SUMMARY OF OPERATIONS AT THE CONOWINGO DAM EAST FISH PASSAGE FACILITY SPRING 2014

December 2014

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EXECUTIVE SUMMARY

Operation of the Conowingo East Fish Lift (EFL) began April 4, 2014 although the water temperature was well below the season start trigger value of 50°F (45.4°F actual average EFL trough water temperature on April 4) and river flow was 120,000 cfs. The first three American shad were passed on April 24 at a water temperature of 55.2°F. The EFL operated for 54 days in 2014 despite dealing with river flows in excess of 100,000 cfs on 18 days and a mechanical problem with the hopper hoist motor that prevented operation on 4 days (12 to 15 April). Continuous operation of the EFL occurred from April 21 through May 17 and again from May 20 through end of season. EFL operations were terminated on June 7 in concurrence with the resource agencies. The 2014 fish passage season marks the twenty-fourth season of overall operation and the eighteenth year of volitional passage operation at the Conowingo EFL.

The EFL passed 1,192,750 fish of 34 species and one hybrid. Gizzard shad (1,170,200), American shad (10,425), channel catfish (9,235), and shorthead redhorse (1,136) dominated the catch, and comprised nearly 100% of the total fish collected and passed. Gizzard shad alone accounted for 98% of the total fish collected and passed.

A total of 10,425 American shad was passed. The highest daily passage of American shad occurred on May 13 when 3,043 shad were passed upstream. On only 3 of the 54 days of operation, American shad passage exceeded 1,000 fish. On a daily basis, overall shad passage was strongest through the fishway between 1500 hours and 1759 hours during which nearly 45% of all shad passage occurred.

Fishway operations were conducted at water temperatures ranging from 45.4°F to 76.2°F and river flows between 25,100 and 138,000 cfs. River flows in excess of 100,000 cfs (flow range: 100,000 to 193,000 cfs) occurred on 18 days between April 4 and May 24.

In 2014, the EFL did not operate on six days due to spill/high river flows. However, fishway operations were conducted on 17 days with 1 to 5 spill gates open; only 7 American shad were passed when fish passage operations coincided with spillage. Based on information gained in 2014 and in previous years, the standard operating procedure when spill conditions are in effect should be to cease operations when river flow is $\geq$ 100,000 cfs as very few American shad are attracted and passed during these severe conditions.

Prior to the start of EFL operations in 2014, routine preseason maintenance activities were conducted, and included testing of the fish collection equipment (crowder, crowder screen hoist, hopper hoist motor, and hopper door along with inspection of associated air hoses, pneumatic cylinders, etc.). Although these maintenance activities were performed, a mechanical failure of the hopper hoist motor occurred and prevented fish passage activities of the EFL from April 12 through April 15. Upon notification of the problem, Exelon personnel quickly responded, resulting in the resolution of the problem and reinstallation of the repaired hopper hoist motor prior to any observed presence of American shad in the Conowingo tailrace.

On 40 of the 54 days of operation, water clarity was adequate ($\geq$ 15 inches of visibility at viewing window), allowing the viewing technicians to identify American shad with attached Maryland DNR floy tags. The number of floy tags observed at the Conowingo EFL in 2014 was 24, (20 yellow = 2014 effort; 4 pink = 2013 effort).

Future operations of the EFL will build on the past eighteen years of operation experience.

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1.0 INTRODUCTION

Exelon Generation Company, LLC, formerly the Susquehanna Electric Company (SECO), has operated a fish passage facility (West lift) at its Conowingo Hydroelectric Station since 1972. Lift operations are part of a cooperative private, state, and federal effort to restore American shad (*Alosa sapidissima*) and other migratory fishes to the Susquehanna River. In accordance with the restoration plan, the operational goal had been to monitor fish populations below Conowingo Dam and transport pre-spawned migratory fishes upriver.

In 1988, the former PECO Energy Company negotiated an agreement with state and federal resource agencies and private organizations to enhance restoration of American shad and other anadromous species to the Susquehanna River. A major element of this agreement was for PECO Energy Company to construct an East Fish Lift Passage Facility (EFL) at Conowingo Dam. Construction of the EFL commenced in April 1990 and it was operational by spring 1991.

With the completion of fishways at Holtwood, Safe Harbor, and York Haven dams, the EFL has been operated to pass fish directly into Conowingo Pond since spring 1997.

Objectives of 2014 operation were: (1) monitor passage of migratory and resident fishes through the fishway; and (2) assess fishway and trough effectiveness and make modifications as feasible.

2.0 CONOWINGO OPERATION

2.1 Project Operation

The Conowingo Hydroelectric Station, built in 1928, is located at river mile 10 on the Susquehanna River (RMC 1992). The powerhouse has a peaking generating capacity of 549.5 MW and a hydraulic capacity of approximately 85,000 cfs. Flows in excess of station draft are spilled through two regulating and 50 crest gates. The powerhouse contains seven vertical Francis (numbered 1 through 7) and four Kaplan (numbered 8 through 11) turbines. The seven Francis units have been equipped with aeration systems that permit a unit to draw air into the unit (vented mode) or operate conventionally (unvented mode). The four original Kaplan turbines installed in 1964 were replaced over a period of four years (1992 to 1996), with more efficient mixed-flow Kaplan type turbines.

Minimum flow releases from the station during the spring spawning and fishway operating season follow the schedule outlined in the settlement agreement. Minimum flows of 10,000 cubic feet per second (cfs) or natural river flow, whichever is less, as measured at the United States Geological Survey (USGS) gauge at Marietta, PA were maintained for the period 1 to 30 April. A minimum flow of 7,500 cfs or natural river flow (as previously noted) was maintained for the period 1 to 31 May. A minimum flow of 5,000 cfs or natural river flow (as previously noted) is maintained when fish lift operations occur in June.

2.2 Fishway Operation

The start of operation for the EFL in 2014 began on April 4, 2014. The first American shad (3) were passed on April 24 (Table 1). The EFL operated for 54 days in 2014 despite dealing with river flows in excess of 100,000 cfs on 18 days and a mechanical problem with the hopper hoist motor that prevented operation on 4 days (12 to 15 April). Continuous operation of the EFL occurred from April 21 through May 17 and again from May 20 through end of season. On June 7, operations were terminated with concurrence from the Resource Agencies.

Daily operation times were planned during optimal fish passage parameters. This year, operational methodologies were influenced by natural river flow, water temperature, generation and spill conditions, and daily/hourly fish passage numbers. EFL operation was conducted by a staff of three people: a lift operator, a supervising biologist, and a biological technician.

