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Summary of Operations at the Conowingo Dam West Fish Lift Facility Spring 2021

FERC Project No. 405

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EXECUTIVE SUMMARY

Since its operation began in 1972, the West Fish Lift (WFL) has been part of a cooperative 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. The operational goal was changed slightly beginning in 2001, to collecting American Shad for spawning trials and egg delivery to Pennsylvania Fish and Boat Commission's Van Dyke Hatchery. Generally from 2001 to 2019, the WFL objective was to collect pre-spawn alosines to monitor abundance, species composition, provide specimens for otolith analysis (monitor hatchery contribution of returning stock), and the collection of live, pre-spawn, adult alosines for tank spawning to support restoration stockings of larval alosines throughout the Susquehanna River Basin. In 2020 the WFL did not operate due to the COVID-19 pandemic. In 2021, the WFL began operations again and initiated a trap and transport program with a new Proof of Concept (POC) transport skid/tank secured to a flatbed truck. WFL operations followed the new license requirements for the Conowingo Hydroelectric Project No. 405 (Conowingo) that was issued by the FERC on March 19, 2021. The license is a Joint Settlement Agreement between the United States Fish and Wildlife Service, the Maryland Department of Environment and Constellation Energy Generation (formerly Exelon Generation Company).

Objectives of 2021 operations were: (1) monitor collection of migratory and resident fishes at the WFL; (2) transport American Shad upriver in a prototype transport skid/tank to Pennsylvania Fish and Boat Commission (PFBC) Columbia Access; and (3) collect and remove three invasive species (Northern Snakehead, Flathead Catfish, and Blue Catfish) from the WFL sorting tank.

The start of operation for the WFL in 2021 began on April 1, 2021. The WFL operated on alternating days until April 15 when daily operations commenced and continued to June 5, 2021. The first American Shad (1) was collected on April 7. The WFL operated for 59 days in 2021 collecting American Shad for transporting upriver to the PFBC Columbia Access. The number of lifts conducted in 2021 was 1,378 and fishing time totaled 552 hours and 28 minutes. A total of 1,476,055 fish of 39 species along with two Tiger Trout, six Splake, twenty-one Tiger Muskellunge and four Striped Bass hybrids were collected and identified in the WFL sorting tank. Gizzard Shad (*Dorosoma cepedianum*) (1,451,584), American Shad (6,825), Channel Catfish (*Ictalurus punctatus)* (4,172), and Shorthead Redhorse (*Moxostoma macrolepidotum*) (2,904) dominated the catch, and comprised nearly 99.3% of the total fish collected. Gizzard Shad alone accounted for 98.3% of the total fish collected.

The WFL collected 6,825 American Shad. The first American Shad was collected on April 7, 2021. Collection of American Shad varied throughout the season with 735 (10.8%) of the American Shad collected during a single day on May 22. The highest catch for a 7-day period was 2,499 (36.6%) and occurred from April 27 through May 3. American Shad were collected at water temperatures ranging from 54.2°F to 75.5°F at Conowingo Dam's WFL and daily river flows between 18,800 and 79,700 cfs at the USGS Marietta gage station. The average daily river flow on May 22 when 735 American Shad were collected was 27,000 cfs. Of the 6,825 American Shad collected, a total of 1,659 males and 1,721 females were identified at the WFL in 2021, the sex was not determined for the remaining 3,445 American Shad collected. On the fifty-nine operational days the male to female ratio ranged from 1:0.00 to 1:3.00. The highest number of male American Shad (102) was identified on May 3. The most female American Shad (87) identified were collected on May 1.

A small number of river herring, (14 Alewife and 13 Blueback Herring) were collected during the 2021 season. Seven (7) Hickory Shad were collected in spring 2021.

This season, the WFL collected twenty-two (22) American Shad that were previously captured, Floy-tagged, and released downstream of Conowingo Dam in 2021 by the Maryland Department of Natural Resources (MDNR). This year, MDNR collected a total of 293 American Shad from shoreline anglers and Floy-tagged a total of 276 American Shad.

Invasive species were identified and removed at the WFL in 2021 at the request of MDNR. The Northern Snakehead (*Channa argus*) was collected during WFL operations on 52 of 59 operating days. A total of nine hundred fifty-two (952) Northern Snakeheads were collected and culled at the WFL in 2021. All but three collected Northern Snakeheads were removed from the WFL sorting tank and placed in a refrigerated unit supplied by MDNR at Conowingo Dam. The three Northern Snakeheads escaped out of the sorting tank and landed in the river before the technicians could safely enter the sorting tank to begin sorting fish. Flathead Catfish (*Pylodictis olivaris*) were collected during WFL operations on 43 of 59 operating days. A total of one thousand ninety-eight (1,098) Flathead Catfish were collected and culled at the WFL in 2021. All collected Flathead Catfish were removed from the WFL sorting tank and placed in a refrigerated unit supplied by MDNR at Conowingo Dam. No Blue Catfish (*Ictalurus furcatus*) were collected at the WFL in 2021. The invasive fishes were provided to the MDNR for the purpose of collecting biological information.

Prior to the start of WFL operations in 2021, routine preseason maintenance activities were conducted, and included testing of the fish collection equipment (barrier screen, crowder doors, crowder, hopper hoist motor, and hopper door along with inspection of associated chain linkage, cables, etc.). These maintenance activities, along with routine maintenance activities performed in season resulted in minimal loss of fishing time due to mechanical failures during the entire fish collection season. Future operations of the WFL will build on the past forty-nine years of operation experience.

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1.0 INTRODUCTION

Constellation Energy Generation, LLC, formerly the Susquehanna Electric Company and then Exelon Generation Company (Constellation), has operated a fish collection facility (West Fish Lift) at its Conowingo Hydroelectric Station since 1972. West Fish Lift (WFL) 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 Basin. 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. The operational goal was changed slightly beginning in 2001, with collecting American Shad for spawning trials and egg delivery to the Pennsylvania Fish and Boat Commission's Van Dyke Hatchery. Generally from 2001 to 2019, the WFL objective was to collect pre-spawn alosines to monitor abundance, species composition, provide specimens for otolith analysis (monitor hatchery contribution of returning stock), and the collection of live, pre-spawn, adult alosines for tank spawning to support restoration stockings of larval alosines throughout the Susquehanna River Basin. In 2020 the WFL did not operate due to the COVID-19 pandemic. In 2021, the WFL began operations again and initiated a trap and transport program with a new Proof of Concept (POC) transport skid/tank secured to a flatbed truck. WFL operations followed the new license requirements for the Conowingo Hydroelectric Project No. 405 (Conowingo) that was issued by the FERC on March 19, 2021. The license is a Joint Settlement Agreement is between the United States Fish and Wildlife Service, the Maryland Department of Environment, and Constellation. Constellation was granted a variance to stock American Shad at the Pennsylvania Fish and Boat Commission (PFBC) Columbia boat launch (downstream or York Haven Dam) per Resource Agency request. The new license requires Constellation to stock American Shad and River Herring at locations upstream of York Haven Dam.

Objectives of 2021 operations were: (1) monitor collection of migratory and resident fishes at the WFL; (2) transport American Shad and River Herring upriver in a prototype transport skid/tank to PFBC Columbia Access; and (3) collect and remove three invasive species (Northern Snakehead, Flathead Catfish, and Blue Catfish) from the WFL sorting tank.

Since its operation began in 1972, the WFL at Conowingo Dam has been a cornerstone in efforts to restore migratory fishes to the Susquehanna River. The WFL operation provided the only source of Susquehanna River American Shad eggs for stock rebuilding initiatives from 2001 to 2019. Additionally, the WFL continues to provide otolith specimens for tracking hatchery contributions and age and growth information for restoration efforts, and providing fisheries independent data for reporting to the Atlantic States Marine Fisheries Commission.

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 peak 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 Mixed-flow/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 Fish Lift Operation

For 2021, WFL operations were conducted during a 9-week period beginning in early April through early June. The start of operation for the WFL in 2021 began on April 1, 2021. The first American Shad (1) was collected on April 7 (Table 1). The WFL operated for 59 days in 2021 and ended on June 5, 2021 collecting American Shad for transportation upriver to PFBC Columbia Access. The number of lifts in 2021 was 1,378 and fishing time totaled 552 hours and 28 minutes (Table 2).

In spring 2021, WFL operation was conducted from 0800 to 1800 hours every other day starting April 1, 2021. Daily WFL operation commenced on April 15, 2021 and continued through the end of season (June 5, 2021). Operational methodologies were influenced by natural river flow, water temperature, and generation schedule. In 2021, WFL operations were not temporarily curtailed due to higher than normal river flow, even though up to four crest gates were open during WFL operations. The WFL operated during spill conditions for 2 days on May 12 and 13. WFL operations would need to be curtailed when five or more spill gates are open. WFL operation was conducted by a staff of five to six personnel: a lift operator, a supervising biologist, and three to four biological technicians. When a fish transport was required, an additional person (driver) was called in to drive the transport truck along with a biological technician to the PFBC Columbia Access site.

The mechanical aspects of WFL operation in 2021 were similar to those described in RMC (1983). Fishing time and/or lift frequency was determined by fish abundance, and the time required to process the catch. However, two modifications to normal operation (first implemented in 1985 to maximize collection of American Shad (RMC 1986)) were utilized to reduce the large numbers of Gizzard Shad (*Dorosoma cepedianum*) attracted to the lift. First, operation "Fast Fish" (RMC 1986), which reduced the mechanical delays associated with normal operation of the crowder was deployed during periods of heavy fish activity. Second, the weir gate settings were adjusted and operation in the "Fast Fish" mode was continued until the accumulated fish were reduced. Normal WFL operation was resumed after the majority of fish activity was reduced.

Attraction velocity and flow at the WFL were similar to those maintained since 1982 (RMC 1983). Hydraulic conditions were maintained in the area of the WFL between the crowder and weir gate entrances similar to that reported in RMC 1983. Modifications to weir gates and house service unit settings were made daily and during periods of heavy fish concentration and were similar to those reported in RMC 1986 (Appendix A).

