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Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2019

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December 17, 2019

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Executive Summary

Operation of the Conowingo East Fish Lift (EFL) began April 1, 2019. The water temperature was 48.8° F and river flow was 52,400 cfs during the first day of operation. The first two American Shad were passed on April 9, 2019 the fifth day of alternate day operation. The EFL operated for 46 days in 2019; with alternate day operation from April 1 through April 14, 2019 followed by daily operation from April 15 through May 31, 2019. The EFL did not operate on April 18, 21, 22, 23, and May 14, 15, 16, and 17, 2019 due to river flows ranging from 116,000 cfs to 167,000 cfs. The EFL was operated eleven (11) days when 1 to 4 spill gates were open due to river flows greater than station capacity (86,000 cfs). EFL operation was terminated on May 31, 2019 as requested by the Resource Agencies. The 2019 fish passage season experienced higher river flows on average than those observed in 2016, 2017 and 2018 which may have impacted the number of American Shad passed at the EFL this season. The 2019 fish passage season marks the twenty-ninth season of overall operation and the twenty-third year of volitional fish passage at the Conowingo EFL.

The EFL passed 832,534 fish of 22 species. Gizzard Shad (820,901), channel catfish (4,551), and American Shad (4,787) dominated the catch, and comprised 99.7% of the total fish collected and passed. Gizzard Shad alone accounted for 98.6% of the total fish collected and passed. We also noted a continued decline in species composition this season (22 species observed in 2019 compared to 25 species observed in 2018 and 33 species observed in 2017), which may have resulted from the above average river flows experienced this season. No invasive species were observed or passed during operation of the EFL this spring.

A total of 4,787 American Shad was passed. The highest daily passage of American Shad occurred on May 3 when 1,314 shad were passed upstream. American Shad passage exceeded 1,000 fish on only 1 of the 46 days of operation. On a daily basis, overall shad passage was strongest through the fishway between 1400 and 1759 hours during which nearly 55.3% (2,647) of the total American Shad passage occurred. The highest hourly passage rate (746) occurred from 1500 to 1559 hours. The highest number of American Shad passed in one hour (296) occurred from 1400 to 1459 hrs on May 3, 2019.

Fishway operations were conducted at water temperatures ranging from 48.8°F to 75.8°F and river flows between 41,300 and 118,000 cfs. High river flow events in 2019 interrupted EFL operations on April 21, 22, 23, and May 14, 15, 16, and 17, 2019; spillage occurred during EFL operations on 11 days between April 17 and May 31, 2019.

Prior to the start of EFL operations in 2019, routine pre-season 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.).

On April 3, 2019, while conducting the last lift of the day, Normandeau personnel reported hearing a loud bang as the hopper was being raised. The incident was reported immediately to Exelon personnel at the Station, and a repair crew was called in to troubleshoot the issue. The crew was unable to determine the cause of the loud bang. Normandeau personnel were directed to operate the EFL, paying close attention to the hopper and cables during each lift cycle. A similar incident occurred on May 8, 2019. During the last hour of operation, while raising the hopper, the hopper extension screen failed to sit flush on the hopper, preventing the hopper from being raised out of

the crowder channel. The hopper was successfully lowered to allow fish to exit the hopper and crowder channel area. Exelon maintenance staff were notified and a repair crew made repairs to the hopper extension screen prior to EFL operations on May 9, 2019. Approximately 30 minutes of operating time was lost due to not completing the final lift on May 8 and no fish kills were observed as a result of this incident.

Debris also created some problems for the EFL operating crew, particularly during or shortly after high river flow events. Start-up operations were delayed approximately one hour on April 17, 2019 to allow the crew to remove debris from Trash Rack A. On April 19, 2019, after clearing debris from the crowder channel prior to start-up operations, the dividing screen between the two hopper pits would not lower completely. The Exelon maintenance staff was contacted and unable to resolve the issue initially. A dive team was on site and called to ascertain the issue. The diver did not find any debris obstructing the screen's channel guides. The maintenance crew made some adjustments to the dividing screen hoist and the screen was lowered successfully. This incident resulted in six hours of lost fishing time as operations did not commence until 1400 hours that day.

Due to multiple rain events, 34 of the 46 days when viewing occurred, water clarity was less than optimum, (<20 inches of visibility at viewing window). These turbid conditions created difficult conditions at times for viewing technicians to identify Maryland DNR floy tagged American Shad. The number of Maryland DNR floy tagged American Shad observed at the Conowingo EFL in 2019 was 1 green tag from this year's tagging efforts conducted in the Conowingo tailrace.

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. A total of 70 American Shad lift mortalities, (1.4% of the total shad passed), was observed in 2019, slightly less than the range of values observed during the 1991 through 1996 trap and transport operations (1.5% to 10.5%). Normandeau and Exelon staff work closely prior to, during, and after the season to assess areas of concern that may cause injury or mortality. Close attention is directed towards hopper alignment at the trough/sluice area as well as the function of the hopper door during the sluicing operation.

1.0 Introduction

Exelon Generation Company, LLC, formerly the Susquehanna Electric Company (SECO), has operated a fish passage facility (West Fish 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.

According to the 1988 negotiated 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 the agreement was construction of the East Fish Lift Passage Facility (EFL) at Conowingo Dam (Settlement Agreement 1988). Construction of the EFL commenced in April 1990 and it was operational by spring 1991.

Upon completion of the fishways at the Holtwood, Safe Harbor, and York Haven Dams, the EFL has been operated as a volitional fish passage facility since the spring 1997.

Objectives of 2019 operation were: (1) monitor passage of migratory and resident fishes through the fishway; (2) assess fishway and trough effectiveness and make modifications as feasible; (3) assist the Muddy Run and Holtwood Hydro stations with their adult American Shad radio-telemetry studies by providing American Shad from the EFL trough for radio-tagging efforts; and (4) deter passage of Northern snake head and blue catfish (invasive species) upstream into Conowingo Pond.

2.0 Conowingo Operation

2.1 Project Operation

The Conowingo Hydroelectric Station, operational in 1928, is located at river mile 10 on the Susquehanna River (RMC 1992). The powerhouse has a peaking generating capacity of 573 MW and a hydraulic capacity of approximately 86,000 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 Mixed-Flow (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 1988 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 are maintained for the period 1 to 30 April. A minimum flow of 7,500 cfs or natural river flow (as previously noted) are 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 2019 began on April 1, 2019, with the passage of the first American Shad on April 9, 2019 (Tables 1 and 2). The EFL operated for 46 days in 2019 with alternate day operation occurring from April 1 through April 14, 2019. Daily operation of the EFL occurred from April 15 through May 31, 2019 with the exception of April 18, 21, 22, 23, and May 14, 15, 16, and 17, 2019 due to high river flows or debris (Table 2).

On April 3, 2019, while conducting the last lift of the day, Normandeau personnel reported hearing a loud bang as the hopper was being raised. The incident was reported immediately to Exelon personnel at the Station, and a repair crew was called in to troubleshoot the issue. The crew was unable to determine the cause of the loud bang. Normandeau personnel were directed to operate the EFL, paying close attention to the hopper and cables during each lift cycle. A similar incident occurred on May 8, 2019. During the last hour of operation, while raising the hopper, the hopper extension screen failed to sit flush on the hopper, preventing the hopper from being raised out of the crowder channel. The hopper was successfully lowered to allow fish to exit the hopper and crowder channel area. Exelon maintenance staff were notified and a repair crew made repairs to the hopper extension screen prior to EFL normal start-up operations (0800 hrs) on May 9, 2019. The repair crew found that the extension screen was not sitting flush on the hopper, so a small section of the screen's frame was cut to allow the frame to rest properly on the hopper when conducting a lift. Approximately 30 minutes of operation time was lost on May 8 due to not completing the final lift of the day.

Debris also created some problems for the EFL operating crew, particularly during or shortly after high river flow events (Appendix I). Start-up operations were delayed approximately one hour on April 17, 2019 to allow the crew to remove debris from Trash Rack A. On April 19, 2019, after clearing debris from the crowder channel prior to start-up operations, the dividing screen between the two hopper pits would not lower completely. The Exelon maintenance staff was contacted and unable to resolve the issue initially. A dive team was on site and called to ascertain the issue. The diver did not find any debris obstructing the screen's channel guides. The maintenance crew made some adjustments to the dividing screen hoist and the screen was lowered successfully. This incident resulted in six hours of lost fishing time as operations did not commence until 1400 hours that day.

Operation of the EFL ended on May 31, 2019 after receiving an email from Sheila Eyler (USFWS) on May 29, 2019, stating that the proposed shutdown scenario was acceptable to the Resource Agencies, (Appendix 2).

Daily operation times were planned during optimal fish passage parameters. This year, operational methodologies were influenced by natural river flow, water temperature, station generation, daily/hourly fish passage numbers, and American Shad tagging events for the Holtwood (FERC Project Number 1881) and Muddy Run Pumped Storage Project (FERC Project Number 2355) Tier II radio-telemetry studies. During American Shad tagging events, EFL operation was modified. The attraction water and the appropriate entrance gates were opened at the regular start time (0800 hrs) to attract fish into the facility. As per the station Lockout/Tag out procedure, the hopper was de-energized to ensure the safety of the tagging crew while working in the trough. Upon completion of the tagging event, the Lock out/Tag out was lifted, and the hopper was placed back in service to initiate the hopper cycle time. The 5 tagging events ranged from 25 to 84 minutes in duration, with

11 to 67 American Shad tagged per event (Appendix 3). The first lift of the day after completion of a tagging event usually occurred between 0930 hrs and 1030 hrs. EFL operation was conducted by a staff of three personnel: a lift operator, a supervising biologist, and a biological technician.