The mechanical aspects of EFL operation in 2014 were similar to those described in RMC (1992) and Normandeau Associates, Inc. (1999). Fishing time and/or lift frequency was determined by fish abundance, but the hopper was generally cycled twice per hour throughout the day. The method of lift operation was also influenced by fish abundance. When a large number of fish were in the fishing channel, the crowder was not operated; instead the crowder screen was raised and then lowered trapping fish over the hopper. This mode of operation, called "fast fish", involved leaving the crowder in the normal fishing position and raising the hopper frequently to remove fish that accumulated in the holding channel.

The specific entrance(s) used to attract fishes was dictated by the station discharge and which turbine units were operating. For example, when Kaplan turbine units 8, 9, 10, and 11 or any combination of Kaplan turbines were operating, entrance C was the primary entrance used to attract fishes. Under these conditions the attraction flow through the other entrances is negated or disrupted. Depending on river flow and/or generation, either entrance A or C was utilized most often throughout the 2014 season to attract fishes.

2.3 Fish Counts

Fish that were lifted and sluiced into the trough were guided by a series of fixed screens. The fixed screens directed the fish to swim up and through a 3 ft wide channel and past a 4 ft by 10 ft counting window located on the west wall of the trough. Fish passing the counting window were identified to species and enumerated by a biologist and/or technician. Passage of fish by the window and out of the trough system was controlled by a set of gates located downstream of the counting window. During periods of peak passage, two people were used to identify and count fish.

At the end of each hour, fish passage data were recorded on data sheets and entered into a Microsoft Excel worksheet on a Personal Computer. Data processing and reporting were PC based and accomplished by program scripts, or macros, created within Microsoft Excel software. After the technician verified the correctness of the raw data, a daily summary of fish passage was produced and distributed electronically to plant personnel. Each day's data were backed up and stored off site. Daily reports and weekly summaries of fish passage were electronically distributed to plant personnel and other cooperators.

3.0 RESULTS

3.1 Relative Abundance

The number of fishes collected and passed by the Conowingo Dam EFL is presented in Table 1. A total of 1,192,750 fish of 34 species and one hybrid passed upstream into Conowingo Pond. Gizzard shad (1,170,200), American shad (10,425), channel catfish (9,235), and shorthead redhorse (1,136) dominated the catch, and comprised nearly 100% of the total fish collected and passed. Gizzard shad alone accounted for 98% of the total fish collected and passed. Peak passage occurred on May 14 when 50,183 fish, (99% gizzard shad), were passed.

3.2 American Shad Passage

The EFL collected and passed 10,425 American shad (Table 1). The first 3 American shad passed on April 24. Collection and passage of shad varied daily with 20.8% (2,173) of the shad passed from April 4 to April 30, 68% (7,089) passed from May 1 to May 20, and 11.2% (1,163) passed from May

21 to June 7, (Figures 1 and 2). On 3 of the 54 days of operation, American shad passage exceeded 1,000 fish. The largest number of American shad passed at the EFL in 2014 occurred on May 13 (3,043).

American shad were collected and passed at water temperatures ranging from 55.2°F to 76.2°F and river flows between 25,100 and 138,000 cfs (Table 2, and Figure 1). The average daily river flow on the 3 days when American shad passage exceeded 1,000 fish was approximately 36,600 cfs. The average daily river flow during the operational season was 72,286 cfs.

The hourly passage of American shad at the EFL is given in Table 3. On a daily basis, overall shad passage was strongest through the fishway between 1500 hours and 1759 hours during which nearly 45% of shad passage occurred. The highest hourly passage rate occurred from 1600 to 1659 hours.

3.3 Gizzard Shad Passage

The EFL collected and passed 1,170,200 Gizzard shad in 2014 (Tables 1 and 4). Gizzard shad accounted for 98% of the total fish collected and passed. On 3 of 54 days of operation, Gizzard shad passage exceeded 40,000 fish. Gizzard shad passage exceeded 30,000 and 20,000 fish on 8 and 20 days, respectively. Table 4 provides the ratio of American shad to Gizzard shad for the years of volitional passage (1997-2014). In years when American shad passage exceeds 50,000 fish, the ratio ranges from 1:2 – 1:14 (Am. shad/gizzard shad). For those years when American shad passage is less than 50,000 fish, the ratio ranges from 1:16 – 1:100. The year 2011 is an exception to this because of the agency requested shutdown on May 19, 2011 which ended EFL operations earlier than previous years.

3.4 Alosids

A small number of river herring, (111 alewife and 25 blueback herring) were passed during the 2014 season. Two hickory shad were also passed in spring 2014.

3.5 Maryland tag-recapture

During the 2014 season, the EFL passed American shad that were captured, floy-tagged and released downstream of Conowingo dam by the Maryland DNR. This year, the Maryland DNR tagged a total of 427 American shad. The number of floy tags observed at the Conowingo EFL in 2014 was 24; 20 yellow tags (2014 effort) and 4 pink tags (2013 effort).

4.0 SUMMARY

EFL operation was initiated on April 4 although river water temperature was less than 50°F (45.4°F) and river flow was 120,000 cfs. The first 3 American shad passed on April 24 at a water temperature of 55.2°F. The EFL passed 10,425 American shad from April 24 through June 7. The total number of American shad passed during the 2014 season was the lowest passage value recorded since 1993, when the EFL was operated for trap and transport purposes (Tables 4, 5, and 6). It is also the fourth consecutive year in which the EFL passed less than 25,000 American shad.

Modifications made to the fish trough, particularly the valve grating and hopper trough chute since 1999 have diminished the potential for the valve grating to clog with various types of debris and have decreased the number of American shad lift mortalities observed throughout the last several fish

passage seasons. Since the valve grating was modified prior to the start of the 2000 season, loss of water flow in the trough has not occurred, particularly during high river flow periods when large amounts of debris may enter the trough through the fish exit area. An aeration system was also installed prior to the 2000 passage season to diminish low dissolved oxygen levels when the American shad population is heavy in the trough. Prior to fishway operations in 2002, a 30 inch diameter fiberglass elbow was attached to the hopper extension chute, which had been installed in 2001. The modification allows fish to enter the trough center stream, instead of being directed toward the east trough wall. A decrease in lift mortalities has also been observed since the fiberglass elbow was installed. A total of 138 American shad lift mortalities, (1.3% of the total shad passed), was observed in 2014, similar to the range observed in recent years (0.2% to 1.0%) and less than values observed during trap and transport operations (1.5% to 10.5%).