The specific entrance(s) used to attract fishes was dictated by the station discharge and which turbine units were operating. For example, when Francis turbine units 1 or 2 were operating, the downstream entrance was the primary entrance used to attract fishes (Figure 1). Under these conditions the attraction flow through the upstream entrance is negated or disrupted. This situation occurred twenty-three (23) times during the 2021 WFL season due to higher than normal river flow this spring. On May 11-15 during WFL operation, both Units 1 and 2 operated the entire time. On April 13 and 20, Unit 2 operated the entire time during WFL operation. On April 3, 5, 7, 15, and May 5 Unit 2 began operating during WFL operation and continued until the end of WFL operations for the day. On April 1, May 7, and 10, both Units 1 and 2 were in operation at the beginning of WFL operations and remained on until various times in the afternoon or until the end of WFL operations. Lastly, on April 29, May 4, 6, 8, 19, 20, June 4 and 5, both Units 1 and 2 started during WFL operations and continued until the end of WFL operations for the day. Depending on river flow, generation, and/or fish densities, the downstream entrance was primarily utilized throughout the 2021 season to attract fishes.

2.3 Fish Counts

Fish that were lifted and emptied into the sorting tank were identified to species and counted or estimated by a biologist and/or technicians. All fishes were released back into the river, except for American Shad for transporting, and river herring species utilized for obtaining biological information, and invasive species. All invasive species collected were to be removed from the sorting tank and placed in bins for the Maryland Department of Natural Resources (MDNR).

Gizzard Shad are the most common and numerous fish species collected by the WFL. Historically, fish lift personnel have considered 1,500 to 2,000 Gizzard Shad in the WFL hopper to be 100% full. This is an estimate since size and

density of fish varies for each lift. For 2021 an estimate of 2,000 Gizzard Shad comprised a full load of fish in the WFL hopper and was the denominator used to calculate the hopper fullness estimate. WFL personnel attempted to minimize overcrowding within the hopper by constantly adjusting the fishing time or by "fast fishing" (described above in Section 2.2). When personnel observed that the hopper was overloaded, the fishing time was decreased, but this was not always successful in reducing the amount of fish in the hopper. When the WFL crowder channel contained large numbers of Gizzard Shad (or Common Carp, at times), WFL personnel switched to the "fast fish" mode of operation until fish numbers in the crowder channel appear to be reduced. Once fish numbers in the crowder channel appeared to be reduced, the WFL was returned to "normal" fishing operations with the crowder being used to concentrate fish over the hopper prior to the hopper being lifted.

Periodically throughout the day, fish collection data were recorded on data sheets and entered into a Microsoft Excel worksheet on a personal computer. Data processing and reporting is PC based and accomplished by program scripts, or macros, created within Microsoft Excel software. After the supervising biologist verified the correctness of the raw data, a daily summary of fish passage was produced and distributed electronically to plant and agency personnel. Each day's data were backed up and stored off site. Daily reports and weekly summaries of fish collected were electronically distributed to plant personnel and other cooperators.

2.4 Holding and Transport

The WFL Facility has two 750 gallon tanks and one 1,000 gallon circular tank available for holding anadromous fishes. The circular tanks were continually supplied with river water by a gravity fed pipe from the Forebay. The dissolved oxygen (DO) level in the tanks could be increased as needed through the aeration system which utilized bottled oxygen connected to an air stone in the holding tank. The holding capacity for each of the 750-gallon circular tanks is up to 60 American Shad or 200 river herring. The holding capacity for the 1,000-gallon circular tank is up to 125 American Shad or 1,000 river herring. As water temperatures increase to 70°F (21.1°C), the number of fish placed in the holding tanks is decreased. When water temperatures are greater than 70°F (21.1°C), the holding capacity for the 750-gallon circular tank is decreased to 50 American Shad or 150 river herring. The holding capacity for the 1,000-gallon circular tank is decreased to 100 American Shad or 500 river herring. Once a holding tank is ready for fish, American Shad are collected from the sorting tank and placed into the holding tank(s) by net and held until enough shad are collected for transport. The water flow and DO level in the tank(s) is checked periodically throughout the day to minimize stress to fish. When a holding tank reached its holding capacity, the tank was covered with a net to prevent escapement and additional American Shad were placed in one of the other two prepared holding tanks. The DO level and water flow was monitored between lifts throughout the day while American Shad were in holding and awaiting transport.

This was the first year since 1996 that a prototype skid/tank transport unit was utilized and tested to safely transport American Shad to upriver locations. The transport skid/tank was secured by chains and binders to a 26 foot flatbed truck. The transport skid/tank consisted of a 1,300 gallon tank, an oxygen bottle, and generator which supplies power to a control panel to power the electric pump and DO monitor. Generally, a transport would occur whenever 100 or more green or gravid American Shad were collected in a day, over multiple days, or at the supervisor's discretion. When a sufficient number of American Shad were collected and available for transport, a transport truck was brought inside the fence to the WFL area. The water supply hose was connected to the transport tank, and the valve was opened to begin filling the transport tank with river water. Oxygen was also supplied to the transport tank as it was filled with water. After the transport skid was partially filled with water, a calibrated DO meter was used to check DO level in the transport tank to ensure the DO was adequate before placing American Shad into the transport tank. Once the DO level was adequate and the circulating water pump started, the fish were carefully netted out of the holding tank(s), gently placed into the transport skid tank, and allowed to swim out of the net. The DO level was closely monitored while American Shad were loaded into the transport tank. As fish become harder to net in the holding tank, the incoming water flow was reduced to the holding tank, and the water level in the tank lowered to facilitate netting the remaining fish. After netting all live fish from the holding tank and transferring them to the transport skid tank, mortalities (if any) were collected from the holding tank(s) and recorded on the holding tank data sheet. Biological data (sex, length [fork and total], weight, and scale samples) was collected and recorded from all mortalities, after which the fish was frozen whole and placed in an individually labeled bag. All

frozen anadromous fish were transferred to PFBC personnel throughout the WFL trap and transport season. Once a holding tank was emptied of all the fish and the water drained, a broom was used to clean the inside of the tank. The incoming water valve was opened to help flush and drain the tank while cleaning. When cleaning was completed, the drain valve was closed and the standpipe was replaced. After the tank was cleaned, the water flow was restored and the tank was prepared for holding fish.

Once all of the available American Shad were placed in the transport tank, the water supply valve was opened to top off the tank with water. The fill valve was closed when the proper water level was reached and the hose disconnected from the tank. The tank lid door was closed and lid latches securely locked prior to the transport truck leaving the WFL area.

A transport data sheet was started and all pertinent information (date, time, number and species being transported, water temperature and DO level,) was filled out before leaving the WFL facility (Appendix B). After leaving the WFL facility, a technician continued to check that the pump was properly operating and the DO level was adequate. The checks occurred every 15 minutes and the time, water temperature, and DO values from the transport tank were recorded on the transport data sheet. The final time, water temperature, and DO value was recorded on the data sheet upon arrival at the release location (Appendix B).

At the release location, the technician guided the driver/truck down the ramp to the water's edge. The driver put the truck in park and set the parking brake. A wheel chuck was placed in back of the front tire as a safety precaution. The drain valve at the bottom of the transport tank was opened to lower the water level in the tank to prevent fish escapement when the tank lid door was opened. The tank lid door was partially opened to make sure the water level was at the proper height (just above the intake pipes), before fully opening the tank lid door.

After the water level was low enough, the tank lid door was opened and the technician checked for any transport mortalities in the tank. A net was used to reach the bottom of the tank to feel for any unseen fish mortalities. When the mortality check was complete, the valve to the oxygen bottle was turned off and the pump was shut off at the control panel. The generator was also turned off at this time. The technician immediately went to the back of the transport tank and lifted and removed the inner door. The knife valve handle was then lifted to release the American Shad into the river. A net was used to help guide any remaining fish in the transport tank out the release chute. The technician verified that all live fish exited the transport tank and release chute, prior to re-inserting the inner door of the transport tank. The tank lid door was closed and the latches locked before driving back to the WFL.

Before leaving the release location, the calibrated DO meter was used to measure the river temperature and DO. These values were recorded on the transport data sheet. Visual observations were made at the ramp to verify that the American Shad swam away from the release location. If any transport mortalities were observed and could be safely reached, they were collected and placed in a bag. All transport mortalities were brought back to the WFL at Conowingo Dam and labeled as transport mortalities. Biological data (sex, length, weight, scales) was collected from each transport mortality. The number of mortalities were recorded on the transport data sheet and all areas of the data sheet were checked for completeness.

3.0 RESULTS

3.1 Relative Abundance

Fishes were processed as reported previously (RMC 1983). The relative abundance of fishes has fluctuated at the WFL, primarily from operational days, species abundance, modifications to the lift and turbine operational changes. The daily number of fishes collected by the Conowingo Dam WFL is presented in Table 1. A total of 1,476,055 fish of 39 species along with two Tiger Trout, six Splake, twenty-one Tiger Muskellunge and four Striped Bass hybrids were collected and identified in the WFL sorting tank (Table 2). Gizzard Shad (1,451,584), American Shad (6,825), Channel Catfish (*Ictalurus punctatus)* (4,172), and Shorthead Redhorse (*Moxostoma macrolepidotum*) (2,904) dominated the catch, and comprised nearly 99.3% of the total fish collected. Gizzard Shad alone accounted for 98.3% of the total fish collected. Greatest collection of fishes occurred on the tenth day of operation (April 16) when 57,582 fish, (over 99% Gizzard Shad), were collected.

Hopper Fullness was determined for each lift throughout the operating season and ranged from a low of 0% to a high of 130%. Daily averages during the season ranged from 3 to 99%. The hopper fullness average of all the lifts throughout the 2021 operating season was 54%.

3.2 American Shad Collection

The WFL collected 6,825 American Shad (Table 2). A total of 6,417 (94%) American Shad were transported, 220 (3.2%) released due to poor condition or spent, 136 (2.0%) sacrificed, 42 (0.6%) holding mortalities, and 10 (0.2%) lift mortalities.