The mechanical aspects of EFL operation in 2019 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, (namely Gizzard Shad) 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 is utilized to attract fishes. Throughout the 2019 season, Entrance Gate A was only utilized three times due to the above average river flows preventing the station from generating solely with the smaller Francis turbines when the EFL was operating.

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, the biologist and technician identified and counted the 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 (PC). 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 Resource Agencies.

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 832,534 fish of 22 species passed upstream into Conowingo Pond. Gizzard Shad (820,901), channel catfish (4,551), and American Shad (4,787), dominated the catch, and comprised 99.7% % of the total fish collected and passed. Gizzard Shad alone accounted for 98.6% of the total fish

collected and passed. Peak passage occurred on April 28 when 46,774 fish, (99.8% Gizzard Shad along with 15 American Shad), were passed. We also noted a decline in species composition this season (22 species observed compared to 25 species observed in 2018, and 33 species observed in 2017), which may have resulted from the above average river flows experienced this season.

3.2 Invasive Species

No invasive species were observed during operation of the EFL this spring. However, invasive species such as Flathead Catfish have been observed in past years. Flathead Catfish have been established in the lower Susquehanna River for nearly twenty years, thus Exelon is not required to report them except for in the annual summary report. However, due to increased sightings and reports of Northern Snakehead and Blue Catfish downstream of Conowingo Dam, the Resource Agencies requested that Exelon implement voluntary measures for the 2019 season to decrease the risk that invasive species, specifically Northern Snakehead and Blue Catfish, would pass through the Conowingo EFL. The voluntary actions to be taken by Exelon during the 2019 fish passage season are listed in Appendix 4.

3.3 American Shad Passage

The EFL collected and passed 4,787 American Shad (Table 1). The first two American Shad passed on April 9, 2019 (fifth day of alternate day operation). Collection and passage of shad varied daily with 1.5% (71) of the shad passed from April 9 to April 30, 2019, 74.0% (3,545) passed from May 1 to May 13, 2019, and 24.5% (1,171) passed from May 18 to May 31, 2019 (Figures 1 and 2). American Shad passage exceeded 1,000 fish on only 1 of the 46 days of operation. The largest number of American Shad passed at the EFL occurred on May 3, 2019 (1,314).

American Shad were collected and passed at water temperatures ranging from 54.8°F to 75.8°F and river flows between 41,300 and 108,000 cfs (Table 2, and Figure 1). The average daily river flow on May 3, 2019 when American Shad passage exceeded 1,000 fish was 52,600 cfs. The average daily river flow when the EFL was operated was 67,522 cfs. The average daily river flow for the entire period (April 1 through May 31) was nearly 75,000 cfs.

The hourly passage of American Shad at the EFL is provided in Table 3. On a daily basis, overall shad passage was strongest through the fishway between 1400 and 1759 hours during which 55.3% (2,647) of the total American Shad passage occurred. The highest hourly passage rate occurred from 1500 to 1559 hours. The highest number of American Shad passed in one hour (296) occurred from 1400 to 1459 hrs on May 3, 2019.

3.4 Gizzard Shad Passage

The EFL collected and passed 820,901 Gizzard Shad in 2019 (Tables 1 and 4). Gizzard Shad passage was consistently strong from 0900 hours to 1459 hours with passage decreasing from 1500 hours to end of daily operations. Gizzard Shad accounted for 98.6% of the total fish collected and passed. Gizzard Shad passage exceeded 40,000 on 1 day, and 30,000 and 20,000 fish on 6 and 15 days, respectively. Table 5 provides the ratio of American Shad to Gizzard Shad for the years of volitional passage (1997-2019). 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 – 1:171. 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.

3.5 Alosids

A small number of Blueback herring, (15) were passed during the 2019 season (Tables 1 and 6). No Hickory Shad or Alewife were passed in spring 2019.

3.6 Maryland Tag-Recapture

American Shad were captured, floy-tagged and released downstream of Conowingo dam by the Maryland DNR. This year, the Maryland DNR caught and floy-tagged a total of 43 American Shad. Due to rain and overall high river flows, water clarity was less than optimum, (<20 inches of visibility at viewing window on 34 of the 46 days of operation). These turbid conditions made it difficult for viewing technicians at times to identify floy-tagged American Shad as they passed the viewing window. The number of Maryland DNR floy tagged American Shad observed at the Conowingo EFL in 2019 was 1 green tag, (May 24), from this year's tagging efforts conducted in the Conowingo tailrace.

3.7 Fish Mortality in EFL

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. A total of 70 American Shad lift mortalities, (1.4% of the total shad passed), was observed in 2019, slightly less than the range of values observed during the 1991 through 1996 trap and transport operations (1.5% to 10.5%). Normandeau and Exelon staff work closely prior to, during, and after the season to assess areas of concern that may cause injury or mortality. Close attention is directed towards hopper alignment at the trough/sluice area as well as the function of the hopper door during the sluicing operation.

4.0 Summary

EFL operation was initiated on April 1, 2019 on an alternate day operating schedule. The first two (2) American Shad passed on the fifth day of alternate day operation (April 9, 2019). Daily EFL operation commenced on April 15, 2019 and continued through May 31, 2019 except for April 21-23 and May 14-17 due to high river flows. The EFL passed 4,787 American Shad from April 9, 2019 through May 31, 2019. The total number of American Shad passed during the 2019 season was the lowest number of American Shad collected or passed at the EFL since operations commenced in 1991. Fish passage operations were suspended seven (7) days due to high river flows but operations were also conducted during spill conditions on eleven (11) days. The average daily river flow during the 2019 operational season was nearly 75,000 cfs, slightly higher than the average river flow value of 70,350 cfs observed in 2018. Water temperature reached 70.0° F on May 26, 2019, and increased to 75.8° by May 31, 2019. Water temperature did not appear to be a limiting factor to American Shad passage in 2019 as temperatures greater than 70°F were not regularly observed until May 26, 2019. This year marks the third year since 2015 in which the EFL passed less than 10,000 American Shad (Tables 6 and 7).

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 make "on the spot" decisions for maximizing 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 any modifications to the EFL.
4. Work with Resource Agencies regarding Invasive Species for the 2020 season.

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.

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Modified Prescription. 2016. U. S. Department of the Interior's Modified Prescription for Fishways Pursuant to Section 18 of the Federal Power Act (Modified Prescription) for the Federal Energy Regulatory commission Project No. 405 Conowingo Hydroelectric Project.