Prior to the start of EFL operations in 2014, routine preseason maintenance activities were conducted, and included testing of the fish collection equipment (crowder, crowder screen hoist, hopper hoist motor, and hopper door along with inspection of associated air hoses, pneumatic cylinders, etc.). Although these maintenance activities were performed, a mechanical failure of the hopper hoist motor occurred and prevented fish passage activities of the EFL from April 12 through April 15. Upon notification of the problem, Exelon personnel quickly responded, resulting in the resolution of the problem and reinstallation of the repaired hopper hoist motor prior to any observed presence of American shad in the Conowingo tailrace.

5.0 RECOMMENDATIONS

1) Continue to operate the EFL at Conowingo Dam per annual guidelines developed and approved by the Susquehanna River Technical Committee. Lift operation should adhere to the guidelines; however, flexibility must remain with operating personnel to maximize fishway performance and fish passage.

2) Continue the use of two fish counters during periods of increased fish passage to accurately reflect the number of fish that pass through the EFL.

3) Continue to inspect cables, limit switches, and lift components to enhance season operability, and continue to evaluate effectiveness of fish trough and hopper door modifications.

6.0 LITERATURE CITED

RMC. 1992. Summary of the operations of the Conowingo Dam fish passage facilities in spring 1991. Prepared for Susquehanna Electric Company, Darlington, MD.

Normandeau Associates, Inc. 1999. Summary of the operations at the Conowingo Dam East fish passage facility in spring, 1998. Prepared for Susquehanna Electric Company, Darlington, MD.

TABLES AND FIGURES

Table 1

Summary of the daily number of fish passed by the Conowingo Dam East Fish Passage Facility in 2014.

Date	4/4	4/8	4/9	4/11	4/16	4/17	4/18	4/19	4/21	4/22
Start Fishing Time	8:30	8:00	8:00	8:00	11:00	8:30	8:00	8:00	8:00	8:00
End Fishing Time	16:30	16:00	16:00	16:00	18:00	16:30	16:00	16:30	16:00	16:00
Elapsed Fishing Time	8.0	8.0	8.0	8.0	7.0	8.0	8.0	8.5	8.0	8.0
Lifts Per Day	15	11	11	14	8	16	16	5	16	16
Water Temperature (°F)*	45.4	48.5	46.7	49.1	54.3	54.7	53.2	52.9	53.6	54.5
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
ALEWIFE	0	0	0	0	0	3	2	3	0	0
GIZZARD SHAD	0	0	0	8	3,921	19,487	19,653	4,654	15,600	31,326
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0
SEA LAMPREY	0	0	0	0	0	1	1	0	0	0
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	0	0	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	0	0	0	0
CARP	0	0	0	0	0	0	0	0	0	0
QUILLBACK	0	0	0	0	0	0	0	0	0	0
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0
SHORTHEAD REDHORSE	0	0	0	0	0	0	0	0	0	0
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH	1	2	1	0	2	0	3	0	3	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
HYBRID STRIPED BASS	0	0	0	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	0	0	0	0
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	0	1	0	0	0	1	0
SMALLMOUTH BASS	0	0	0	0	1	0	0	0	0	0
LARGEMOUTH BASS	0	0	0	0	1	0	0	0	0	0
YELLOW PERCH	0	0	0	0	0	0	0	0	0	0
WALLEYE	0	0	0	0	0	0	0	0	2	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
RAINBOW SMELT	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	1	0	0	0
SPOTFIN SHINER	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER	1	0	0	0	0	0	0	0	0	0
LOGPERCH	0	0	0	0	0	0	0	0	1	0
FLATHEAD CATFISH	0	0	0	0	0	0	0	0	0	0
Total	**2**	**2**	**1**	**8**	**3,926**	**19,491**	**19,660**	**4,657**	**15,607**	**31,326**

Table 1 (continued)

Date	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2
Start Fishing Time	8:00	8:00	8:00	7:45	8:00	8:00	8:00	8:00	9:00	8:00
End Fishing Time	16:00	16:00	16:00	17:00	18:00	18:00	18:00	17:30	18:00	18:00
Elapsed Fishing Time	8.0	8.0	8.0	9.3	10.0	10.0	10.0	9.5	9.0	10.0
Lifts Per Day	16	16	16	18	20	20	20	19	17	19
Water Temperature (°F)	54.5	55.2	55.8	56	56.5	57.9	57.7	56.9	56.7	55.5
AMERICAN SHAD	0	3	5	112	296	1,124	605	28	6	6
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
ALEWIFE	2	8	1	0	0	0	25	8	1	12
GIZZARD SHAD	19,988	13,705	7,079	21,998	18,130	23,893	10,412	20,240	20,107	11,743
HICKORY SHAD	0	0	0	0	0	1	1	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0
SEA LAMPREY	1	0	0	0	0	3	2	0	0	0
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	1	0	0	1	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	0	0	0	0
CARP	0	0	0	2	1	0	2	0	3	1
QUILLBACK	0	0	0	0	0	2	32	0	5	0
WHITE SUCKER	0	0	0	0	0	1	0	0	0	0
SHORTHEAD REDHORSE	0	0	0	0	2	6	49	20	264	116
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH	1	1	0	0	0	0	1	4	127	101
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
HYBRID STRIPED BASS	0	0	0	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	0	0	0	0
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	2	0	0	1	1	0	0
SMALLMOUTH BASS	0	0	0	5	2	0	1	1	1	0
LARGEMOUTH BASS	0	0	0	1	0	0	0	0	0	0
YELLOW PERCH	0	0	0	0	0	1	0	0	0	0
WALLEYE	0	0	0	0	0	0	0	0	0	1
AMERICAN EEL	0	0	0	0	0	0	1	0	0	0
RAINBOW SMELT	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	1	0	0	0	0	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER	0	0	2	0	0	0	0	0	0	0
TESSELLATED DARTER	0	0	0	0	0	1	0	0	0	0
LOGPERCH	0	0	0	0	0	0	0	0	0	0
FLATHEAD CATFISH	0	0	1	0	0	0	0	0	0	0
Total	**19,992**	**13,717**	**7,089**	**22,121**	**18,431**	**25,032**	**11,133**	**20,302**	**20,514**	**11,980**

Table 1 (continued)