The first American Shad was collected on April 7. Collection of American Shad varied throughout the season with 735 (10.8%) of the American Shad collected during a single day on May 22 (Figure 2). The highest catch for a 7-day period was 2,499 (36.6%) and occurred from April 27 through May 3. American Shad collection was 1,921 (28.1%) for 23 days in April, 4,813 (70.5%) for 31 days in May, and 91 (1.3%) for 5 days in June (Table 1). On 20 of the 59 days of operation (April 1, 3, 5, 7, 13, 15-17, 20, 23; May 6, 7, 10-16; and June 1), ten or less American Shad were collected. The daily catch of American Shad exceeded 100 and 200 fish on 21 and 11 of the 59 operational days, respectively (Table 1).

Life history information (length, weight, sex, spawning condition, scales and otolith samples) was taken from American Shad that were sacrificed or died (lift, holding, or transport mortalities). All collected life history information, scale samples, and the entire frozen fish was provided to the PFBC and they perform the age analysis on the scale and otolith samples. Per 2021 operation guidelines, every fiftieth American Shad collected was to be sacrificed. A total of 136 American Shad were sacrificed for life history information, comprised of 78 males and 58 females (Table 3). A total of 56 (0.8%) American Shad mortalities occurred during daily operation at the WFL and from transports upriver (Table 3). Handling and holding accounted for 42 (9 males; 33 females) American Shad mortalities. Lift operations accounted for 10 (5 males; 5 females) American Shad mortalities. Transport trips accounted for 4 (4 females) American Shad mortalities. The mortality observed at the WFL facility and through transports upriver was under the 5% mortality criteria set by the Resource Agencies. American Shad mortalities resulted from mechanical operation of the WFL, handling and holding procedures, and transports.

American Shad were collected at water temperatures ranging from 54.2°F (12.3°C) to 75.5°F (24.1°C) at Conowingo Dam's WFL and daily natural river flows between 18,800 and 79,700 cfs at the USGS Marietta gage station (Figure 2). A total of 4,216 (61.8%) American Shad were collected at water temperatures ≤65°F (Table 1). Water temperature during the peak American Shad abundance (April 21 to May 31) varied from 56.4 °F (13.6°C) to 75.5°F (24.1°C). The water temperature and average daily river flow on the day when 735 American Shad were collected was 67.6°F (19.8°C) and 27,000 cfs, respectively. The average daily river flow during the operational season was 44,000 cfs.

The sex ratio of American Shad collected at the WFL is provided in Table 4. Typically, the sex of the first one hundred American Shad collected daily is recorded by the Supervising Biologist. Of the 6,825 American Shad collected, a total of 1,659 males and 1,721 females were identified at the WFL in 2021, the sex was not determined for the remaining 3,445 American Shad collected. Generally, males dominate the catch during the early and middle of the season and females tend to dominate the catch at the end of the season. In 2021, the male to female ratio was relatively even during the early and middle part of the season, however more females were caught the last seven days of the season. On the 59 operational days the male to female ratio ranged from 1:0.00 to 1:3.00. Overall male to female American Shad ratio was 1:1.04. The highest number of male American Shad (102) was identified on May 3. The most female American Shad (87) identified were collected on May 1.

The catch and effort of American Shad collected at the WFL from 1985 to 2021 is shown in Table 5. The total catch was lower prior to 2021, due mainly to fewer operational days, lifts, and fishing hours; the catch per day, catch per lift, and catch per hour was also lower during those previous years. In 2021, with the start of collecting and transporting American Shad, the catch and effort increased for operational days, lifts, and fishing hours. The operating days and fishing hours were the highest since 1995. The number of lifts was highest since 1992. This

equated to an increase in catch per day from the previous 8 years, but the catch per lift and catch per hour was relatively the same as previous years.

Table 6 shows the operations and fish catch at the Conowingo Dam WFL from 1985-2021.

3.3 American Shad Holding and Transport

American shad were held overnight on 46 of the 59 operating days. Holding events varied from 1 night up to four nights. The four night holding event occurred at the beginning of WFL operations on the nights of April 7-11 to maximize transport operations and release a larger school of American Shad. The majority of holding events lasted only one night. A total of 2,244 American Shad were held overnight in the tanks at the WFL for at least one night. There were 42 American Shad (9 males; 33 females) mortalities recorded during overnight holding events.

The transport of pre-spawned adult American Shad to upriver spawning areas was one of the objectives for the 2021 season. Pre-spawned adult American Shad were transported from April 11 through June 5, 2021 (Appendix B). A total of 6,417 adult American Shad were transported to the PFBC Columbia Access boat ramp at Columbia River Park, Columbia, PA (40.0307°, -76.5091°) and 6,413 American Shad were stocked with an overall stocking survival rate of 99.9%. Transport trips accounted for 4 (4 females) American Shad mortalities. American Shad transports occurred on 31 days and totaled 42 trips. Generally, individual transport trips were 1 to 1.5 hours in length from Conowingo Dam to Columbia River Park. The number of trips per day varied from one to three and multiple transport trips were conducted on 9 days. Three transport trips occurred during two days of the season; May 1 and 27. The number of American Shad transported per trip ranged from a low of 14 to a high of 226 fish (Table 7).

3.4 Gizzard Shad Collection

The WFL collected 1,451,584 Gizzard Shad in 2021 (Tables 1 and 2). Gizzard Shad accounted for 98.3% of the total fish collected. On 30 of 59 days of operation, Gizzard Shad collections exceeded 25,000 fish. Gizzard Shad collection exceeded 20,000 and 15,000 fish on 36 and 43 days, respectively. Table 1 provides the number of American Shad and Gizzard Shad collected each operational day in 2021. On days when American Shad collections equaled or exceeded 50 fish, the American Shad to Gizzard Shad ratio ranged from 1:11 – 1:539. For the days when American Shad collection is less than 50 fish, the ratio ranged from 1:430 – 1:42,015. Overall, the American Shad to Gizzard Shad ratio during the WFL operation was 1:213.

3.5 Alosines

A small number of river herring, (14 Alewife and 13 Blueback Herring) were collected during the 2021 season. Seven (7) Hickory Shad were also collected in spring 2021. Per 2021 operation guidelines, the first 50 of each herring species (Alewife and Blueback Herring) collected were to be sacrificed followed by every twenty-fifth of each species. Length, weight, sex, scale, and otolith samples were taken from all collected river herring during the 2021 season and provided to the PFBC.

3.6 Maryland Tag-Recapture

During the 2021 season, the WFL collected twenty-two (22) American Shad that were previously captured, Floy-tagged and released downstream of Conowingo Dam by MDNR. Of the 22 tagged American Shad, twelve (12) were females and ten (10) were males (Table 8). The first tagged American Shad was collected at the WFL on May 18. A total of five (5) tagged American Shad were collected on each of the following two days; May 21 and 25. This year, MDNR caught 293 and tagged a total of 276 American Shad during the 41.7 hours fished or collected from shoreline anglers below Conowingo Dam. The first six (6) American Shad were tagged on April 22 and the last American Shad was tagged on May 25. The minimum number of days a tagged American Shad was “at large” was 4 days; the maximum was 29 days; and the average number of days between captures was 12 days. The 220 American Shad tagged prior to the high water event from May 11-15 tended to be “at large” for a longer number of days and ranged from 7 to 29 days. The 56 American Shad tagged after the high water event were “at large” for a relatively shorter duration ranging from 4 to 9 days. Of the 220 American Shad tagged prior to the high water event, none were re-captured at the WFL before the high water event. All of the 276 American Shad in 2021 were collected

and tagged from shoreline anglers below Conowingo Dam, which may have affected the WFL recapture from previous years when MDNR tagged fish from their boat in the tailrace.

Per the 2021 operational guidelines, all re-captured MDNR tagged American Shad from the current year (2021) were transported upriver. Any MDNR tagged American Shad collected from previous years (prior to 2021) were to be sacrificed for study. No MDNR tagged American Shad from previous years were collected in 2021.

3.7 Invasive Species Collection/Removal

The Resource Agencies requested Constellation to remove any invasive fish (Northern Snakehead, Blue Catfish, and Flathead Catfish) from the WFL during the sorting process in 2021. For each lift, the majority of anadromous fish were removed first to minimize their stress while in the sorting tank. After removing anadromous fish, the remaining fish from each lift were sorted and any invasive fish listed above was removed from the sorting tank. Invasive fish were collected from the sorting tank and placed in storage bins located near the WFL sorting tank. Once a storage bin was full, the invasive fishes were carted over to the MDNR refrigerated storage unit and placed inside the unit. An empty storage bin was placed next to the sorting tank in preparation for more invasive fish. The MDNR or agency partners were contacted throughout the day or at the end of the day depending on the number of invasive fish collected.

The Northern Snakehead (*Channa argus*) was collected during WFL operations on 52 of 59 operating days. Daily catches ranged from a low of one on April 17 to a high of eighty-five (85) on May 8 (Figure 3). A total of nine hundred fifty-two (952) Northern Snakeheads were collected at the WFL in 2021. All but three collected Northern Snakeheads were removed from the WFL sorting tank and placed in the MDNR refrigerated storage unit at Conowingo Dam near the WFL. The three Northern Snakeheads escaped out of the sorting tank and landed in the river before the technicians could safely enter the sorting tank to begin sorting fish.

Flathead Catfish (*Pylodictis olivaris*) were collected during WFL operations on 43 of 59 operating days. Daily catches ranged from a low of one each on April 3, 21, 27, 29, May 14, and 18 to a high of one hundred seventy-two (172) on June 3 (Figure 4). A total of one thousand ninety-eight (1,098) Flathead Catfish were collected at the WFL in 2021. All collected Flathead Catfish were removed from the WFL sorting tank and placed in the MDNR refrigerated storage unit at Conowingo Dam near the WFL.

Although Blue Catfish (*Ictalurus furcatus*) have been caught by anglers in the Conowingo Dam tailrace since 2019, no Blue Catfish were collected during WFL operations in 2021.