Figures

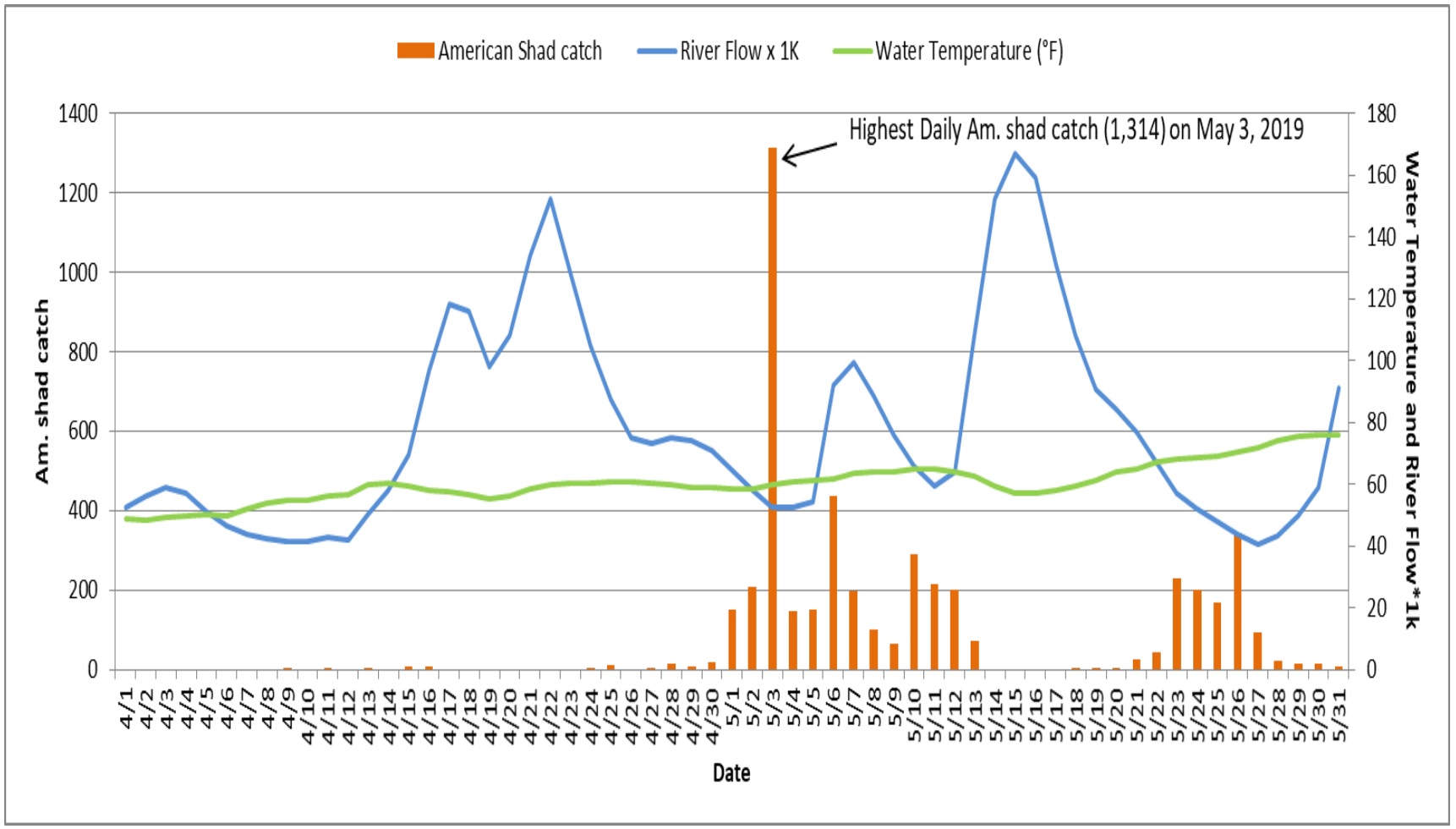

Figure 1. A plot of river flow (x 1000 cfs) (USGS Marietta Gauge) and water temperature (°F) in relation to daily American Shad passage at the Conowingo EFL, spring 2019.

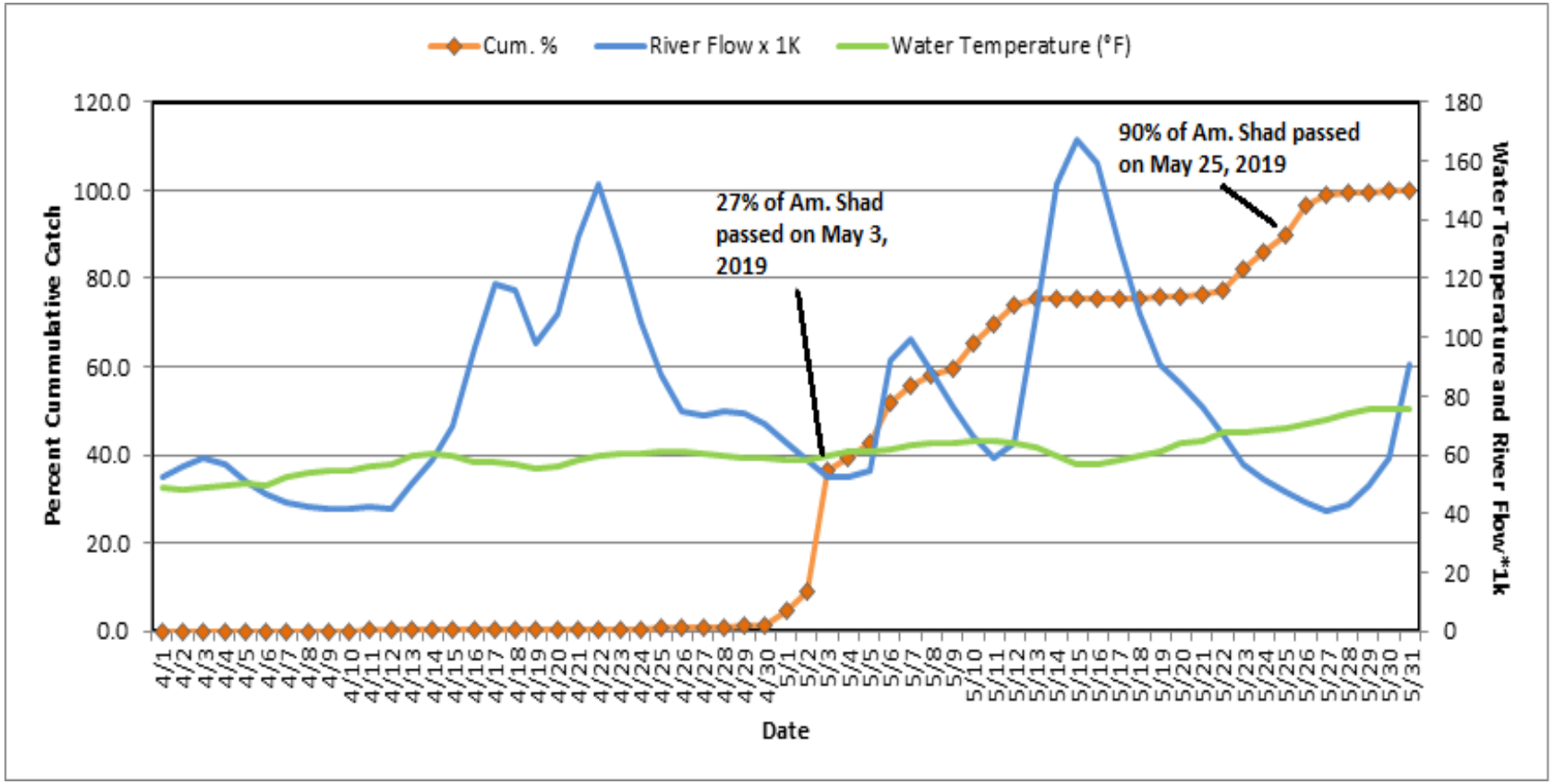

Figure 2. A plot of river flow (x 1000 cfs) (USGS Marietta Gauge) and water temperature (°F) in relation to the percent cumulative American Shad passage at the Conowingo EFL in spring, 2019.

Tables

Table 1. Summary of the daily number of fish passed by the Conowingo Dam East Fish Passage Facility in 2019.

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Summary of the daily number of fish passed by the Conowingo Dam East Fish Passage Facility in 2019.

Date	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11
Start Fishing Time	8:00		8:00		8:00		8:00		8:00		8:00
End Fishing Time	15:30		15:30		16:00		15:30		15:30		15:30
Elapsed Fishing Time	7.5		7.5		7.5		7.5		7.5		7.5
Viewing Hours	7.5		7.5		8.0		8.0		7.5		7.5
Lifts Per Day	15		15		15		15		15		15
Water Temperature (°F)*	48.8	48.5	49.2	49.8	50.2	49.7	52.2	54.0	54.8	54.9	56.0
AMERICAN EEL	0		0		0		0		0		0
AMERICAN SHAD	0		0		0		0		2		2
HICKORY SHAD	0		0		0		0		0		0
BLUEBACK HERRING	0		0		0		0		0		0
ALEWIFE	0		0		0		0		0		0
GIZZARD SHAD	135		184		600		2,774		1,761		3,540
RAINBOW TROUT	0		0		0		0		0		0
BROWN TROUT	0		0		0		0		0		1
MUSKELLUNGE	0		0		0		0		0		1
CARP	0		0		0		0		0		0
QUILLBACK	0		0		0		0		3		5
WHITE SUCKER	2		0		0		0		1		1
SHORTHEAD REDHORSE	0		1		8		1		51		40
BROWN BULLHEAD	0		0		0		0		0		0
CHANNEL CATFISH	1		0		0		0		0		0
WHITE PERCH	0		0		0		0		0		0
STRIPED BASS	0		0		0		0		0		0
ROCK BASS	0		0		0		0		0		0
BLUEGILL	0		0		0		0		0		0
SMALLMOUTH BASS	0		1		0		3		22		14
LARGEMOUTH BASS	0		0		4		0		0		0
WALLEYE	1		4		0		0		0		2
ATLANTIC NEEDLEFISH	0		0		0		0		0		0
SEA LAMPREY	0		0		0		0		0		0
Total	**139**	**0**	**190**	**0**	**612**	**0**	**2,778**	**0**	**1,840**	**0**	**3,606**

Table 1. (Continued)

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Date	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22
Start Fishing Time		8:00		8:00	8:00	9:00		14:00	8:00		
End Fishing Time		15:30		15:30	15:30	15:30		15:30	16:00		
Elapsed Fishing Time		7.5		7.5	7.5	6.5		1.5	8.0		
Viewing Hours		7.5		8.0	7.5	7.0		8.0	8.0		
Lifts Per Day		16		16	15	12		4	16		
Water Temperature (°F)	56.7	59.8	60.4	59.5	57.8	57.5	56.5	55.2	56.1	58.5	60.0
AMERICAN EEL		0		0	1	0		0	1		
AMERICAN SHAD		2		6	7	0		0	0		
HICKORY SHAD		0		0	0	0		0	0		
BLUEBACK HERRING		0		0	0	0		0	0		
ALEWIFE		0		0	0	0		0	0		
GIZZARD SHAD		13,307		29,331	15,727	4,868		1,029	4,418		
RAINBOW TROUT		2		0	0	0		0	1		
BROWN TROUT		0		0	0	0		0	0		
MUSKELLUNGE		0		0	0	0		0	0		
CARP		0		0	0	0		0	0		
QUILLBACK		3		0	2	0		0	0		
WHITE SUCKER		0		3	1	0		0	0		
SHORTHEAD REDHORSE		23		13	128	6		1	5		
BROWN BULLHEAD		0		0	0	0		0	0		
CHANNEL CATFISH		0		18	82	113		15	103		
WHITE PERCH		0		0	0	0		0	1		
STRIPED BASS		0		0	0	0		0	0		
ROCK BASS		0		0	0	0		0	0		
BLUEGILL		0		0	0	0		0	0		
SMALLMOUTH BASS		20		3	6	1		0	2		
LARGEMOUTH BASS		1		0	0	0		0	0		
WALLEYE		1		6	3	1		1	0		
ATLANTIC NEEDLEFISH		0		0	0	0		0	0		
SEA LAMPREY		0		0	0	0		0	0		
Total	**0**	**13,359**	**0**	**29,380**	**15,957**	**4,989**	**0**	**1,046**	**4,531**	**0**	**0**