Date	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12
Start Fishing Time	8:00	7:55	8:00	8:00	8:00	8:00	8:00	8:00	8:00	6:40
End Fishing Time	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:30	16:00	18:00
Elapsed Fishing Time	10.0	10.1	10.0	10.0	10.0	10.0	10.0	10.5	8.0	11.3
Lifts Per Day	20	20	22	20	21	20	20	20	20	20
Water Temperature (°F)	56.2	57.6	57.3	57.7	58.2	59.2	61.1	62.8	64.7	66.4
AMERICAN SHAD	11	47	60	131	237	62	575	731	1,114	748
BLUEBACK HERRING	0	0	0	0	0	0	0	14	2	0
ALEWIFE	23	1	18	3	1	0	0	0	0	0
GIZZARD SHAD	22,960	25,520	27,757	25,870	35,696	23,872	22,194	31,250	19,670	32,960
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	4	1	2	0	0	0	0	0	1	0
SEA LAMPREY	0	0	0	4	1	1	0	0	0	1
RAINBOW TROUT	0	0	0	1	1	0	0	0	1	0
BROWN TROUT	0	0	0	1	4	0	1	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	0	1	0	0
CARP	6	4	4	5	2	4	0	7	3	7
QUILLBACK	0	0	0	9	7	2	8	0	1	22
WHITE SUCKER	0	0	0	0	1	1	2	0	0	2
SHORTHEAD REDHORSE	67	72	33	112	93	57	53	16	6	19
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	0	0	0	0	1	0	0	0	0	0
CHANNEL CATFISH	48	44	134	89	75	18	5	3	5	25
WHITE PERCH	0	0	2	0	58	1	0	5	11	0
HYBRID STRIPED BASS	0	0	0	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	0	0	0	0
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	1	0	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	0	0	0	0	0	0	4
SMALLMOUTH BASS	0	5	2	7	18	14	4	4	2	3
LARGEMOUTH BASS	0	0	0	0	0	0	0	1	1	0
YELLOW PERCH	0	0	0	0	0	0	0	0	0	0
WALLEYE	5	2	4	9	7	2	0	1	9	4
AMERICAN EEL	1	0	0	0	0	0	0	0	0	0
RAINBOW SMELT	0	0	0	1	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER	0	0	0	0	0	0	0	0	0	0
LOGPERCH	0	0	0	1	0	0	0	0	0	0
FLATHEAD CATFISH	0	2	2	1	0	0	0	0	0	1
Total	**23,126**	**25,698**	**28,018**	**26,244**	**36,202**	**24,034**	**22,842**	**32,033**	**20,826**	**33,796**

Table 1 (continued)

Date	5/13	5/14	5/15	5/16	5/17	5/20	5/21	5/22	5/23	5/24
Start Fishing Time	8:00	8:00	8:00	8:00	8:00	8:30	8:00	8:00	8:00	8:00
End Fishing Time	19:30	18:00	18:00	18:00	16:00	18:00	18:00	18:00	18:00	18:00
Elapsed Fishing Time	11.5	10.0	10.0	10.0	8.0	9.5	10.0	10.0	10.0	10.0
Lifts Per Day	25	20	20	21	18	19	19	19	18	20
Water Temperature (°F)	67.6	68.8	69.3	69.5	68.2	61.1	60.5	61.4	61.4	62.9
AMERICAN SHAD	3,043	234	56	25	2	1	0	0	0	1
BLUEBACK HERRING	2	0	1	0	0	0	0	0	0	0
ALEWIFE	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	25,904	49,865	28,875	24,272	42,403	16,021	4,472	24,812	28,370	24,919
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	1	4	0	2	1	0	0	0	1	0
SEA LAMPREY	3	2	0	2	2	1	0	1	0	0
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	3	0	0	0	0	0	0	0
MUSKELLUNGE	0	1	0	0	0	0	0	0	0	0
CARP	7	5	3	2	108	0	6	0	1	1
QUILLBACK	213	15	67	10	6	0	0	0	1	5
WHITE SUCKER	1	0	0	0	1	0	0	0	0	0
SHORTHEAD REDHORSE	3	20	11	7	15	3	27	32	1	5
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0
BROWN BULLHEAD	1	5	3	2	54	2	1	0	1	0
CHANNEL CATFISH	11	11	7	40	1,532	2,580	598	893	816	571
WHITE PERCH	0	4	0	1	13	0	0	1	0	0
HYBRID STRIPED BASS	0	0	0	0	0	0	0	0	0	0
ROCK BASS	0	1	0	0	0	0	0	0	0	0
GREEN SUNFISH	0	0	1	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0
BLUEGILL	1	0	0	1	0	4	0	0	0	1
SMALLMOUTH BASS	19	12	5	5	2	1	0	0	0	0
LARGEMOUTH BASS	0	0	1	0	0	0	0	0	0	0
YELLOW PERCH	0	1	0	1	0	0	0	0	0	0
WALLEYE	3	2	0	5	14	5	1	3	3	5
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
RAINBOW SMELT	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER	0	0	0	0	0	0	0	0	0	0
LOGPERCH	0	0	0	0	0	0	0	0	0	0
FLATHEAD CATFISH	0	1	0	0	0	6	4	8	6	24
Total	**29,212**	**50,183**	**29,033**	**24,375**	**44,153**	**18,624**	**5,109**	**25,750**	**29,200**	**25,532**

Table 1 (continued)

Date	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1	6/2	6/3
Start Fishing Time	8:00	8:00	8:00	8:00	9:00	8:00	8:00	8:00	8:00	8:00
End Fishing Time	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00
Elapsed Fishing Time	10.0	10.0	10.0	10.0	9.0	10.0	10.0	10.0	10.0	10.0
Lifts Per Day	20	20	20	20	18	20	20	20	20	19
Water Temperature (°F)	64.1	64.8	66.9	67.9	68.3	68.3	68.9	70	71.5	72.3
AMERICAN SHAD	15	4	17	38	84	93	108	91	295	168
BLUEBACK HERRING	0	0	4	0	1	0	1	0	0	0
ALEWIFE	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	35,984	37,702	37,746	45,680	33,103	21,078	26,082	17,630	18,830	18,959
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	1	5	8	2	17	3	5	9	7
SEA LAMPREY	0	1	1	0	0	0	1	0	0	0
RAINBOW TROUT	0	0	0	0	0	0	3	0	1	0
BROWN TROUT	1	0	0	0	0	0	0	0	0	0
MUSKELLUNGE	0	0	0	0	0	0	0	1	0	0
CARP	0	1	2	1	0	0	1	2	1	0
QUILLBACK	0	0	0	36	15	1	2	36	4	22
WHITE SUCKER	0	0	0	2	0	0	0	0	0	0
SHORTHEAD REDHORSE	4	10	1	4	2	0	1	0	0	1
YELLOW BULLHEAD	0	0	0	2	0	0	0	0	0	0
BROWN BULLHEAD	9	1	2	0	0	0	22	0	0	0
CHANNEL CATFISH	136	77	313	52	150	7	11	23	20	17
WHITE PERCH	0	0	0	0	0	0	0	0	1	0
HYBRID STRIPED BASS	0	0	0	0	0	0	0	0	0	0
ROCK BASS	3	0	0	0	0	0	0	0	0	0
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0
BLUEGILL	4	1	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	6	1	2	1	3	0	0	0	1	3
LARGEMOUTH BASS	0	0	0	0	0	0	0	0	1	1
YELLOW PERCH	0	0	0	0	0	0	0	0	0	0
WALLEYE	7	5	8	9	10	2	0	4	0	1
AMERICAN EEL	2	6	1	0	0	0	0	0	0	2
RAINBOW SMELT	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER	1	0	0	0	0	0	0	0	0	0
LOGPERCH	0	0	0	0	0	0	0	0	0	0
FLATHEAD CATFISH	1	0	1	0	0	1	0	0	0	0
Total	**36,173**	**37,810**	**38,103**	**45,833**	**33,370**	**21,199**	**26,235**	**17,792**	**19,163**	**19,181**