4.0 SUMMARY

WFL operation was initiated on April 1, river water temperature was 51.4°F (10.8°C) and daily river flow was 58,200 cfs at Marietta. The first American Shad was collected on April 7 at a water temperature of 54.2°F. The WFL collected 6,825 American Shad from April 1 through June 5. The total number of American Shad collected during the 2021 season was the highest collection value recorded since 2003 and the fourteenth highest since 1985 when the WFL was operated for trap and transport purposes (Tables 4 and 5). It is also the first year since 2014 in which the WFL collected more than 1,000 American Shad. Of the 6,825 American Shad collected, a total of 1,659 males and 1,721 females were identified at the WFL in 2021. Overall male to female American Shad ratio was 1:1.04. The highest number of male American Shad (102) was identified on May 3. The most female American Shad (87) identified were collected on May 1.

A total of 56 (0.8%) American Shad mortalities occurred during daily operation at the WFL and from transports upriver. Handling and holding accounted for 42 (9 males; 33 females) American Shad mortalities. Lift operations accounted for 10 (5 males; 5 females) American Shad mortalities. Transport trips accounted for 4 (4 females) American Shad mortalities. The mortality observed at the WFL facility and through transports upriver was under the 5% mortality criteria set by the Resource Agencies.

Pre-spawned adult American Shad were transported from April 11 through June 5, 2021. A total of 6,417 adult American Shad were transported to the boat ramp at Columbia River Park and 6,413 American Shad were stocked

with an overall stocking survival rate of 99.9%. American Shad transports occurred on 31 days and accomplished in 42 trips.

The Resource Agencies requested Constellation to remove any invasive fish (Northern Snakehead, Blue Catfish, and Flathead Catfish) from the WFL during the sorting process in 2021. Invasive fish were collected from the sorting tank and placed in storage bins located near the sorting tank. The MDNR or agency partners were contacted throughout the day or at the end of the day depending on the number of invasive fish collected. A total of nine hundred fifty-two (952) Northern Snakeheads were collected at the WFL in 2021. All but three collected Northern Snakeheads were removed from the WFL sorting tank and placed in the MDNR refrigerated storage unit at Conowingo Dam near the WFL. The three Northern Snakeheads escaped out of the sorting tank and landed in the river before the technicians could safely enter the sorting tank to begin sorting fish. A total of one thousand ninety-eight (1,098) Flathead Catfish were collected at the WFL in 2021. All collected Flathead Catfish were removed from the WFL sorting tank and placed in the MDNR refrigerated storage unit at Conowingo Dam near the WFL. No Blue Catfish were collected during WFL operations in 2021.

Prior to the start of WFL operations in 2021, routine preseason maintenance activities were conducted, and included testing of the fish collection equipment (barrier screen, crowder doors, crowder, hopper hoist motor, and hopper door along with inspection of associated chain linkage, cables, etc.). These maintenance activities, along with routine maintenance activities performed in season resulted in minimal loss of fishing time due to mechanical failures during the entire fish collection season.

5.0 RECOMMENDATIONS

1) Continue to operate the WFL 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 WFL performance and fish collection.

2) Continue to inspect weir gate cables, limit switches, and lift components to enhance season operability, and continue to evaluate effectiveness of fish sorting tank and hopper door. Constellation maintenance should adhere to all maintenance schedules and requirements stated in the new license issued by FERC.

6.0 LITERATURE CITED

RMC. 1983. Summary of the operation of the Conowingo Dam Lift in spring 1982. Prepared for the Philadelphia Electric Company by RMC Environmental Services, Muddy Run Ecological Laboratory, Drumore, Pennsylvania. 32 pp.

RMC. 1986. Summary of the operation of the Conowingo Dam Lift in spring 1985. Prepared for the Philadelphia Electric Company by RMC Environmental Services, Muddy Run Ecological Laboratory, Drumore, Pennsylvania. 44 pp.

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

Tables

Table 1. Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 through June 5, 2021

DATE	1-Apr THURSDAY	2-Apr FRIDAY	3-Apr SATURDAY	4-Apr SUNDAY	5-Apr MONDAY	6-Apr TUESDAY	7-Apr WEDNESDAY	8-Apr THURSDAY	9-Apr FRIDAY	10-Apr SATURDAY	11-Apr SUNDAY
Number of Lifts	25		20		24		24		24		28
Time of First Lift	8:30		8:10		8:05		8:05		8:05		8:05
Time of Last lift	17:30		17:40		17:40		17:37		17:40		17:43
Operating time (hours)	9:00	0:00	9:30	0:00	9:35	0:00	9:32	0:00	9:35	0:00	9:38
Average Water Temperature (F)	51.4		51.9		51.8		54.2		57.2		59.1
American Shad	0	DID	0	DID	0	DID	1	DID	38	DID	43
Blueback Herring	0	NOT	0	NOT	0	NOT	0	NOT	0	NOT	0
Alewife	0	OPERATE	0	OPERATE	0	OPERATE	0	OPERATE	1	OPERATE	0
Gizzard Shad	49250		32940		16219		42015		30565		49950
Hickory Shad	0		0		0		0		0		0
Striped Bass	0		0		0		0		0		0
White Perch	0		0		0		0		0		1
American Eel	1		0		1		0		0		1
Rainbow Trout	1		2		0		1		0		0
Brown Trout	0		0		0		0		0		0
Muskellunge	0		0		0		0		0		0
Carp	7		0		0		2		5		1
Comely Shiner	0		0		0		0		0		0
Spottail Shiner	0		0		2		0		0		0
Spotfin Shiner	0		0		0		0		0		0
Quillback	0		0		0		0		0		0
White Sucker	0		0		0		0		0		0
Shorthead Redhorse	1		0		0		54		121		32
Brown Bullhead	0		0		0		0		0		0
Channel Catfish	12		5		3		13		21		14
Rock Bass	0		0		0		0		1		0
Redbreast Sunfish	0		0		0		0		0		0
Green Sunfish	0		0		0		0		0		0
Pumpkinseed	0		0		0		0		0		0
Bluegill	0		0		0		0		0		0
Smallmouth Bass	8		2		16		111		58		49
Largemouth Bass	1		0		0		1		4		3
White Crappie	0		0		0		0		0		0
Black Crappie	0		0		0		0		0		0
Tessellated Darter	0		1		0		0		0		0
Yellow Perch	0		0		0		0		0		0
Walleye	9		4		46		94		66		34
Sea Lamprey	3		2		1		3		2		2
Greenside Darter	0		5		1		0		2		0
Hybrid Striped Bass	1		0		1		0		0		1
Tiger Muskie	1		1		0		1		2		3
Chain Pickerel	0		0		0		0		0		0
Logperch	1		0		1		0		0		0
Splake	0		0		0		0		0		0
Flathead catfish	2		1		0		2		0		2
Northern Snakehead	0		0		0		0		10		3
Blue Catfish	0		0		0		0		0		0
Banded Darter	0		0		0		0		0		0
Tiger Trout	0		0		0		0		0		0
Total	49,298	0	32,963	0	16,291	0	42,298	0	30,896	0	50,139

Table 1. (Continued)

Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

DATE	12-Apr MONDAY	13-Apr TUESDAY	14-Apr WEDNESDAY	15-Apr THURSDAY	16-Apr FRIDAY	17-Apr SATURDAY	18-Apr SUNDAY	19-Apr MONDAY	20-Apr TUESDAY	21-Apr WEDNESDAY	22-Apr THURSDAY
Number of Lifts		21		29	32	27	20	26	22	20	21
Time of First Lift		8:20		8:05	8:03	8:25	8:05	8:01	8:09	8:05	8:10
Time of Last lift		17:35		17:46	17:45	17:40	17:40	17:42	17:46	17:41	17:40
Operating time (hours)	0:00	9:15	0:00	9:41	9:42	9:15	9:35	9:41	9:37	9:36	9:30
Average Water Temperature (F)		59.9		58.8	57.3	57.1	57.6	57.0	57.1	57.8	56.4
American Shad	DID	4	DID	2	4	3	37	40	8	176	31
Blueback Herring	NOT	0	NOT	0	0	0	0	0	0	0	0
Alewife	OPERATE	0	OPERATE	0	0	0	0	0	0	1	0
Gizzard Shad		28050		46260	57480	45150	15922	20657	26080	12150	27351
Hickory Shad		0		0	0	0	0	0	0	0	0
Striped Bass		0		0	0	0	0	0	0	0	0
White Perch		1		2	0	0	0	0	0	0	0
American Eel		0		0	0	1	2	0	1	2	1
Rainbow Trout		0		0	0	0	1	0	0	0	0
Brown Trout		0		0	1	0	0	1	0	1	0
Muskellunge		0		0	0	0	0	0	1	0	0
Carp		16		8	6	1	1	0	2	1	1
Comely Shiner		0		0	0	0	0	0	0	0	0
Spottail Shiner		0		0	0	0	0	0	0	0	0
Spotfin Shiner		0		0	0	0	0	0	0	0	0
Quillback		0		0	0	0	0	0	0	1	0
White Sucker		0		0	0	0	0	0	0	0	0
Shorthead Redhorse		15		89	29	14	109	26	61	127	26
Brown Bullhead		0		0	0	0	0	0	0	0	0
Channel Catfish		71		54	31	14	25	19	7	15	8
Rock Bass		0		0	0	0	0	0	0	0	0
Redbreast Sunfish		0		0	0	0	0	0	0	0	0
Green Sunfish		0		0	0	0	0	0	0	0	0
Pumpkinseed		0		0	0	0	0	0	0	0	0
Bluegill		0		0	0	0	0	0	0	0	0
Smallmouth Bass		47		19	23	14	26	33	43	63	12
Largemouth Bass		1		0	0	1	2	3	1	2	2
White Crappie		0		0	0	0	0	0	0	0	0
Black Crappie		0		0	0	0	0	0	0	0	0
Tessellated Darter		0		0	0	0	0	0	0	0	0
Yellow Perch		0		0	0	0	0	0	0	0	0
Walleye		96		11	3	5	3	12	14	10	1
Sea Lamprey		1		5	2	0	1	2	0	1	2
Greenside Darter		0		1	0	0	0	0	0	0	0
Hybrid Striped Bass		1		0	0	0	0	0	0	0	0
Tiger Muskie		0		2	1	0	1	1	0	2	1
Chain Pickerel		0		0	0	0	0	0	0	0	0
Logperch		0		0	0	0	0	0	0	0	0
Splake		1		0	0	0	0	0	0	0	0
Flathead catfish		6		0	0	0	2	2	0	1	0
Northern Snakehead		40		34	2	1	11	75	40	12	48
Blue Catfish		0		0	0	0	0	0	0	0	0
Banded Darter		0		0	0	0	1	0	0	0	0
Tiger Trout		0		0	0	0	1	0	0	0	0
Total	0	28,350	0	46,487	57,582	45,204	16,145	20,871	26,258	12,565	27,484