Table 1. (Continued)

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Date	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3
Start Fishing Time		8:00	8:00	8:00	7:45	8:00	8:00	8:00	8:00	8:00	8:00
End Fishing Time		15:30	15:30	15:30	17:30	15:30	16:00	17:30	19:00	18:15	20:45
Elapsed Fishing Time		7.5	7.5	7.5	7.8	7.5	8.0	9.5	9.5	10.0	12.5
Viewing Hours		8.0	8.0	8.0	8.0	8.0	8.0	9.5	10.0	8.3	10.8
Lifts Per Day		15	15	15	20	17	15	19	19	19	27
Water Temperature (°F)	60.5	60.1	60.9	60.8	60.1	60	58.9	58.8	58.6	58.3	60.0
AMERICAN EEL		0	0	0	0	0	0	0	0	0	0
AMERICAN SHAD		1	10	0	2	15	7	17	150	209	1,314
HICKORY SHAD		0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING		0	0	0	1	3	2	0	0	1	0
ALEWIFE		0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD		20,562	5,144	25,467	32,280	46,719	17,191	27,196	21,003	29,605	31,460
RAINBOW TROUT		0	1	0	0	1	1	0	0	0	0
BROWN TROUT		0	1	0	0	0	5	0	0	0	0
MUSKELLUNGE		0	0	0	0	0	0	0	0	0	0
CARP		1	2	0	0	0	0	0	1	0	0
QUILLBACK		0	1	1	0	0	0	0	0	0	0
WHITE SUCKER		0	0	0	0	1	0	0	0	0	0
SHORTHEAD REDHORSE		6	40	16	1	12	1	6	15	32	228
BROWN BULLHEAD		0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH		55	28	38	6	12	3	11	3	6	12
WHITE PERCH		0	0	0	1	1	0	0	0	5	0
STRIPED BASS		0	0	0	0	2	0	1	0	1	0
ROCK BASS		0	0	0	0	0	0	0	0	0	0
BLUEGILL		0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS		2	0	5	1	1	0	5	0	6	13
LARGEMOUTH BASS		0	0	0	0	0	7	0	4	0	0
WALLEYE		0	3	8	3	7	7	5	8	7	14
ATLANTIC NEEDLEFISH		0	0	0	0	0	0	0	0	0	0
SEA LAMPREY		0	0	0	0	0	0	0	2	1	0
Total	**0**	**20,627**	**5,230**	**25,535**	**32,295**	**46,774**	**17,224**	**27,241**	**21,186**	**29,873**	**33,041**

Table 1. (Continued)

Table 1 (continued) Page 4 of 6

Date	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14
Start Fishing Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	
End Fishing Time	18:00	18:00	19:00	18:00	18:00	18:00	18:30	18:00	18:00	18:40	
Elapsed Fishing Time	9.5	9.5	11.0	9.5	9.0	9.5	10.0	9.5	9.5	9.5	
Viewing Hours	10.0	10.0	8.5	10.0	10.0	10.0	10.5	10.0	10.0	8.0	
Lifts Per Day	20	19	18	19	16	20	21	20	19	15	
Water Temperature (°F)	60.8	61	61.6	63.6	64.0	64.0	64.9	65	63.8	62.4	59.5
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0	
AMERICAN SHAD	146	149	435	198	102	66	289	214	200	73	
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	
BLUEBACK HERRING	0	0	0	1	0	0	0	0	0	0	
ALEWIFE	0	0	0	0	0	0	0	0	0	0	
GIZZARD SHAD	22,306	32,721	20,392	18,913	25,636	32,637	30,105	28,683	22,640	9,948	
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	5	0	0	1	0	0	0	
QUILLBACK	0	0	0	1	0	0	0	0	0	0	
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0	
SHORTHEAD REDHORSE	170	32	96	74	22	5	3	3	4	1	
BROWN BULLHEAD	0	1	0	4	1	9	0	1	1	3	
CHANNEL CATFISH	11	6	16	258	111	99	78	51	198	105	
WHITE PERCH	10	218	4	10	3	1	0	0	33	0	
STRIPED BASS	2	1	1	3	1	0	0	1	5	5	
ROCK BASS	0	1	0	0	0	0	0	0	0	0	
BLUEGILL	0	0	0	0	0	0	0	1	0	0	
SMALLMOUTH BASS	11	12	1	13	1	5	1	5	0	2	
LARGEMOUTH BASS	0	1	0	0	0	0	0	0	0	0	
WALLEYE	8	43	28	20	19	12	3	15	16	0	
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	0	0	
SEA LAMPREY	1	1	2	1	1	0	0	0	2	0	
Total	**22,665**	**33,186**	**20,975**	**19,501**	**25,897**	**32,834**	**30,480**	**28,974**	**23,099**	**10,137**	**0**

Table 1. (Continued)

Table 1 (continued) Page 5 of 6

Date	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25
Start Fishing Time				8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00
End Fishing Time				18:00	18:00	18:00	18:00	18:30	19:00	18:00	18:00
Elapsed Fishing Time				9.5	9.5	9.5	9.5	10.3	11.0	9.5	9.5
Viewing Hours				10.0	10.0	10.0	10.0	10.5	11.3	7.5	10.0
Lifts Per Day				19	18	19	19	23	23	15	19
Water Temperature (°F)	57.1	57.1	58.0	59.5	61	64.1	65	67.4	67.9	68.5	68.9
AMERICAN EEL				0	0	1	0	0	0	0	0
AMERICAN SHAD				4	4	5	27	43	228	199	167
HICKORY SHAD				0	0	0	0	0	0	0	0
BLUEBACK HERRING				0	0	0	1	0	0	0	6
ALEWIFE				0	0	0	0	0	0	0	0
GIZZARD SHAD				6,218	12,070	17,231	22,221	39,236	27,217	23,489	12,119
RAINBOW TROUT				0	0	0	0	0	0	0	1
BROWN TROUT				0	0	0	0	0	0	0	0
MUSKELLUNGE				0	0	0	0	0	0	2	0
CARP				0	0	0	2	0	0	0	0
QUILLBACK				0	0	0	0	0	3	4	10
WHITE SUCKER				0	0	0	0	0	0	0	0
SHORTHEAD REDHORSE				3	1	4	4	0	3	2	2
BROWN BULLHEAD				0	1	0	3	2	2	4	4
CHANNEL CATFISH				78	35	106	123	34	178	134	114
WHITE PERCH				0	0	0	0	1	0	0	0
STRIPED BASS				1	0	0	3	1	0	2	1
ROCK BASS				0	0	0	0	0	0	0	0
BLUEGILL				0	0	1	0	0	0	0	0
SMALLMOUTH BASS				0	0	6	2	7	10	15	5
LARGEMOUTH BASS				0	0	0	0	0	0	0	0
WALLEYE				0	0	4	1	9	17	14	5
ATLANTIC NEEDLEFISH				0	0	0	0	0	0	0	0
SEA LAMPREY				0	1	0	0	0	0	0	0
Total	**0**	**0**	**0**	**6,304**	**12,112**	**17,358**	**22,387**	**39,333**	**27,658**	**23,865**	**12,434**

Table 1. (Continued)

Table 1 (continued) Page 6 of 6

Date	5/26	5/27	5/28	5/29	5/30	5/31	
Start Fishing Time	8:00	8:00	8:00	8:00	8:00	8:00	**Season**
End Fishing Time	18:00	18:00	18:00	18:00	18:00	18:00	**Total**
Elapsed Fishing Time	9.5	9.5	9.5	9.5	9.5	9.5	403
Viewing Hours	10.0	10.0	10.0	10.0	10.0	10.0	415
Lifts Per Day	22	19	19	13	11	12	788
Water Temperature (°F)	70.5	71.7	73.9	75.5	75.8	75.8	
AMERICAN EEL	0	0	0	0	0	0	3
AMERICAN SHAD	343	94	22	15	13	7	4,787
HICKORY SHAD	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	15
ALEWIFE	0	0	0	0	0	0	0
GIZZARD SHAD	27,886	13,549	10,639	12,866	12,113	5,765	820,901
RAINBOW TROUT	0	0	0	0	0	0	7
BROWN TROUT	0	0	0	0	0	0	7
MUSKELLUNGE	0	0	0	0	0	0	3
CARP	0	2	3	5	29	4	55
QUILLBACK	2	1	23	10	16	9	94
WHITE SUCKER	0	0	0	0	0	0	9
SHORTHEAD REDHORSE	1	1	1	0	0	0	1,066
BROWN BULLHEAD	3	0	3	0	0	2	44
CHANNEL CATFISH	90	282	643	333	395	567	4,551
WHITE PERCH	0	0	0	0	1	0	289
STRIPED BASS	3	2	1	5	1	2	45
ROCK BASS	0	0	0	0	0	0	1
BLUEGILL	0	0	0	0	0	0	2
SMALLMOUTH BASS	7	6	2	3	7	2	228
LARGEMOUTH BASS	2	0	0	0	0	0	19
WALLEYE	53	20	8	2	10	4	392
ATLANTIC NEEDLEFISH	0	0	0	0	1	1	2
SEA LAMPREY	1	0	0	0	0	0	13
Total	**28,391**	**13,957**	**11,345**	**13,239**	**12,586**	**6,363**	**832,534**

*Hobo water temperature data logger placed in EFL trough.