Table 1 (continued)

Date	6/4	6/5	6/6	6/7	
Start Fishing Time	8:00	8:00	8:00	8:00	**Season**
End Fishing Time	18:00	18:00	18:00	18:00	**Total**
Elapsed Fishing Time	10.0	10.0	10.0	10.0	509
Lifts Per Day	20	20	20	20	988
Water Temperature (°F)	74.6	74.4	74.4	76.2	
AMERICAN SHAD	48	24	31	146	10,425
BLUEBACK HERRING	0	0	0	0	25
ALEWIFE	0	0	0	0	111
GIZZARD SHAD	25,598	26,979	13,023	12,200	1,170,200
HICKORY SHAD	0	0	0	0	2
STRIPED BASS	9	16	7	4	110
SEA LAMPREY	0	0	0	0	29
RAINBOW TROUT	0	0	0	0	7
BROWN TROUT	0	0	0	0	12
MUSKELLUNGE	0	1	0	0	4
CARP	0	1	2	58	253
QUILLBACK	13	6	12	18	570
WHITE SUCKER	0	0	0	0	11
SHORTHEAD REDHORSE	3	0	1	0	1,136
YELLOW BULLHEAD	0	0	0	0	2
BROWN BULLHEAD	0	1	0	0	105
CHANNEL CATFISH	59	328	241	49	9,235
WHITE PERCH	0	0	0	0	97
HYBRID STRIPED BASS	1	0	0	0	1
ROCK BASS	0	0	0	0	4
GREEN SUNFISH	0	0	0	0	1
PUMPKINSEED	0	1	0	0	2
BLUEGILL	0	5	1	0	28
SMALLMOUTH BASS	1	1	0	0	133
LARGEMOUTH BASS	1	0	0	0	8
YELLOW PERCH	0	0	0	0	3
WALLEYE	0	6	2	9	150
AMERICAN EEL	1	1	0	0	15
RAINBOW SMELT	0	0	0	0	1
GOLDEN SHINER	0	0	0	0	1
SPOTTAIL SHINER	0	0	0	0	1
SPOTFIN SHINER	0	0	0	0	2
TESSELLATED DARTER	0	0	1	0	4
LOGPERCH	0	0	0	0	2
FLATHEAD CATFISH	1	0	0	0	60
Total	**25,735**	**27,370**	**13,321**	**12,484**	**1,192,750**

*Hobo water temperature data logger placed in EFL trough.

Table 2

Summary of American shad catch, Maryland DNR recaptures, daily average river flow, water temperature, turbidity (secchi), unit operation, entrance gates utilized, attraction flow, and project water elevations during operation of the Conowingo Dam East Fish Passage Facility in 2014.

Date	American Shad Catch	MD DNR Recaptures	Marietta River Flow (cfs)	Water Temp. (°F)	Secchi (in)	Maximum Units in Operation	Entrance Gates Utilized	Attraction Flow (cfs)	Tailrace Elevation (ft)	Forebay Elevation (ft)	Crest Gates Open
4/4	0		120,000	45.4	0-6		C	310	25.5	108.5	4
4/5	DNO		114,000	47.5				310			
4/6	DNO		117,000	47.9				310			
4/7	DNO		118,000	43.8				310			
4/8	0		110,000	48.5	6-12		C	310	25.5	108.5	5
4/9	0		103,000	46.7	6-12		C	310	25.0	108.5	3
4/10	DNO		105,000	47.6				310			
4/11	0		103,000	49.1	15		C	310	24.0	108.5	2
4/12	DNO		90,500	50.4				310			
4/13	DNO		82,000	52.3				310			
4/14	DNO		78,400	53.8				310			
4/15	DNO		75,800	55.0				310			
4/16	0		91,500	54.3	15		C	310	24.5	108.0	4
4/17	0		115,000	54.7	15		C/B	310	25.0	108.5	5
4/18	0		114,000	53.2	12		B/C	310	25.5	108.5	5
4/19	0		100,000	52.9	12		B/C	310	24.0	108.5	4
4/20	DNO		84,300	53.1				310			
4/21	0		71,400	53.6	12		C	310	23.8	109.0	3
4/22	0		61,600	54.5	10		C/A	310	23.5	108.5	2
4/23	0		54,900	54.5	15		C/A	310	22.0	108.5	1
4/24	3		49,400	55.2	18		A/C	310	21.8	108.5	1
4/25	5		46,100	55.8	24-30		A	310	21.8	107.0	
4/26	112		43,100	56.0	24		C/A	310	20.5	105.5	
4/27	296	*2 pink*	40,200	56.5	24		C/A	310	20.5	106.5	
4/28	1124		37,700	57.9	24		C/A	310	21.0	107.5	
4/29	605		35,500	57.7	30		C/A	310	22.9	105.5	
4/30	28		47,600	56.9	24		C	310	23.5	106	
5/1	6		76,100	56.7	6		C	310	24.0	107	
5/2	6		70,800	55.5	6		C	310	23.5	107.0	
5/3	11		67,700	56.2	6-12		C	310	22.5	106	
5/4	47		67,900	57.6	12-18		C	310	22.5	105.5	
5/5	60		63,100	57.3	15		C	310	23.5	107.5	
5/6	131		57,000	57.7	30		C	310	23.5	107	
5/7	237		52,200	58.2	30		C	310	23.5	106	
5/8	62		47,200	59.2	25		C	310	23.0	105.5	
5/9	575		42,700	61.1	25		C	310	22.5	107	
5/10	731	*1 yellow*	39,300	62.8	18		C	310	22.0	106.5	

Continued.