Table 1. (Continued)

Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

DATE	23-Apr FRIDAY	24-Apr SATURDAY	25-Apr SUNDAY	26-Apr MONDAY	27-Apr TUESDAY	28-Apr WEDNESDAY	29-Apr THURSDAY	30-Apr FRIDAY	1-May SATURDAY	2-May SUNDAY	3-May MONDAY
Number of Lifts	22	25	29	28	24	25	25	23	14	28	19
Time of First Lift	9:10	8:02	8:10	8:15	8:13	8:07	8:07	8:05	8:28	8:12	8:17
Time of Last lift	17:40	17:37	17:40	17:44	17:41	17:40	17:55	17:22	17:39	17:55	17:57
Operating time (hours)	8:30	9:35	9:30	9:29	9:28	9:33	9:48	9:17	9:11	9:43	9:40
Average Water Temperature (F)	56.6	56.6	58.5	57.7	57.1	58.6	60.1	61.3	59.6	62.6	63.2
American Shad	10	139	144	66	213	280	142	540	447	235	642
Blueback Herring	0	0	0	0	0	0	0	1	0	1	0
Alewife	0	0	0	1	2	0	2	3	1	0	0
Gizzard Shad	15098	20742	47445	30171	12129	27570	26320	27500	16010	37070	13350
Hickory Shad	0	0	0	0	0	0	0	2	5	0	0
Striped Bass	0	0	0	0	1	0	0	0	0	2	0
White Perch	0	0	0	0	0	0	0	3	0	1	6
American Eel	0	0	0	0	0	1	0	0	2	2	0
Rainbow Trout	0	0	0	0	0	0	0	1	0	0	0
Brown Trout	1	0	0	1	2	0	3	3	1	3	2
Muskellunge	0	1	0	2	0	0	0	0	0	0	0
Carp	0	0	2	1	0	0	1	1	0	0	2
Comely Shiner	0	0	0	0	0	0	0	0	0	0	0
Spottail Shiner	0	0	0	0	0	0	0	6	0	0	0
Spotfin Shiner	0	0	0	0	0	0	0	0	0	0	0
Quillback	0	0	0	0	0	2	3	5	0	1	0
White Sucker	0	0	0	0	0	0	0	0	0	0	0
Shorthead Redhorse	14	48	78	54	36	117	163	239	17	45	76
Brown Bullhead	0	0	0	0	0	0	0	0	0	0	0
Channel Catfish	4	2	5	5	1	21	24	54	9	15	181
Rock Bass	1	0	1	1	0	0	0	1	0	1	0
Redbreast Sunfish	0	0	0	0	0	0	0	0	0	0	0
Green Sunfish	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0
Bluegill	0	0	0	0	0	0	0	0	0	1	0
Smallmouth Bass	28	57	152	89	43	40	57	52	34	26	67
Largemouth Bass	1	4	1	2	0	3	0	0	0	1	0
White Crappie	0	0	0	0	1	0	0	0	0	0	0
Black Crappie	0	0	0	0	0	0	0	1	0	0	0
Tessellated Darter	0	0	0	0	0	1	0	0	0	0	0
Yellow Perch	1	0	0	0	0	0	0	0	0	0	0
Walleye	0	13	15	16	15	22	56	41	24	28	15
Sea Lamprey	0	1	7	0	1	0	3	0	0	2	0
Greenside Darter	0	0	0	0	0	0	0	0	0	0	0
Hybrid Striped Bass	0	0	0	0	0	0	0	0	0	0	0
Tiger Muskie	0	0	0	0	0	0	0	0	0	1	0
Chain Pickerel	0	0	0	0	0	0	0	0	0	0	0
Logperch	0	0	0	0	0	0	0	0	0	0	0
Splake	1	0	0	0	0	0	0	1	0	0	0
Flathead catfish	0	0	0	0	1	0	1	0	2	0	24
Northern Snakehead	30	15	10	32	10	0	74	8	7	2	2
Blue Catfish	0	0	0	0	0	0	0	0	0	0	0
Banded Darter	0	0	0	0	0	0	0	0	0	0	0
Tiger Trout	0	0	0	0	0	0	0	0	0	0	0
Total	15,189	21,022	47,860	30,441	12,455	28,057	26,849	28,462	16,559	37,437	14,367

Table 1. (Continued)

Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

DATE	4-May TUESDAY	5-May WEDNESDAY	6-May THURSDAY	7-May FRIDAY	8-May SATURDAY	9-May SUNDAY	10-May MONDAY	11-May TUESDAY	12-May WEDNESDAY	13-May THURSDAY	14-May FRIDAY
Number of Lifts	26	36	28	24	21	26	28	27	19	18	31
Time of First Lift	8:05	8:05	8:13	8:14	8:15	8:05	8:08	8:03	8:05	8:06	8:16
Time of Last lift	17:40	17:43	17:45	17:37	17:30	17:30	17:41	17:35	17:35	17:42	17:35
Operating time (hours)	9:35	9:38	9:32	9:23	9:15	9:25	9:33	9:32	9:30	9:36	9:19
Average Water Temperature (F)	63.5	65.5	64.3	64.0	63.2	61.6	60.4	59.5	58.1	57.9	57.6
American Shad	15	20	7	2	64	103	7	9	0	0	0
Blueback Herring	0	0	0	0	0	0	0	0	0	0	0
Alewife	0	0	0	0	2	0	0	0	0	0	0
Gizzard Shad	46620	52500	34043	31048	24300	25315	32160	31925	1253	900	31401
Hickory Shad	0	0	0	0	0	0	0	0	0	0	0
Striped Bass	1	1	2	0	2	5	3	2	2	5	1
White Perch	10	0	12	8	228	142	104	78	20	7	1
American Eel	2	3	1	4	4	3	1	0	2	4	1
Rainbow Trout	0	0	0	0	0	0	0	0	0	0	0
Brown Trout	0	0	0	1	2	0	1	0	0	0	0
Muskellunge	0	0	1	0	0	0	0	0	0	0	0
Carp	121	44	103	78	54	1	2	1	1	15	2
Comely Shiner	1	0	0	0	0	0	0	0	0	0	0
Spottail Shiner	0	0	0	0	0	0	0	0	0	0	0
Spotfin Shiner	0	0	0	0	0	0	0	0	0	0	0
Quillback	0	0	0	0	0	0	0	0	0	0	0
White Sucker	0	0	0	1	0	0	0	0	0	0	0
Shorthead Redhorse	65	92	41	122	47	36	18	21	35	119	20
Brown Bullhead	1	4	2	4	22	10	3	2	5	1	0
Channel Catfish	110	136	127	254	108	68	97	26	71	47	7
Rock Bass	0	1	1	1	6	2	0	1	0	1	0
Redbreast Sunfish	0	0	0	0	0	0	0	0	0	0	0
Green Sunfish	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0
Bluegill	2	0	0	1	1	0	0	0	1	0	0
Smallmouth Bass	35	108	77	51	36	28	10	28	12	12	5
Largemouth Bass	0	0	0	0	0	1	0	0	0	0	0
White Crappie	0	0	0	0	0	0	0	0	0	0	0
Black Crappie	1	0	1	0	0	1	1	0	0	0	0
Tessellated Darter	1	0	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	0	0	2	0	0	0	0	0	0
Walleye	29	86	60	43	46	54	4	24	8	1	1
Sea Lamprey	3	2	1	0	1	1	2	0	0	0	0
Greenside Darter	0	0	0	0	0	1	0	0	0	0	0
Hybrid Striped Bass	0	0	0	0	0	0	0	0	0	0	0
Tiger Muskie	0	0	0	0	0	0	0	0	0	0	0
Chain Pickerel	0	0	0	0	0	0	0	0	0	0	0
Logperch	0	0	0	0	0	0	0	0	0	0	0
Splake	0	0	0	0	0	0	0	0	0	0	0
Flathead catfish	8	15	17	24	3	11	11	8	23	4	1
Northern Snakehead	5	14	28	0	85	11	11	6	57	22	8
Blue Catfish	0	0	0	0	0	0	0	0	0	0	0
Banded Darter	0	0	0	0	0	0	0	0	0	0	0
Tiger Trout	0	1	0	0	0	0	0	0	0	0	0
Total	47,030	53,027	34,524	31,642	25,013	25,793	32,435	32,131	1,490	1,138	31,448

Table 1. (Continued)

Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

DATE	15-May SATURDAY	16-May SUNDAY	17-May MONDAY	18-May TUESDAY	19-May WEDNESDAY	20-May THURSDAY	21-May FRIDAY	22-May SATURDAY	23-May SUNDAY	24-May MONDAY	25-May TUESDAY
Number of Lifts	20	24	27	24	21	20	23	15	24	24	16
Time of First Lift	8:00	8:15	8:05	8:12	8:05	8:40	8:05	8:02	8:45	8:04	8:03
Time of Last lift	17:35	17:37	17:40	17:37	17:37	17:36	17:30	17:42	17:28	17:36	15:40
Operating time (hours)	9:35	9:22	9:35	9:25	9:32	8:56	9:25	9:40	8:43	9:32	7:37
Average Water Temperature (F)	57.7	59.6	60.9	61.2	64.0	64.4	64.9	67.6	70.8	71.1	71.0
American Shad	2	5	51	124	196	136	250	735	221	74	472
Blueback Herring	0	0	0	10	0	0	0	0	0	1	0
Alewife	0	0	0	1	0	0	0	0	0	0	0
Gizzard Shad	24190	26545	27493	23040	19237	10632	11380	17425	29500	12300	5105
Hickory Shad	0	0	0	0	0	0	0	0	0	0	0
Striped Bass	1	0	1	0	1	2	3	1	7	2	0
White Perch	1	0	9	13	124	29	80	40	33	20	5
American Eel	0	0	4	2	2	2	2	19	1	3	2
Rainbow Trout	0	0	1	0	0	0	0	0	0	0	0
Brown Trout	1	2	2	0	2	3	1	0	0	3	1
Muskellunge	0	0	0	0	0	0	0	0	0	0	0
Carp	2	0	0	0	1	4	0	1	21	83	4
Comely Shiner	0	0	0	0	89	4	73	0	10	5	57
Spottail Shiner	0	0	0	0	0	0	0	0	0	0	0
Spotfin Shiner	0	0	0	0	0	0	0	0	0	0	50
Quillback	0	0	1	0	1	0	2	2	4	22	20
White Sucker	0	0	0	0	0	0	0	0	0	1	2
Shorthead Redhorse	69	21	257	120	103	63	26	13	11	1	5
Brown Bullhead	0	1	1	0	6	2	3	8	8	2	0
Channel Catfish	15	10	24	55	94	50	43	48	78	194	137
Rock Bass	2	1	4	2	8	2	2	0	8	7	3
Redbreast Sunfish	0	0	0	0	0	0	0	0	0	1	2
Green Sunfish	0	0	0	0	0	0	1	0	1	2	1
Pumpkinseed	0	0	0	0	0	0	0	0	0	1	1
Bluegill	0	1	7	0	3	4	4	0	9	16	9
Smallmouth Bass	9	41	197	103	116	67	34	40	30	18	2
Largemouth Bass	0	0	2	0	2	0	0	1	1	2	1
White Crappie	0	0	0	1	1	0	0	0	0	0	0
Black Crappie	0	1	1	1	0	1	1	0	1	3	0
Tessellated Darter	0	0	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	0	0	0	0	0	0	2	1	0
Walleye	7	13	49	54	52	40	42	62	44	97	61
Sea Lamprey	1	1	0	1	1	0	0	0	0	0	0
Greenside Darter	0	0	0	0	0	0	0	0	0	0	0
Hybrid Striped Bass	0	0	0	0	0	0	0	0	0	0	0
Tiger Muskie	0	0	0	0	0	0	0	1	0	0	0
Chain Pickerel	0	0	0	0	0	0	0	0	0	0	0
Logperch	0	0	0	0	0	0	0	0	0	0	0
Splake	0	1	0	0	0	0	2	0	0	0	0
Flathead catfish	13	2	7	1	13	7	3	0	0	2	29
Northern Snakehead	37	20	36	3	7	9	2	7	6	10	11
Blue Catfish	0	0	0	0	0	0	0	0	0	0	0
Banded Darter	0	0	0	0	0	0	0	0	0	0	0
Tiger Trout	0	0	0	0	0	0	0	0	0	0	0
Total	24,350	26,665	28,147	23,531	20,059	11,057	11,954	18,403	29,996	12,871	5,980

Table 1. (Continued)

Daily summary of fishes collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

DATE	26-May WEDNESDAY	27-May THURSDAY	28-May FRIDAY	29-May SATURDAY	30-May SUNDAY	31-May MONDAY	1-Jun TUESDAY	2-Jun WEDNESDAY	3-Jun THURSDAY	4-Jun FRIDAY	5-Jun SATURDAY	Total for the Year
Number of Lifts	20	18	21	23	19	21	22	20	21	24	22	1378
Time of First Lift	8:32	8:01	8:05	8:09	8:10	8:26	8:02	8:01	8:02	8:01	8:02	
Time of Last lift	17:06	15:25	17:36	17:42	17:39	17:30	17:30	17:30	16:50	17:30	17:35	
Operating time (hours)	8:34	7:24	9:31	9:33	9:29	9:04	9:28	9:29	8:48	9:29	9:33	552:28:00
Average Water Temperature (F)	71.9	73.7	75.5	75.1	72.9	71.4	71.1	71.6	71.3	70.3	70.5	
American Shad	69	414	220	20	89	184	7	12	14	20	38	6,825
Blueback Herring	0	0	0	0	0	0	0	0	0	0	0	13
Alewife	0	0	0	0	0	0	0	0	0	0	0	14
Gizzard Shad	10503	7043	12464	30035	8110	9733	10504	6583	20665	26172	18016	1,451,584
Hickory Shad	0	0	0	0	0	0	0	0	0	0	0	7
Striped Bass	2	1	2	4	5	8	5	2	4	1	4	83
White Perch	26	16	0	0	1	0	1	0	0	0	0	1,022
American Eel	3	2	3	2	1	0	5	2	0	1	0	96
Rainbow Trout	0	0	0	0	0	0	0	0	0	0	0	7
Brown Trout	1	0	0	0	0	0	0	3	5	1	5	53
Muskellunge	0	0	0	2	0	0	0	0	0	0	0	7
Carp	0	1	27	10	11	4	11	2	1	1	2	666
Comely Shiner	195	0	1050	0	0	30	0	41	0	0	0	1,555
Spottail Shiner	0	0	0	0	0	0	0	0	0	0	0	8
Spotfin Shiner	0	0	0	0	0	0	0	5	0	0	0	55
Quillback	28	2	2	5	0	2	2	0	0	0	0	105
White Sucker	0	0	0	0	0	0	0	0	0	0	0	4
Shorthead Redhorse	1	2	0	0	0	3	1	0	0	0	1	2,904
Brown Bullhead	0	0	0	0	0	1	0	0	0	0	0	86
Channel Catfish	58	37	491	430	181	117	18	78	65	163	102	4,172
Rock Bass	3	1	0	0	0	0	0	0	0	0	0	62
Redbreast Sunfish	0	0	1	0	0	0	0	0	0	0	0	4
Green Sunfish	1	0	0	0	0	0	0	0	0	0	0	6
Pumpkinseed	0	0	1	0	0	2	0	0	0	0	0	5
Bluegill	10	4	5	2	2	10	3	8	2	2	3	110
Smallmouth Bass	8	5	24	8	3	14	4	0	0	3	0	2,297
Largemouth Bass	0	1	2	0	0	1	1	0	0	0	0	48
White Crappie	0	0	1	0	0	0	0	0	0	0	0	4
Black Crappie	0	0	0	0	0	0	0	0	0	0	0	14
Tessellated Darter	0	0	0	0	0	0	0	0	0	0	0	3
Yellow Perch	0	0	0	0	0	0	0	0	0	0	0	6
Walleye	80	40	98	125	60	44	28	26	15	17	15	2,078
Sea Lamprey	0	0	0	0	0	0	0	0	0	0	0	55
Greenside Darter	0	0	0	0	0	0	0	0	0	0	0	10
Hybrid Striped Bass	0	0	0	0	0	0	0	0	0	0	0	4
Tiger Muskie	0	0	0	0	0	1	1	0	0	1	0	21
Chain Pickerel	0	0	0	0	0	1	0	0	0	0	0	1
Logperch	0	0	0	0	0	0	0	0	0	0	0	2
Splake	0	0	0	0	0	0	0	0	0	0	0	6
Flathead catfish	62	32	28	53	130	62	54	140	172	95	22	1,098
Northern Snakehead	15	20	6	4	11	5	0	19	3	6	2	952
Blue Catfish	0	0	0	0	0	0	0	0	0	0	0	0
Banded Darter	0	0	0	0	0	0	0	0	0	0	0	1
Tiger Trout	0	0	0	0	0	0	0	0	0	0	0	2
Total	11,065	7,621	14,425	30,700	8,604	10,222	10,645	6,921	20,946	26,483	18,210	1,476,055

Table 2. Catch of fishes at the Conowingo Dam West Fish Lift, 2021.

Number of Days	**59**
Number of Lifts	**1,378**
Fishing Time (hours : minutes)	**552:28:00**
Number of Taxa	**39**
AMERICAN SHAD	6,825
HICKORY SHAD	7
BLUEBACK HERRING	13
ALEWIFE	14
GIZZARD SHAD	1,451,584
STRIPED BASS	83
AMERICAN EEL	96
Carp	666
White Perch	1,022
Hybrid Striped Bass*	4
Rainbow Trout	7
Brown Trout	53
Tiger Trout*	2
Splake*	6
Chain Pickerel	1
Muskellunge	7
Tiger Muskellunge*	21
Comely Shiner	1,555
Spottail Shiner	8
Spotfin Shiner	55
Quillback	105
White Sucker	4
Shorthead Redhorse	2,904
Brown Bullhead	86
Channel Catfish	4,172
Rock Bass	62
Redbreast Sunfish	4
Green Sunfish	6
Pumpkinseed	5
Bluegill	110
Smallmouth Bass	2,297
Largemouth Bass	48
White Crappie	4
Black Crappie	14
Yellow Perch	6
Walleye	2,078
Tessellated Darter	3
Greenside Darter	10
Banded Darter	1
Logperch	2
Sea Lamprey	55
Northern Snakehead	952
Flathead catfish	1,098
Blue Catfish	0
Total	**1,476,055**

* Denotes hybrid fish

Table 3. American Shad sacrifice and mortality summary for the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

Date	Sacrificed		Holding Mort		Lift Mort		Transport Mort		Total
	Males	Females	Males	Females	Males	Females	Males	Females	
1-Apr									0
3-Apr									0
5-Apr									0
7-Apr									0
9-Apr									0
11-Apr	1		1	1					3
13-Apr				2					2
15-Apr				1					1
16-Apr									0
17-Apr				2					2
18-Apr	1								1
19-Apr	1								1
20-Apr									0
21-Apr	4								4
22-Apr									0
23-Apr									0
24-Apr	1	2							3
25-Apr	2	1							3
26-Apr	1						0	1	2
27-Apr	3	2							5
28-Apr	3	4		1					8
29-Apr		2							2
30-Apr	7	3							10
1-May	7	3		2					12
2-May	3	1							4
3-May	5	7		3					15
4-May	2						0	1	3
5-May									0
6-May									0
7-May									0
8-May		1							1
9-May	2								2
10-May									0
11-May									0
12-May									0
13-May									0
14-May									0
15-May									0
16-May									0
17-May		1							1
18-May	2	1							3
19-May	3	1							4
20-May	1	1							2
21-May	5								5
22-May	10	5							15
23-May	1	5	6	12	1		0	2	27
24-May	1								1
25-May	4	5							9
26-May		1	2	7					10
27-May	5	4		1	4	5			19
28-May	2	1							3
29-May		1							1
30-May		2		1					3
31-May	1	2							3
1-Jun		1							1
2-Jun									0
3-Jun									0
4-Jun									0
5-Jun		1							1
TOTAL	78	58	9	33	5	5	0	4	192

Table 4. American Shad sex ratio information, Conowingo Dam West Fish Lift, 2021. No operation on April 2, 4, 6, 8, 10, 12, and 14, 2021.