Table 2. Summary of American Shad catch, Maryland DNR recaptures, daily average river flow (USGS Gauge Marietta) and water temperature, turbidity (secchi), unit operation, entrance gates utilized, attraction flow, and average project water elevations during operation of the Conowingo Dam EFL in 2019.

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
4/1	0		52,400	48.8	24	11	C	310	23.5	106.2	0
4/2	DNO		56,300	48.5							
4/3	0		58,900	49.2	26	11	C	310	23.1	107.8	0
4/4	DNO		56,900	49.8							
4/5	0		51,300	50.2	26	11	C	310	23.0	106.9	0
4/6	DNO		46,600	49.7							
4/7	0		43,800	52.2	36	7	C/A	310	21.0	107.2	0
4/8	DNO		42,400	54.0							
4/9	2		41,300	54.8	36	7	C	310	22.0	106.6	0
4/10	DNO		41,500	54.9							
4/11	2		42,700	56.0	36	7	C	310	22.4	107.2	0
4/12	DNO		42,000	56.7							
4/13	2		50,200	59.8	36	7	C	310	22.2	107.0	0
4/14	DNO		58,000	60.4							
4/15	6		69,700	59.5	32	11	C	310	23.5	105.8	0
4/16	7		96,800	57.8	10	11	C	310	23.5	106.4	0
4/17	0		118,000	57.5	10	11	C	310	24.5	108.7	2
4/18	DNO		116,000	56.5							
4/19	0		98,100	55.2	8-10	11	C	310	25.2	108.7	2
4/20	0		108,000	56.1	4-6	11	C	310	23.7	106.9	0
4/21	DNO		134,000	58.5				310			
4/22	DNO		152,000	60.0				310			
4/23	DNO		129,000	60.5				310			
4/24	1		105,000	60.1	4-6	11	C	310	25.0	108.5	3
4/25	10		87,300	60.9	4-6	11	C	310	23.8	107.7	0
4/26	0		75,100	60.8	4-6	11	C	310	23.5	106.5	0
4/27	2		73,200	60.1	12	9	C	310	22.5	106.2	0
4/28	15		75,000	60.0	15	11	C	310	22.8	106.0	0
4/29	7		74,000	58.9	12	11	C	310	22.3	106.7	0
4/30	17		70,800	58.8	10-12	11	C	310	23.5	106.2	0
5/1	150		64,200	58.6	15-18	11	C	310	22.4	106.6	0
5/2	209		58,200	58.3	15-18	11	C	310	23.4	107.2	0
5/3	1,314		52,600	60.0	24	10	C	310	23.3	106.0	0
5/4	146		52,500	60.8	12	9	C	310	22.4	106.7	0
5/5	149		54,300	61.0	24	7	C	310	22.9	106.0	0
5/6	435		92,200	61.6	8-12	7	C	310	23.7	105.6	0
5/7	198		99,500	63.6	18	9	C/B	310	25.0	108.5	2

Table 2. (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)	Crest Gates Open
5/8	102		88,800	64.0	12-15	10	C	310	23.8	107.8	2
5/9	66		76,000	64.0	8-12	10	C	310	23.2	106.2	0
5/10	289		66,000	64.9	10-12	10	C	310	24.5	105.8	0
5/11	214		59,300	65.0	12-18	10	C	310	22.9	107.5	0
5/12	200		64,100	63.8	14	9	C	310	23.1	106.0	0
5/13	73		108,000	62.4	6	10	C	310	25.3	108.4	4
5/14	DNO		152,000	59.5							
5/15	DNO		167,000	57.1							
5/16	DNO		159,000	57.1							
5/17	DNO		131,000	58.0							
5/18	4		108,000	59.5	6-8	8	C	310	24.2	107.6	2
5/19	4		90,500	61.0	8-10	8	C	310	23.7	107.7	1
5/20	5		84,300	64.1	14	7	C	310	24.2	108.4	3
5/21	27		76,600	65.0	14-18	7	C	310	23.7	108.3	3
5/22	43		66,600	67.4	10-18	7	C	310	22.8	106.7	0
5/23	228		57,100	67.9	12-16	8	C	310	23.1	108.0	0
5/24	199	*1 green*	51,800	68.5	12-14	6	C	310	22.1	107.2	0
5/25	167		47,700	68.9	14	8	A/C	310	22.9	107.5	0
5/26	343		43,500	70.5	20	8	C	310	22.3	107.8	0
5/27	94		40,700	71.7	18	8	A/C	310	20.1	108.0	0
5/28	22		43,200	73.9	18	8	C	310	22.9	107.7	0
5/29	15		49,600	75.5	22	9	C	310	23.3	106.8	0
5/30	13		59,100	75.8	18	6	C	310	21.2	107.2	0
5/31	7		90,900	75.8	12	10	C	310	23.5	107.2	1

DNO = Did Not Operate Green (1) = 2019 MDNR floy tags

Table 3. Hourly summary of American Shad passage at the Conowingo Dam East Fish Passage Facility in 2019.

Date:	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Observation Time-Start:	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO
Observation Time-End:	16:00		16:00		16:00		16:00		16:00		16:00	
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0		0		0		0		1		0	
0900 to 0959	0		0		0		0		0		0	
1000 to 1059	0		0		0		0		0		0	
1100 to 1159	0		0		0		0		0		0	
1200 to 1259	0		0		0		0		1		1	
1300 to 1359	0		0		0		0		0		0	
1400 to 1459	0		0		0		0		0		0	
1500 to 1559	0		0		0		0		0		1	
1600 to 1659												
1700 to 1759												
1800 to 1859												
1900 to 1959												
2000 to 2059												
Total	0	0	0	0	0	0	0	0	2	0	2	0

Date:	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24
Observation Time-Start:	8:00	DNO	8:00	8:00	9:00	DNO	8:00	8:00	DNO	DNO	DNO	8:00
Observation Time-End:	16:00		16:00	16:00	16:00		16:00	16:00				16:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	1		0	0	0		0	0				0
0900 to 0959	0		0	0	0		0	0				0
1000 to 1059	1		0	0	0		0	0				0
1100 to 1159	0		0	2	0		0	0				0
1200 to 1259	0		2	0	0		0	0				0
1300 to 1359	0		1	1	0		0	0				0
1400 to 1459	0		0	1	0		0	0				1
1500 to 1559	0		3	3	0		0	0				0
1600 to 1659												
1700 to 1759												
1800 to 1859												
1900 to 1959												
2000 to 2059												
Total	2	0	6	7	0	0	0	0	0	0	0	1

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:	8:00	8:00	8:00	8:00	8:00	8:30	8:00	10:00	10:00	8:00	8:00	10:30
Observation Time-End:	16:00	16:00	16:00	16:00	16:00	18:00	18:00	18:15	20:45	18:00	18:00	19:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0	0	0	0	2	0	2			14	22	
0900 to 0959	0	0	0	2	0	0	0			4	12	
1000 to 1059	2	0	0	0	0	0	3	58	55	11	5	39
1100 to 1159	0	0	0	1	1	0	3	45	49	9	2	40
1200 to 1259	1	0	1	1	0	1	1	11	74	17	9	41
1300 to 1359	2	0	0	3	1	0	2	13	40	13	18	32
1400 to 1459	3	0	0	0	1	0	4	10	296	22	10	36
1500 to 1559	2	0	1	8	2	1	16	14	218	20	35	52
1600 to 1659						9	61	23	83	19	25	60
1700 to 1759						6	58	30	116	17	11	78
1800 to 1859								5	177			57
1900 to 1959									168			
2000 to 2059									38			
Total	10	0	2	15	7	17	150	209	1,314	146	149	435

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	5/18
Observation Time-Start:	8:00	8:00	8:00	8:00	8:00	8:00	10:00	DNO	DNO	DNO	DNO	8:00
Observation Time-End:	18:00	18:00	18:00	18:30	18:00	18:00	18:00					18:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	48	8	0	12	17	36						0
0900 to 0959	24	0	3	1	10	15						1
1000 to 1059	6	2	3	8	3	8	22					0
1100 to 1159	10	3	3	11	13	6	7					1
1200 to 1259	6	7	0	5	8	26	8					0
1300 to 1359	8	8	3	0	5	31	13					0
1400 to 1459	7	16	3	14	9	20	10					0
1500 to 1559	16	23	8	40	36	48	7					1
1600 to 1659	21	29	20	54	26	8	4					0
1700 to 1759	52	6	23	84	87	2	2					1
1800 to 1859				60								
1900 to 1959												
2000 to 2059												
Total	198	102	66	289	214	200	73	0	0	0	0	4