Date	American Shad Catch	MD DNR Recaptures*	Marietta River Flow (cfs)	Water Temp. (°F)	Secchi (in)	Maximum Units in Operation	Entrance Gates Utilized	Attraction Flow (cfs)	Tailrace Elevation (ft)	Forebay Elevation (ft)
5/11	1114		37,800	64.70	29		A/C	310	23.0	108.0
5/12	748		34,800	66.40	25		C	310	21.0	106.5
5/13	3043	*14 yellow 2 pink*	34,400	67.6	25		A/C	310	23.0	107.5
5/14	234	*2 yellow*	34,400	68.8	28		A/C	310	21.5	107.0
5/15	56		32,500	69.3	30		A/C	310	22.0	106.5
5/16	25		47,600	69.5	22		A/C	310	21.0	108.0
5/17	2		158,000	68.2	16		C	310	25.5	108.0
5/18	DNO		193,000	63.8				310		
5/19	DNO		177,000	60.9				310		
5/20	1		138,000	61.1	8-12		C/B	310	26.0	108.5
5/21	0		112,000	60.5	6		C/B	310	25.0	108.5
5/22	0		95,800	61.4	0-6		C/B	310	24.5	108.5
5/23	0		106,000	61.4	9		C/B	310	24.8	108.0
5/24	1		103,000	62.9	12-16		C/B	310	24.0	108.5
5/25	15		85,000	64.1	15		C	310	24.0	107.5
5/26	4		70,300	64.8	15		C	310	24.0	108.0
5/27	17		58,900	66.9	17		C	310	23.0	107.0
5/28	38		53,200	67.9	21		C	310	22.5	106.0
5/29	84		47,600	68.3	26		C	310	22.5	106.5
5/30	93		44,000	68.3	26		A/C	310	23.0	107.5
5/31	108		41,400	68.9	26		A/C	310	23.0	108.5
6/1	91	*1 yellow*	36,400	70.0	26-28		A/C	310	22.5	108.5
6/2	295	*1 yellow*	31,900	71.5	27		A/C	310	23.0	106.5
6/3	168	*1 yellow*	28,800	72.3	27		A/C	310	22.5	106.5
6/4	48		26,800	74.6	27		A/C	310	22.5	107.0
6/5	24		25,100	74.4	24		C	310	21.5	106.0
6/6	31		26,200	74.4	36		A/C	310	23.0	107.0
6/7	146		25,700	76.2	30		A/C	310	21.5	108

DNO = Did Not Operate Yellow = 2014 MDNR floy tags Pink = 2013 MDNR floy tags

Table 3

Hourly summary of American shad passage at the Conowingo Dam East Fish Passage Facility in 2014.

Date:	4/4	4/8	4/9	4/11	4/16	4/17	4/18	4/19	4/21	4/22	4/23	4/24
Observation Time-Start:	9:00	8:30	8:00	8:00	11:00	8:30	8:00	8:30	8:20	8:00	8:20	8:00
Observation Time-End:	16:40	16:30	16:15	16:30	18:20	16:45	16:20	17:00	16:20	16:15	16:20	16:20
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0	0	0	0		0	0	0	0	0	0	0
0900 to 0959	0	0	0	0		0	0	0	0	0	0	1
1000 to 1059	0	0	0	0		0	0	0	0	0	0	1
1100 to 1159	0	0	0	0	0	0	0	0	0	0	0	0
1200 to 1259	0	0	0	0	0	0	0	0	0	0	0	0
1300 to 1359	0	0	0	0	0	0	0	0	0	0	0	0
1400 to 1459	0	0	0	0	0	0	0	0	0	0	0	1
1500 to 1559	0	0	0	0	0	0	0	0	0	0	0	0
1600 to 1659	0	0	0	0	0	0	0	0	0	0	0	0
1700 to 1759					0							
1800 to 1859					0							
1900 to 1959												
2000 to 2059												
Total	0	0	0	0	0	0	0	0	0	0	0	3

Date:	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6
Observation Time-Start:	8:30	8:00	8:00	8:00	8:00	8:00	9:00	8:00	8:30	7:55	8:00	8:30
Observation Time-End:	16:30	17:15	18:15	18:15	18:15	18:00	18:15	18:15	18:30	18:20	18:15	18:30
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0	0	4	1	15	17		1	6	0	1	9
0900 to 0959	0	0	0	3	6	1	1	1	0	0	2	0
1000 to 1059	0	2	0	0	9	2	0	0	0	0	1	0
1100 to 1159	0	0	1	1	30	3	0	1	1	0	0	0
1200 to 1259	0	0	5	0	9	0	0	0	1	0	0	1
1300 to 1359	0	3	33	1	14	1	0	1	0	1	1	10
1400 to 1459	5	15	67	193	11	0	0	0	1	1	5	25
1500 to 1559	0	29	68	536	156	0	1	1	1	4	11	18
1600 to 1659	0	60	100	307	228	0	2	1	0	3	14	36
1700 to 1759		3	15	63	121	4	1	0	0	27	17	24
1800 to 1859			3	19	6		1	0	1	11	8	8
1900 to 1959												
2000 to 2059												
Total	5	112	296	1,124	605	28	6	6	11	47	60	131

Table 3 (Continued).

Date:	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/20
Observation Time-Start:	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:30
Observation Time-End:	18:15	18:15	18:15	18:45	16:15	18:30	19:45	18:20	18:15	18:15	16:30	18:05
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	5	8	2	7	128	7	25	33	9	0	0	0
0900 to 0959	3	25	0	6	463	131	174	32	9	1	1	0
1000 to 1059	0	4	3	14	175	146	397	31	6	4	0	1
1100 to 1159	0	10	95	19	26	75	210	10	1	1	0	0
1200 to 1259	3	4	179	76	60	231	34	43	9	2	0	0
1300 to 1359	27	0	160	103	73	78	26	58	9	8	1	0
1400 to 1459	39	4	67	64	100	29	6	4	3	4	0	0
1500 to 1559	28	1	21	51	65	17	389	11	2	2	0	0
1600 to 1659	35	1	14	81	20	12	1011	5	6	3	0	0
1700 to 1759	69	2	21	226	4	9	481	4	2	0		0
1800 to 1859	28	3	13	84	0	13	195	3	0			0
1900 to 1959							95					
2000 to 2059												
Total	237	62	575	731	1,114	748	3,043	234	56	25	2	1

Date:	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1
Observation Time-Start:	8:00	8:30	8:00	8:30	8:00	8:00	8:30	8:00	9:00	8:30	8:00	8:00
Observation Time-End:	18:10	18:30	18:15	18:10	18:15	18:15	18:30	18:10	18:10	18:10	18:10	18:10
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0	0	0	0	0	0	2	4		3	8	5
0900 to 0959	0	0	0	0	0	0	1	0	4	12	26	18
1000 to 1059	0	0	0	0	1	0	1	0	3	11	9	22
1100 to 1159	0	0	0	0	2	0	0	0	8	15	7	8
1200 to 1259	0	0	0	0	0	0	0	0	4	37	8	6
1300 to 1359	0	0	0	0	0	0	2	1	16	5	7	3
1400 to 1459	0	0	0	0	0	2	1	7	21	3	12	6
1500 to 1559	0	0	0	0	4	1	0	11	6	1	12	2
1600 to 1659	0	0	0	0	1	0	0	8	11	3	12	5
1700 to 1759	0	0	0	1	4	1	9	4	8	2	5	12
1800 to 1859	0	0	0	0	3	0	1	3	3	1	2	4
1900 to 1959												
2000 to 2059												
Total	0	0	0	1	15	4	17	38	84	93	108	91

Table 3 (Continued).