Date	Sample size	Males	Females	Male:Female Ratio
1-Apr	0	0	0	N/A
3-Apr	0	0	0	N/A
5-Apr	0	0	0	N/A
7-Apr	1	0	1	N/A
9-Apr	38	21	17	1: 0.81
11-Apr	43	18	25	1: 1.39
13-Apr	4	3	1	1: 0.33
15-Apr	2	2	0	1: 0.00
16-Apr	4	3	1	1: 0.33
17-Apr	3	2	1	1: 0.50
18-Apr	37	20	17	1: 0.85
19-Apr	40	20	20	1: 1.00
20-Apr	8	2	6	1: 3.00
21-Apr	176	80	80	1: 1.00
22-Apr	31	19	12	1: 0.63
23-Apr	10	6	4	1: 0.67
24-Apr	139	61	78	1: 1.28
25-Apr	144	52	67	1: 1.29
26-Apr	66	34	32	1: 0.94
27-Apr	213	58	63	1: 1.09
28-Apr	280	56	66	1: 1.18
29-Apr	142	47	53	1: 1.13
30-Apr	540	65	47	1: 0.72
1-May	447	80	87	1: 1.09
2-May	235	49	51	1: 1.04
3-May	642	102	73	1: 0.72
4-May	15	6	9	1: 1.50
5-May	20	7	13	1: 1.86
6-May	7	4	3	1: 0.75
7-May	2	0	2	N/A
8-May	64	39	25	1: 0.64
9-May	103	57	46	1: 0.81
10-May	7	3	4	1: 1.33
11-May	9	4	5	1: 1.25
12-May	0	0	0	N/A
13-May	0	0	0	N/A
14-May	0	0	0	N/A
15-May	2	1	1	1: 1.00
16-May	5	4	1	1: 0.25
17-May	51	25	26	1: 1.04
18-May	124	71	42	1: 0.59
19-May	196	52	48	1: 0.92
20-May	136	67	69	1: 1.03
21-May	250	52	55	1: 1.06
22-May	735	70	75	1: 1.07
23-May	221	40	41	1: 1.03
24-May	74	47	27	1: 0.57
25-May	472	54	46	1: 0.85
26-May	69	33	36	1: 1.09
27-May	414	69	67	1: 0.97
28-May	220	40	60	1: 1.50
29-May	20	10	10	1: 1.00
30-May	89	26	63	1: 2.42
31-May	184	46	86	1: 1.87
1-Jun	7	2	5	1: 2.50
2-Jun	12	4	8	1: 2.00
3-Jun	14	5	9	1: 1.80
4-Jun	20	8	12	1: 1.50
5-Jun	38	13	25	1: 1.92
TOTAL	**6,825**	**1,659**	**1,721**	**1: 1.04**

Table 5. Catch and effort of American Shad collected at the Conowingo Dam West Fish Lift during primary collection periods,* 1985-2021.

Year	Number Days	Number Lifts	Fishing Hours	Total Catch	Catch Per Day	Catch Per Lift	Catch Per Hour
1985	37	839	328.6	1,518	41	2	4.6
1986	53	737	431.5	5,136	97	7	11.9
1987	49	1,295	506.5	7,659	156	6	15.1
1988	54	1,166	471.7	5,137	95	4	10.9
1989	46	1,034	447.2	8,216	179	8	18.4
1990	62	1,247	541.0	15,958	257	13	29.5
1991	59	1,123	478.5	13,273	225	12	27.7
1992	61	1,517	566.0	10,323	169	7	18.2
1993	41	971	398.0	5,328	130	5	13.4
1994	44	918	414.0	5,595	127	6	13.5
1995	64	1,216	632.2	15,588	244	13	24.7
1996	27	441	245.2	11,458	424	26	46.7
1997	44	611	295.1	12,974	295	21	44.0
1998	26	476	238.6	6,577	253	14	27.6
1999	43	709	312.6	9,658	225	14	30.9
2000	34	424	206.5	9,785	288	23	47.4
2001	41	425	195.1	10,940	267	26	56.1
2002	31	417	147.1	9,347	302	22	63.5
2003	31	637	171.8	9,802	316	27	57.0
2004	14	151	74.3	3,426	245	23	46.1
2005	30	295	165.9	3,896	130	13	23.5
2006	37	394	214.9	3,970	107	10	18.5
2007	29	288	135.3	4,272	147	15	31.6
2008	34	481	174.4	2,627	77	5	15.1
2009	28	282	144.1	6,534	233	23	45.3
2010	27	238	138.2	5,605	208	24	40.6
2011	15	144	85.6	3,074	205	21	35.9
2012	37	404	244.0	1,486	40	4	6.1
2013	24	288	134.1	2,030	85	7	15.1
2014	27	321	173.1	513	19	2	3.0
2015	19	194	100.5	875	46	4	8.7
2016	11	131	58.2	861	78	7	14.8
2017	13	123	56.4	736	56	6	13.0
2018	15	200	84.7	465	31	2	5.5
2019	20	227	124.3	390	19	2	3.1
2020	DID NOT OPERATE DUE TO COVID-19 PANDEMIC						
2021	**59**	**1,378**	**552.5**	**6,825**	**115**	**5**	**12.3**

*Only applies to 1985-1995 data. Excludes early and late season catch and effort when less than 10 shad/day were taken.

Table 6. Operations and fish catch at Conowingo Dam West Fish Lift, 1985-2021.

Year	Number of Days	Total Fish (Millions)	Number of Taxa	American Shad	Hickory Shad	Alewife	Blueback Herring
1985	55	2.318	41	1,546	9	377	6,763
1986	59	1.831	43	5,195	45	2,822	6,327
1987	60	2.593	43	7,667	35	357	5,861
1988	60	1.602	49	5,169	64	712	14,570
1989	53	1.066	45	8,311	28	1,902	3,611
1990	72	1.188	44	15,964	77	425	9,658
1991	63	0.533	45	13,330	120	2,649	15,616
1992	64	1.560	46	10,335	376	3,344	27,533
1993	45	0.713	37	5,343	0	572	4,052
1994	47	0.564	46	5,615	1	70	2,603
1995	68	0.995	44	15,588	36	5,405	93,859
1996	28	1.233	39	11,473	0	1	871
1997	44	0.346	39	12,974	118	11	133,257
1998	41	0.575	38	6,577	6	31	5,511
1999	43	0.722	34	9,658	32	1,795	8,546
2000	34	0.458	37	9,785	1	9,189	14,326
2001	41	0.310	38	10,940	36	7,824	16,320
2002	31	0.419	35	9,347	0	141	428
2003	31	0.147	30	9,802	1	16	183
2004	14	0.039	30	3,426	0	0	1
2005	30	0.094	36	3,896	0	0	0
2006	37	0.163	38	3,970	0	2	6
2007	29	0.159	36	4,272	0	7	153
2008	34	0.733	37	2,627	0	2	7
2009	28	0.226	39	6,534	4	20	165
2010	27	0.158	36	5,605	1	1	81
2011	15	0.100	32	3,074	0	0	0
2012	37	0.322	38	1,486	0	0	7
2013	24	0.489	33	2,030	0	0	2
2014	27	0.597	33	513	0	13	233
2015	19	0.242	29	875	0	29	17
2016	11	0.179	25	861	0	20	14
2017	13	0.177	29	736	0	5	0
2018	15	0.315	29	465	3	6	21
2019	20	0.228	31	390	1	0	13
2020	DID NOT OPERATE DUE TO COVID-19 PANDEMIC						
2021	**59**	**1.476**	**39**	**6,825**	**7**	**14**	**13**

Table 7. American Shad Transport Summary for the Conowingo Dam West Fish Lift, April 1 – June 5, 2021.

Date	Number Transported	Number of Transport Mortalities	Number Stocked	Total Number of Fish Stocked for Season
11-Apr	63	0	63	63
17-Apr	20	0	20	83
21-Apr	96	0	96	179
22-Apr	164	0	164	343
25-Apr	197	0	197	540
26-Apr	116	1	115	655
27-Apr	124	0	124	779
28-Apr	148	0	148	927
28-Apr	199	0	199	1,126
29-Apr	181	0	181	1,307
30-Apr	200	0	200	1,507
30-Apr	200	0	200	1,707
1-May	205	0	205	1,912
1-May	226	0	226	2,138
1-May	142	0	142	2,280
2-May	226	0	226	2,506
3-May	206	0	206	2,712
3-May	225	0	225	2,937
4-May	163	1	162	3,099
7-May	32	0	32	3,131
9-May	167	0	167	3,298
13-May	14	0	14	3,312
18-May	167	0	167	3,479
20-May	203	0	203	3,682
20-May	69	0	69	3,751
21-May	207	0	207	3,958
21-May	96	0	96	4,054
22-May	207	0	207	4,261
22-May	200	0	200	4,461
23-May	200	1	199	4,660
23-May	223	1	222	4,882
24-May	85	0	85	4,967
25-May	205	0	205	5,172
26-May	200	0	200	5,372
27-May	82	0	82	5,454
27-May	200	0	200	5,654
27-May	192	0	192	5,846
28-May	198	0	198	6,044
30-May	106	0	106	6,150
31-May	175	0	175	6,325
3-Jun	29	0	29	6,354
5-Jun	59	0	59	6,413
TOTALS	6,417	4	6,413	

Table 8. Summary of Floy Tagged American Shad Collected at the Conowingo Dam West Fish Lift, April 1 - June 5, 2021.