Date:	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
Observation Time-Start:	8:00	8:00	8:00	8:00	8:00	10:30	8:00	8:00	8:00	8:00	8:00	8:00
Observation Time-End:	18:00	18:00	18:00	18:30	19:15	18:00	18:00	18:00	18:00	18:00	18:00	18:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	0	1	0	0	13		3	6	19	1	0	0
0900 to 0959	0	1	1	0	8		14	19	2	1	4	0
1000 to 1059	0	0	0	1	0	21	7	44	2	5	0	0
1100 to 1159	0	0	0	0	12	24	21	40	3	3	1	0
1200 to 1259	0	1	1	3	4	25	30	38	14	4	4	1
1300 to 1359	1	0	1	2	27	32	16	36	3	2	1	1
1400 to 1459	0	2	2	8	24	11	40	33	24	1	2	1
1500 to 1559	0	0	4	6	64	36	14	50	14	2	1	0
1600 to 1659	1	0	3	4	51	17	6	44	10	2	1	4
1700 to 1759	2	0	15	11	8	33	16	33	3	1	1	6
1800 to 1859				8	14							
1900 to 1959					3							
2000 to 2059												
Total	4	5	27	43	228	199	167	343	94	22	15	13

Date:	5/31	Season Total
Observation Time-Start:	8:00	
Observation Time-End:	18:00	
Military Time (hrs)		
0600 to 0659		**0**
0700 to 0759		**0**
0800 to 0859	3	**209**
0900 to 0959	0	**122**
1000 to 1059	0	**306**
1100 to 1159	1	**311**
1200 to 1259	0	**346**
1300 to 1359	0	**316**
1400 to 1459	0	**611**
1500 to 1559	0	**746**
1600 to 1659	3	**588**
1700 to 1759	0	**702**
1800 to 1859		**321**
1900 to 1959		**171**
2000 to 2059		**38**
Total	7	**4,787**

Table 4. Hourly summary of Gizzard Shad passage at the Conowingo Dam East Fish Passage Facility in 2019.

Date:	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12
Observation Time-Start:	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO	8:00	DNO
Observation Time-End:	16:00		16:00		16:00		16:00		16:00		16:00	
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	48		77		212		10		10		62	
0900 to 0959	34		42		122		92		167		865	
1000 to 1059	8		29		51		85		267		119	
1100 to 1159	16		11		32		494		313		432	
1200 to 1259	7		9		19		184		366		189	
1300 to 1359	2		0		54		145		90		164	
1400 to 1459	8		15		40		1190		101		883	
1500 to 1559	12		1		70		574		447		826	
1600 to 1659												
1700 to 1759												
1800 to 1859												
1900 to 1959												
2000 to 2059												
Total	135	0	184	0	600	0	2,774	0	1,761	0	3,540	0

Date:	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24
Observation Time-Start:	8:00	DNO	8:00	8:00	9:00	DNO	9:00	8:00	DNO	DNO	DNO	8:00
Observation Time-End:	16:00		16:00	16:00	16:00		16:00	16:00				16:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	2417		3517	340			221	1031				1030
0900 to 0959	972		3741	2260	1510		0	105				2390
1000 to 1059	1253		3774	1380	588		0	231				2030
1100 to 1159	2070		2881	2770	642		8	397				3353
1200 to 1259	672		3273	2077	665		0	617				2430
1300 to 1359	2274		4510	2890	311		0	546				3730
1400 to 1459	1181		3973	2320	533		739	729				3429
1500 to 1559	2468		3662	1690	619		61	762				2170
1600 to 1659												
1700 to 1759												
1800 to 1859												
1900 to 1959												
2000 to 2059												
Total	13,307	0	29,331	15,727	4,868	0	1,029	4,418	0	0	0	20,562

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:	8:00	8:00	7:45	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Observation Time-End:	16:00	16:00	16:00	16:00	16:00	18:00	18:00	18:15	20:45	18:00	18:00	19:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	915	2724	4400	3825	2130	2878	2166	5164	2630	871	2320	1756
0900 to 0959	603	3374	4820	9681	1898	3410	3019	6810	4160	1903	3814	3843
1000 to 1059	323	2712	3930	6769	2765	3360	2121	3092	3310	3185	4305	2874
1100 to 1159	590	3166	5110	3427	2034	3822	2003	3117	3570	1957	5408	2327
1200 to 1259	531	4299	3860	7827	2382	4111	1652	2957	3640	3210	5130	1894
1300 to 1359	378	3562	3120	7672	2107	2543	2361	2437	2530	2744	3176	2019
1400 to 1459	907	3368	4280	5178	1693	1803	1809	3123	2610	2101	3052	2111
1500 to 1559	897	2262	2760	2340	2182	1425	2332	2500	4390	2592	2456	2500
1600 to 1659						2515	1550	405	1670	2014	2510	1068
1700 to 1759						1329	1990		2010	1729	550	
1800 to 1859									940			
1900 to 1959												
2000 to 2059												
Total	5,144	25,467	32,280	46,719	17,191	27,196	21,003	29,605	31,460	22,306	32,721	20,392

Table 4. (Continued)

Date:	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Observation Time-Start:	8:00	8:00	8:00	8:00	8:00	8:00	8:00	DNO	DNO	DNO	DNO	8:00
Observation Time-End:	18:00	18:00	18:00	18:30	18:00	18:00	18:00					18:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	1340	2107	2230	1562	2329	2310						90
0900 to 0959	2290	2692	4148	4239	3190	4290						551
1000 to 1059	1720	3342	3730	4078	3264	1680	2331					327
1100 to 1159	2950	3454	2428	4317	2564	3840	1327					726
1200 to 1259	3060	2721	4534	3781	2782	1770	1449					805
1300 to 1359	1760	3009	3943	2680	2115	2720	1394					997
1400 to 1459	1183	2763	3483	2867	3471	2600	1188					629
1500 to 1559	1670	2970	3504	2200	3264	1470	1292					541
1600 to 1659	1620	2461	2442	2009	2961	1440	657					824
1700 to 1759	1320	117	2195	1481	2743	520	310					728
1800 to 1859				891								
1900 to 1959												
2000 to 2059												
Total	18,913	25,636	32,637	30,105	28,683	22,640	9,948	0	0	0	0	6,218

Date:	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
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	8:00
Observation Time-End:	18:00	18:00	18:00	18:30	19:15	18:00	18:00	18:00	18:00	18:00	18:00	18:00
Military Time (hrs)												
0600 to 0659												
0700 to 0759												
0800 to 0859	613	527	720	4611	1927		249	410	110	339	93	527
0900 to 0959	1265	2126	2800	4407	5824		990	3286	390	983	480	760
1000 to 1059	988	2814	2043	5775	3279	2190	1071	3179	352	1778	2275	1432
1100 to 1159	862	2056	2954	4962	3219	1100	1515	2193	2130	1723	1600	2042
1200 to 1259	1822	2187	3256	4211	2387	4010	1943	3913	2500	1427	2900	1410
1300 to 1359	1872	1481	2656	3447	1937	6360	1637	4329	2605	857	1120	1784
1400 to 1459	1273	3150	2686	3087	1876	3567	1139	2980	2652	1182	1835	1665
1500 to 1559	1140	1125	1702	2706	2319	2710	1508	2742	1330	997	420	965
1600 to 1659	1614	794	2442	2387	1700	2112	958	3687	1040	744	1372	1211
1700 to 1759	621	971	962	2765	1480	1440	1109	1167	440	609	771	317
1800 to 1859				878	891							
1900 to 1959					378							
2000 to 2059												
Total	12,070	17,231	22,221	39,236	27,217	23,489	12,119	27,886	13,549	10,639	12,866	12,113

Date:	5/31	**Season Total**
Observation Time-Start:	8:00	
Observation Time-End:	18:00	
Military Time (hrs)		
0600 to 0659		**0**
0700 to 0759		**0**
0800 to 0859	610	**63,458**
0900 to 0959	583	**104,929**
1000 to 1059	487	**96,696**
1100 to 1159	1123	**99,035**
1200 to 1259	601	**105,470**
1300 to 1359	767	**98,835**
1400 to 1459	452	**92,904**
1500 to 1559	580	**79,153**
1600 to 1659	291	**46,498**
1700 to 1759	271	**29,945**
1800 to 1859		**3,600**
1900 to 1959		**378**
2000 to 2059		**0**
Total	5,765	**820,901**

Table 5. Summary Information for Conowingo EFL Volitional Passage, 1997 through 2019.

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	1/112
2015	46	433	674	754,057	8,341	742,661	13	1,119	1/89
2016	55	536	860	865,179	14,276	833,681	34	1,006	1/58
2017	46	463	849	844,917	16,265	813,687	65	995	1/50
2018	48	416	714	1,040,789	6,992	1,022,819	60	1,458	1/146
2019	**46**	**415**	**788**	**832,534**	**4,787**	**820,901**	**15**	**1,057**	**1/171**

Table 6. Summary of selected operation and fish catch statistics at the Conowingo Dam East Fish Passage Facility, 1991 to 2019.