Date:	6/2	6/3	6/4	6/5	6/6	6/7	*Season*
Observation Time-Start:	8:00	8:00	8:00	8:00	8:30	8:00	*Total*
Observation Time-End:	18:10	18:10	18:15	18:10	18:30	18:10	
Military Time (hrs)							
0600 to 0659							**0**
0700 to 0759							**0**
0800 to 0859	0	8	4	3	0	3	**318**
0900 to 0959	10	37	24	0	0	23	**1,015**
1000 to 1059	12	22	12	0	0	35	**924**
1100 to 1159	12	17	3	9	10	4	**579**
1200 to 1259	41	29	0	5	10	12	**809**
1300 to 1359	134	18	2	3	2	17	**818**
1400 to 1459	41	3	0	1	6	19	**766**
1500 to 1559	22	14	1	0	3	13	**1,502**
1600 to 1659	12	13	1	1	0	11	**2,017**
1700 to 1759	10	6	1	2	0	7	**1,165**
1800 to 1859	1	1	0	0	0	2	**417**
1900 to 1959							**95**
2000 to 2059							**0**
Total	295	168	48	24	31	146	**10,425**

Table 4

Summary Information for Conowingo EFL Volitional Passage, 1997 through 2014.

Year	#Days of Ops	#Hrs of Ops	Total # of Lifts	# Fish passed	# Am. shad	# Gizzard shad	# Herring	Avg.#fish/lift	Ratio A.S./Gizz
1997	64	640	652	719,297	90,971	344,332	242,815	1,103	1/4
1998	50	433	460	712,993	39,904	654,575	706	1,550	1/16
1999	52	467	610	1,184,101	69,712	950,500	130,639	1,941	1/14
2000	45	368	570	493,955	153,546	317,753	14,965	866	1/2
2001	43	360	559	921,916	193,574	429,461	292,379	1,649	1/2
2002	49	440	560	656,894	108,001	513,794	2,111	1,173	1/5
2003	44	416	645	589,177	125,135	459,634	551	913	1/4
2004	44	390	590	715,664	109,360	602,677	190	1,212	1/6
2005	52	434	541	377,762	68,926	305,378	4	698	1/4
2006	61	430	619	714,918	56,899	655,990	0	1,154	1/12
2007	39	335	479	539,203	25,464	508,627	889	1,125	1/20
2008	51	409	483	943,838	19,914	919,975	5	1,954	1/46
2009	57	495	618	915,417	29,272	876,412	231	1,481	1/30
2010	59	526	685	857,263	37,757	813,429	5	1,251	1/22
2011	15	142	259	289,453	20,571	257,522	19	1,117	1/13
2012	62	633	1,230	1,109,911	22,143	1,070,672	52	902	1/48
2013	60	575.6	925	1,094,526	12,733	1,076,048	7	1,183	1/85
2014	**54**	**509**	**988**	**1,192,750**	**10,425**	**1,170,200**	**136**	**1,207**	**1/100**

Table 5

Summary of selected operation and fish catch statistics at the Conowingo Dam East Fish Passage Facility, 1991 to 2014.

Year	Number of Days Operated	Number of Lifts	Operating Time (hrs)	Catch (millions)	Number of Species	American shad	Blueback herring	Alewife	Hickory shad
1991	60	1168	647.2	0.651	42	13,897	13,149	323	0
1992	49	599	454.1	0.492	35	26,040	261	3	0
1993	42	848	463.5	0.530	29	8,203	4,574	0	0
1994	55	955	574.8	1.062	36	26,715	248	5	1
1995	68	986	706.2	1.796	36	46,062	4,004	170	1
1996	49	599	454.1	0.492	35	26,040	261	3	0
1997	64	652	640.0	0.719	36	90,971	242,815	63	0
1998	50	652	640.0	0.713	33	39,904	700	6	0
1999	52	610	467.0	1.184	31	69,712	130,625	14	0
2000	45	570	367.8	0.494	30	153,546	14,963	2	0
2001	43	559	359.8	0.922	30	193,574	284,921	7,458	0
2002	49	560	440.7	0.657	31	108,001	2,037	74	6
2003	44	645	416.6	0.589	25	125,135	530	21	0
2004	44	590	390.3	0.716	30	109,360	101	89	0
2005	52	541	434.3	0.378	30	68,926	4	0	0
2006	61	619	429.8	0.715	32	56,899	0	0	4
2007	39	479	335.3	0.539	31	25,464	460	429	0
2008	51	483	407.0	0.944	29	19,914	1	4	0
2009	57	618	495.6	0.915	30	29,272	71	160	0
2010	59	685	526.2	0.857	38	37,757	4	1	0
2011	15	259	142.4	0.021	24	20,571	17	2	20
2012	62	1230	633.7	0.022	35	22,143	25	27	0
2013	60	925	575.6	0.013	27	12,733	7	0	1
2014	**54**	**988**	**509**	**0.010425**	**34**	**10,425**	**25**	**111**	**2**

Table 6

Summary of American shad passage counts and percent passage values at Susquehanna River dams, 1997-2014.

