.