Year	Number of Days Operated	Number of Lifts	Operating Time (hrs)	Number of Species	American shad	Blueback herring	Alewife	Hickory shad
1991	60	1168	647.2	42	13,897	13,149	323	0
1992	49	599	454.1	35	26,040	261	3	0
1993	42	848	463.5	29	8,203	4,574	0	0
1994	55	955	574.8	36	26,715	248	5	1
1995	68	986	706.2	36	46,062	4,004	170	1
1996	49	599	454.1	35	26,040	261	3	0
1997	64	652	640.0	36	90,971	242,815	63	0
1998	50	652	640.0	33	39,904	700	6	0
1999	52	610	467.0	31	69,712	130,625	14	0
2000	45	570	367.8	30	153,546	14,963	2	0
2001	43	559	359.8	30	193,574	284,921	7,458	0
2002	49	560	440.7	31	108,001	2,037	74	6
2003	44	645	416.6	25	125,135	530	21	0
2004	44	590	390.3	30	109,360	101	89	0
2005	52	541	434.3	30	68,926	4	0	0
2006	61	619	429.8	32	56,899	0	0	4
2007	39	479	335.3	31	25,464	460	429	0
2008	51	483	407.0	29	19,914	1	4	0
2009	57	618	495.6	30	29,272	71	160	0
2010	59	685	526.2	38	37,757	4	1	0
2011	15	259	142.4	24	20,571	17	2	20
2012	62	1230	633.7	35	22,143	25	27	0
2013	60	925	575.6	27	12,733	7	0	1
2014	54	988	509	34	10,425	25	111	2
2015	46	674	433	28	8,341	3	10	8
2016	55	860	536	27	14276	34	0	0
2017	46	849	463	32	16,265	59	6	0
2018	48	714	416	25	6992	2	58	0
2019	46	788	415	22	4,787	15	0	0

Table 7. Summary of American Shad passage counts and percent passage values at Susquehanna River dams, 1997-2019.

	Conowingo East	Holtwood		Safe Harbor		York Haven	
		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%
2015	8,341	5,286	63.3%	3,896	73.7%	43	1.1%
2016	14,276	6,718	47.0%	4,242	63.1%	178	4.2%
2017	16,265	3,171	19.5%	2,007	63.3%	62	3.1%
2018	6,992	1,483	21.2%	661	44.6%	N/A	N/A
2019	**4,787**	**571**	**11.9%**	**316**	**55.3%**	**N/A**	**N/A**

*Includes all American Shad passed at Holtwood during resident and migratory fish passage operations.
**Visual counts not conducted at York Haven in spring, 2019.

Appendices 1-4

Appendix 1. Conowingo East Fish Lift Daily Reports with explanation of issues that interrupted normal operating procedures.

Conowingo East Fish Lift Daily Report

Daily Fish Lift Operational Report		Daily Fish Passage Report		YTD Am. Shad Total
Date	4/17/2019	American Shad	0	**19**
Viewing Hrs.	7.0	Blueback Herring	0	
Number Lifts/Day	12	Alewife	0	
Water Temp. (F)	57.6	Gizzard Shad	4868	
Water Usage	118.1	Hickory Shad	0	
Actual EFL Run Hours/Day	7.00	Striped Bass	0	
Scheduled EFL Run Hours/Day	8.00	Other Fish	121	
% Fish Lift Availability	88%	Total Number of Fish	**4989**	
Hrs/Day EFL Out of Service	1.00			
Fishing but Not Lifting (Hrs)	0.00			

NORMANDEAU environmental consultants

Reason: Due to debris removal, the lift operation start-up time was delayed an hour.

Appendix 1. (Continued) Conowingo East Fish Lift Daily Reports with explanation of issues that interrupted normal operating procedures.

Conowingo East Fish Lift Daily Report

Daily Fish Lift Operational Report		Daily Fish Passage Report		YTD Am. Shad Total
Date	4/19/2019	American Shad	0	**19**
Viewing Hrs.	8.0	Blueback Herring	0	
Number Lifts/Day	4	Alewife	0	
Water Temp. (F)	56.1	Gizzard Shad	1029	
Water Usage	62.9	Hickory Shad	0	
Actual EFL Run Hours/Day	2.00	Striped Bass	0	
Scheduled EFL Run Hours/Day	8.00	Other Fish	17	
% Fish Lift Availability	25%	Total Number of Fish	**1046**	
Hrs/Day EFL Out of Service	6.00			
Fishing but Not Lifting (Hrs)	0.00			

NORMANDEAU environmental consultants

Reason: After clearing debris from the EFL crowder channel prior to today's operation, the hopper dividing screen failed to lower completely. This screen must be lowered completely to prevent fish from swimming into areas upstream of the first hopper pit. The maintenance crew was contacted and initially unable to successfully lower the dividing screen. A dive team was on site and they were dispatched to inspect the crowder channel upstream of the first hopper. The diver did not find any debris obstructing the dividing screen channel guides. Maintenance crew made some adjustments to the dividing screen hoist and the screen was successfully lowered. Fishing operations resumed at approximately 1400 hours. Conowingo EFL operations for the next few days will be tentative if the forecasted rainfall does in fact impact the river.

Appendix 1. (Continued) Conowingo East Fish Lift Daily Reports with explanation of issues that interrupted normal operating procedures.

Conowingo East Fish Lift Daily Report

Daily Fish Lift Operational Report		Daily Fish Passage Report		YTD Am. Shad Total
Date	5/8/2019	American Shad	102	2774
Viewing Hrs.	10.0	Blueback Herring	0	
Number Lifts/Day	16	Alewife	0	
Water Temp. (F)	64.4	Gizzard Shad	25636	
Water Usage	151.0	Hickory Shad	0	
Actual EFL Run Hours/Day	9.00	Striped Bass	1	
Scheduled EFL Run Hours/Day	10.00	Other Fish	158	
% Fish Lift Availability	90%	Total Number of Fish	25897	
Hrs/Day EFL Out of Service	1.00			
Fishing but Not Lifting (Hrs)	0.00			

NORMANDEAU environmental consultants

Reason: We had a mechanical issue with the hopper in last the hour of operation.

Appendix 2. Operation of the EFL ended on May 31, 2019 after receiving an email from Sheila Eyler (USFWS) on May 29, 2019, stating that the proposed shutdown scenario was acceptable to the Resource Agencies.

Ray Bleistine

From: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>
Sent: Wednesday, May 29, 2019 3:17 PM
To: Eyler, Sheila; Ray Bleistine
Cc: Lester, Katie; Thomas O'Connor
Subject: RE: [EXTERNAL] Susquehanna River Fish Lift Operation Shutdown Plan 2019

Thanks Sheila.

Andrea

Andrea Danucalov
FERC License Compliance Manager

Exelon

Exelon Generation
300 Exelon Way
Kennett Square, PA 19348
Skype: 267.533.1125
Cell: 610.301.1664
andrea.danucalov@exeloncorp.com

From: Eyler, Sheila <sheila_eyler@fws.gov>
Sent: Wednesday, May 29, 2019 3:11 PM
To: Ray Bleistine <rbleistine@normandeau.com>
Cc: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>; Lester, Katie <Kathleen.Lester@brookfieldrenewable.com>; Thomas O'Connor <toconnor@midatlantichydro.com>
Subject: [EXTERNAL] Susquehanna River Fish Lift Operation Shutdown Plan 2019

Good afternoon,

Due to the increasing water temperatures, predicted high flows, and low American Shad catches at the East Fish Lift, the Resource Agencies recommend beginning the fishway shutdown protocol for the Susquehanna River Fish Lifts.

We recommend the following timing:
1. Conowingo East Fish Lift operations at the end of the day Friday May 31
2. Holtwood Migratory Fish Passage Season end at the end of the day Wednesday June 5 (to allow 5 days passage after the final day of operation at Conowingo)
3. Safe Harbor Fish Lift Operations to end at the end of the day Thursday June 6.
4. York Haven will continue status quo operations until December 15

Please let me know if you have any questions or concerns about the proposed timing.

Thank you,
Sheila Eyler
U.S. Fish & Wildlife Service
Mid-Atlantic Fish and Wildlife Conservation Office
177 Admiral Cochrane Dr., Annapolis, MD 21401

Appendix 3. The 5 American Shad tagging events at the Conowingo EFL in 2019.

Summary of Tier II radio-telemetry tagging events in the Conowingo EFL trough during spring, 2019.

Release No.	Date	No. Released	Water Temp °F	Start Tagging	End Tagging	Total Tagging Time (minutes)
1	5/2/2019	35	57.6	900	949	49
2	5/3/2019	33	59.2	850	930	40
3	5/6/2019	52	61.2	910	1020	70
4	5/13/2019	11	62.6	950	1015	25
5	5/24/2019	67	68.2	841	1005	84

Appendix 4. Voluntary invasive species protocol measures at Conowingo EFL in 2019.