	Conowingo	Holtwood		Safe Harbor		York Haven	
	East	Number	% of C.E.L.	Number	% of Holt.	Number	% of S.H.
1997	90,971	28,063	30.8%	20,828	74.2%	-	-
1998	39,904	8,235	20.6%	6,054	73.5%	-	-
1999	69,712	34,702	49.8%	34,150	98.4%	-	-
2000	153,546	29,421	19.2%	21,079	71.6%	4,687	22.2%
2001	193,574	109,976	56.8%	89,816	81.7%	16,200	18.0%
2002	108,001	17,522	16.2%	11,705	66.8%	1,555	13.3%
2003	125,135	25,254	20.2%	16,646	65.9%	2,536	15.2%
2004	109,360	3,428	3.1%	2,109	61.5%	219	10.4%
2005	68,926	34,189	49.6%	25,425	74.4%	1,772	7.0%
2006	56,899	35,968	63.2%	24,929	69.3%	1,913	7.7%
2007	25,464	10,338	40.6%	7,215	69.8%	192	2.7%
2008	19,914	2,795	14.0%	1,252	44.8%	21	1.7%
2009	29,272	10,896	37.2%	7,994	73.4%	402	5.0%
2010	37,757	16,472	43.6%	12,706	77.1%	907	7.1%
2011	20,571	21	0.1%	8	38.1%	0	0.0%
2012	22,143	4,238	19.1%	3,089	72.9%	224	7.3%
2013	12,733	2,503	19.7%	1,927	77.0%	202	10.5%
2014	**10,425**	**2,589**	**24.8%**	**1,336**	**51.6%**	**8**	**0.6%**

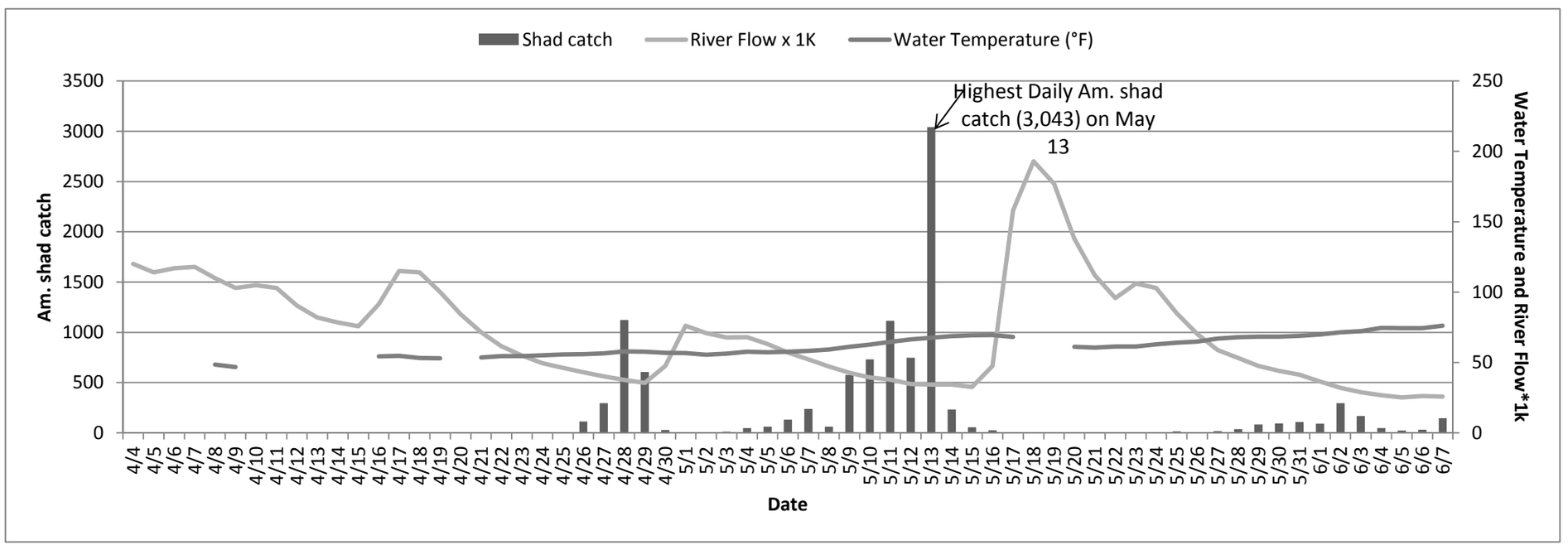

Figure 1

A plot of river flow (x 1000 cfs) (USGS Marietta Gauge) and water temperature (°F) in relation to daily American shad passage at the Conowingo EFL, spring 2014.

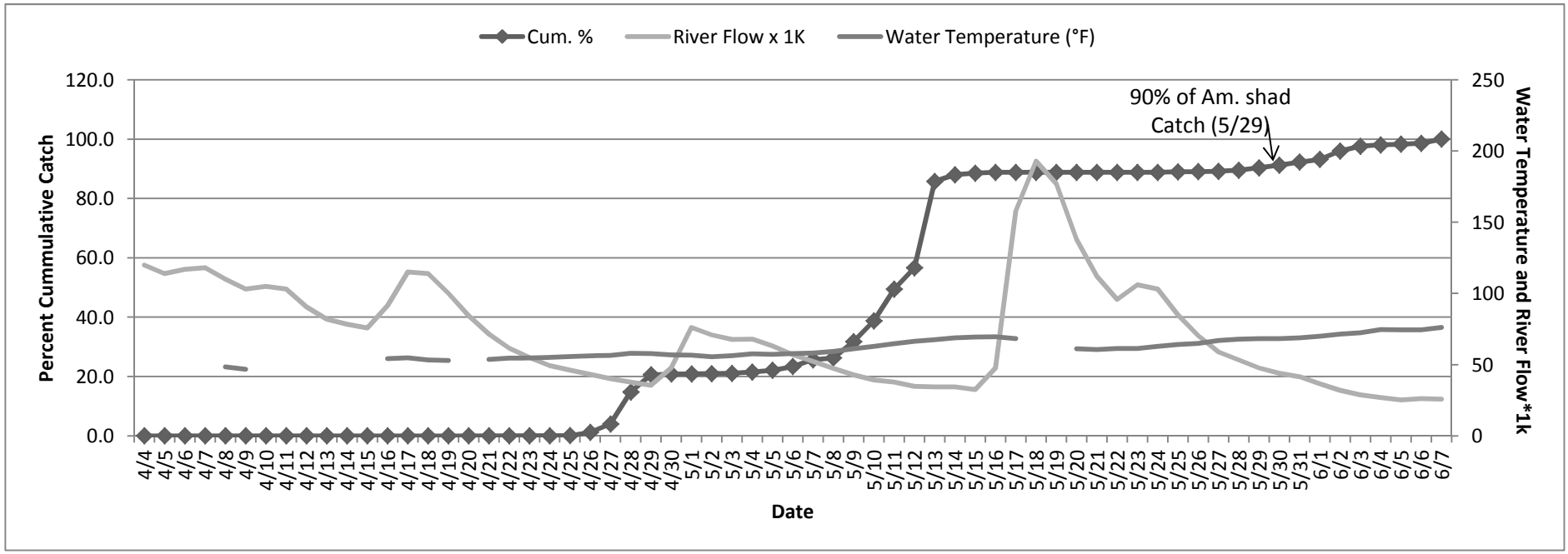

Figure 2

A plot of river flow (x 1000 cfs) (USGS Marietta Gauge) and water temperature in relation to the percent cumulative American shad passage at the Conowingo EFL, spring, 2014.