From: Eyler, Sheila <sheila_eyler@fws.gov>
Sent: Wednesday, February 20, 2019 12:07 PM
To: Danucalov, Andrea <andrea.danucalov@exeloncorp.com>; Lester, Katie <Kathleen.Lester@brookfieldrenewable.com>
Subject: 2019 SRAFRC BMPs for Invasive Species at Susquehanna River Fish Lifts

Andrea and Katie,

The Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) again requests that Exelon and Brookfield implement voluntary measures for the 2019 fish passage season to minimize the spread of invasive species through the fish lifts. The measures are identical to what was implemented in the 2018 season with updated dates in the attached document.

If you have questions or concerns about this document or would like SRAFRC to consider edits to the document, please let me know.

Thank you,

Sheila Eyler

SRAFRC Coordinator

U.S. Fish & Wildlife Service
Mid-Atlantic Fish and Wildlife Conservation Office
177 Admiral Cochrane Dr., Annapolis, MD 21401
410-573-4554 (O)
717-387-2117 (C)
Sheila_Eyler@fws.gov

Appendix 4. (Continued)

2019 Susquehanna River Fish Passage Voluntary Best Management Practices to Mitigate Spread of Aquatic Invasive Species

Date: February 20, 2019

Goal: Achieve appreciable results for American shad passage in 2019, including completing telemetry study objectives while utilizing voluntary best management practices to minimize the introduction and spread of aquatic invasive species (AIS) into the Susquehanna River through the fish lifts at Conowingo, Holtwood and Safe Harbor Dams.

Conowingo:

1. Begin migratory fish passage operations on April 1, 2019.
2. Prioritize operations to complete tagging for telemetry studies early in the fish passage season to reduce likelihood of invasive species passage.
3. Notify Resource Agencies (Agencies)if an invasive species is observed at Conowingo Dam (see Agency Notification Protocol below) under any of the following circumstances:
    a. Collected in the Conowingo West Fish Lift (WFL)
    b. Collected in the Conowingo East Fish Lift (EFL)
    c. Passed in the EFL into Conowingo Pond
4. EFL Operations
    a. View the hopper dumping into the fish exit trough. If an invasive species is viewed in the hopper or chute, close the gate at the viewing window immediately, and institute a draw-down to remove the invasive species from the trough before releasing the remaining fish into Conowingo Pond.
    b. Remove any invasive species that are observed while conducting tagging operations in the East Fish Lift trough.
5. WFL Operations
    a. Remove any invasive species that are collected in the West Fish Lift.
6. For all invasive species collected at Conowingo Dam, kill or dispatch the fish and place it in the freezer (used for shad heads during the tank spawning studies) and the Agencies will dispose of the fish.
    a. If freezer space becomes limited during the fish passage season, please notify Resource Agency staff, (Sheila_Eyler@fws.gov, jtryninews@pa.gov, and genine.mcclair@maryland.gov) and we will arrange for pick-up.
    b. If freezer space is not limited, at the end of the season, send the frozen invasive species with the shad heads to the Van Dyke Hatchery.

Appendix 4. (Continued)

7. The Agencies will consult with Normandeau, Exelon, and Brookfield on closure of volitional fish passage in 2019 to occur at, or near, the end of the American shad upstream migration period. Expected proportion of fish passage by date based on environmental conditions (see Appendix) will be considered in making a final closure decision.

Holtwood:

1. Begin resident fish passage operations April 1, 2019.
2. Notify Agencies (see Agency Notification Protocol) if an invasive species is passed at Holtwood Dam.

Safe Harbor:

1. Begin resident fish passage operations when the American shad passage at Holtwood Dam trigger is met.
2. Notify Agencies (see Agency Notification Protocol) if an invasive species is passed at Safe Harbor Dam.

Agency Notification Protocol:

1. If an invasive species (Northern Snakehead or Blue Catfish) is captured and removed or passed in a fish lift, notify the Agencies within 24 hours.
2. Notification should be sent by email to Sheila Eyler (Sheila_Eyler@fws.gov) with a copy to station management. If email is not accessible during that time period, call 717-387-2117.
3. Notification should include:
    a. Species name and number observed/collected
    b. Disposition of the fish (collected or passed)
    c. Approximate size of fish
    d. Date and time of passage
    e. Estimated flow thru the dam at time of passage
4. The SRAFRC Policy Board will convene within 72 hours to decide how to address the invasive species incident.

Appendix 4. (Continued)

Appendix. Daily estimates for percent of cumulative shad passage occurring by date at Conowingo Dam, based on multiple scenarios of spring air temperature and river flow based on data from 2008-2017.

Date	Typical	high flow; cool	high flow; warm	low flow; cool	low flow; warm	T&T model 1990-2014
1-Apr	0%	0%	0%	0%	0%	1%
2-Apr	0%	0%	0%	0%	3%	1%
3-Apr	0%	0%	0%	0%	3%	1%
4-Apr	0%	0%	0%	0%	6%	1%
5-Apr	0%	0%	0%	0%	7%	1%
6-Apr	0%	0%	0%	0%	8%	1%
7-Apr	0%	0%	0%	0%	9%	1%
8-Apr	0%	0%	0%	0%	10%	2%
9-Apr	0%	0%	0%	0%	11%	2%
10-Apr	0%	0%	0%	0%	12%	2%
11-Apr	0%	0%	0%	0%	12%	2%
12-Apr	0%	0%	0%	0%	12%	3%
13-Apr	1%	0%	0%	0%	14%	3%
14-Apr	1%	0%	0%	0%	17%	3%
15-Apr	1%	0%	0%	0%	20%	4%
16-Apr	1%	0%	0%	0%	21%	4%
17-Apr	1%	0%	2%	0%	24%	5%
18-Apr	2%	0%	5%	0%	30%	6%
19-Apr	4%	0%	9%	0%	33%	7%
20-Apr	8%	0%	10%	0%	35%	8%
21-Apr	12%	0%	12%	0%	37%	9%
22-Apr	15%	0%	14%	0%	37%	10%
23-Apr	17%	0%	14%	0%	37%	11%
24-Apr	21%	0%	14%	0%	45%	12%
25-Apr	22%	0%	14%	1%	46%	14%
26-Apr	23%	1%	14%	15%	46%	16%
27-Apr	23%	4%	14%	25%	54%	18%
28-Apr	25%	15%	16%	31%	55%	20%
29-Apr	26%	21%	19%	37%	55%	22%
30-Apr	29%	21%	23%	38%	56%	24%
1-May	31%	21%	25%	38%	57%	27%
2-May	35%	21%	31%	51%	59%	30%
3-May	42%	21%	32%	56%	60%	33%
4-May	49%	22%	32%	58%	63%	36%
5-May	51%	22%	33%	63%	69%	39%
6-May	53%	23%	34%	73%	72%	43%
7-May	56%	26%	34%	75%	72%	46%

Appendix 4. (Continued)

8-May	59%	26%	34%	79%	74%	50%
9-May	60%	32%	34%	81%	75%	53%
10-May	64%	39%	34%	82%	76%	57%
11-May	67%	49%	37%	85%	76%	60%
12-May	69%	57%	42%	87%	76%	63%
13-May	73%	86%	46%	87%	77%	66%
14-May	75%	88%	56%	87%	82%	69%
15-May	76%	89%	63%	87%	82%	72%
16-May	78%	89%	71%	87%	83%	75%
17-May	81%	89%	75%	87%	83%	78%
18-May	82%	89%	77%	87%	83%	80%
19-May	83%	89%	79%	88%	83%	82%
20-May	84%	89%	85%	91%	84%	84%
21-May	85%	89%	89%	92%	86%	86%
22-May	86%	89%	94%	93%	88%	88%
23-May	88%	89%	95%	94%	92%	89%
24-May	89%	89%	96%	95%	94%	90%
25-May	91%	89%	96%	95%	96%	92%
26-May	93%	89%	98%	96%	97%	93%
27-May	94%	89%	99%	97%	99%	94%
28-May	95%	90%	99%	97%	99%	94%
29-May	96%	90%	100%	98%	100%	95%
30-May	97%	91%	100%	98%	100%	96%
31-May	98%	92%	100%	98%	100%	96%
1-Jun	98%	93%	100%	100%	100%	97%
2-Jun	99%	96%	100%	100%	100%	97%
3-Jun	99%	98%	100%	100%	100%	98%
4-Jun	100%	98%	100%	100%	100%	98%
5-Jun	100%	98%	100%	100%	100%	98%
6-Jun	100%	99%	100%	100%	100%	99%
7-Jun	100%	100%	100%	100%	100%	99%
8-Jun	100%	100%	100%	100%	100%	99%
9-Jun	100%	100%	100%	100%	100%	99%
10-Jun	100%	100%	100%	100%	100%	100%

Appendix 4. (Continued)

Invasive Species Alert

During operations of the Conowingo East and West Fish Lifts, if at any time an invasive fish species (Northern Snakehead or Blue Catfish) is observed, passed volitionally, or collected, the following personnel must be contacted ASAP:

Ray Bleistine: Rbleistine@normandeau.com; 717-380-4204

Sheila Eyler: sheila_eyler@fws.gov; 717-387-2117

Jay Campbell: Jay.Campbell@exeloncorp.com; 484-844-2832

Andrea Danucalov: Andrea.Danucalov@exeloncorp.com; 267-533-1125

Thank you for your time and dedication to the American Shad Restoration Program.

Sincerely,

Ray A. Bleistine

Senior Scientist, Normandeau Associates, Inc.