TAG NUMBER	SEX OF FISH	DATE TAGGED*	DATE COLLECTED	DAYS AT LARGE
167915	F	5/11/2021	5/18/2021	7
167838	M	5/6/2021	5/18/2021	12
167699	F	5/5/2021	5/20/2021	15
167790	F	5/6/2021	5/20/2021	14
167676	F	4/26/2021	5/21/2021	25
167851	M	5/7/2021	5/21/2021	14
167786	M	5/6/2021	5/21/2021	15
167863	M	5/7/2021	5/21/2021	14
167832	M	5/6/2021	5/21/2021	15
167902	F	5/10/2021	5/22/2021	12
167950	F	5/19/2021	5/23/2021	4
167960	F	5/19/2021	5/23/2021	4
167905	M	5/10/2021	5/24/2021	14
167944	M	5/19/2021	5/25/2021	6
167678	M	4/26/2021	5/25/2021	29
167933	M	5/18/2021	5/25/2021	7
167935	F	5/18/2021	5/25/2021	7
167961	F	5/19/2021	5/25/2021	6
167958	M	5/19/2021	5/26/2021	7
167927	F	5/11/2021	5/27/2021	16
167936	F	5/18/2021	5/27/2021	9
167978	F	5/24/2021	5/30/2021	6

* Date Floy tagged provided by Maryland Department of Natural Resources (MDNR)

Figures

Figure 1. Photo of WFL entrance gates (upstream and downstream), April 1 to June 5, 2021.

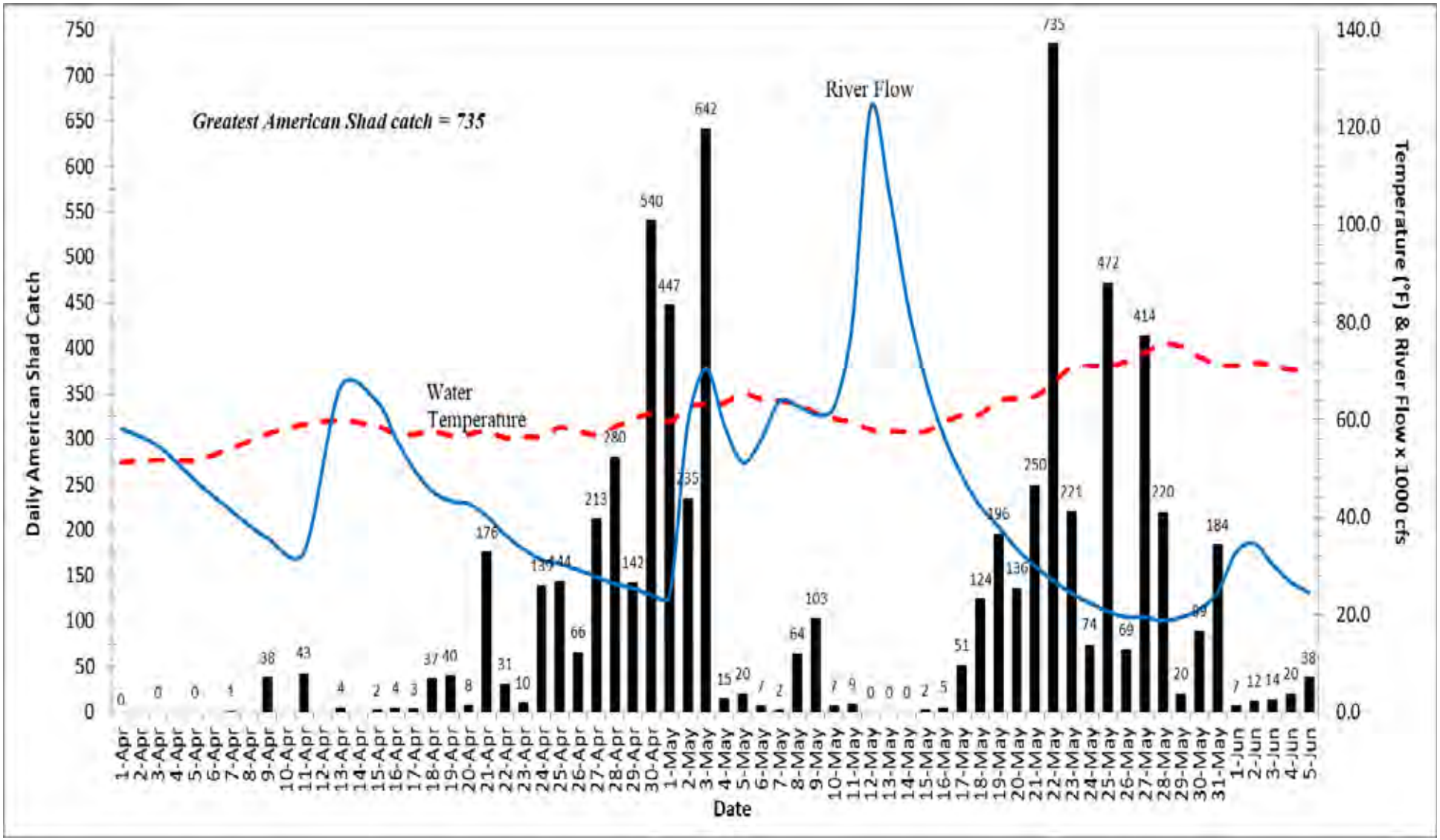

Figure 2. A plot of river flow (x 1000 cfs) as recorded at Marietta and water temperature (°F) recorded at Conowingo Dam versus the daily American Shad catch at the West Fish Lift, Spring 2021. The West Lift was not operated on April 2, 4, 6, 8, 10, 12, and 14, 2021.

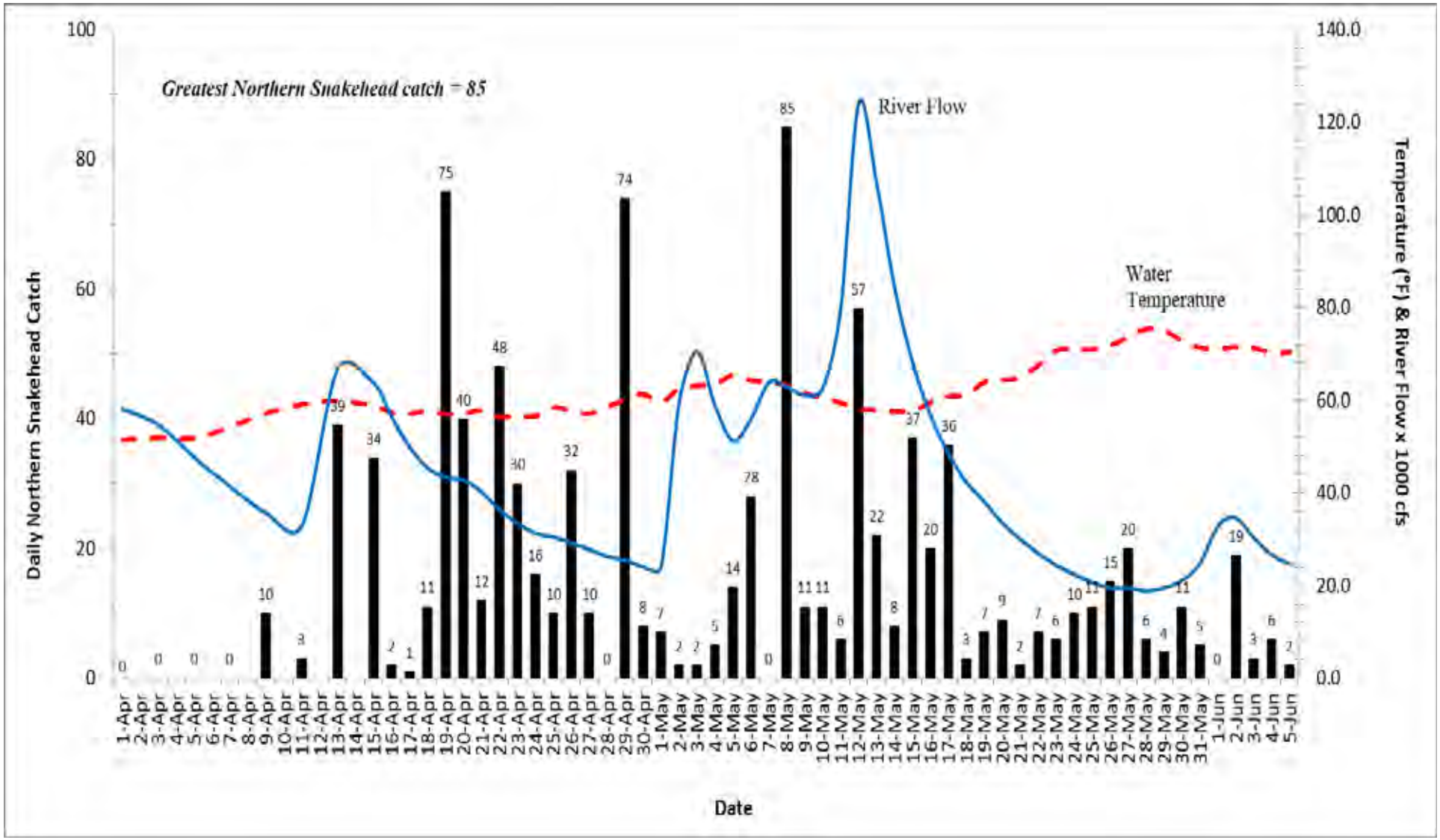

Figure 3. A plot of river flow (x 1000 cfs) as recorded at Marietta and water temperature (°F) recorded at Conowingo Dam versus the daily Northern Snakehead catch at the West Fish Lift, Spring 2021. The West Lift was not operated on April 2, 4, 6, 8, 10, 12, and 14, 2021.

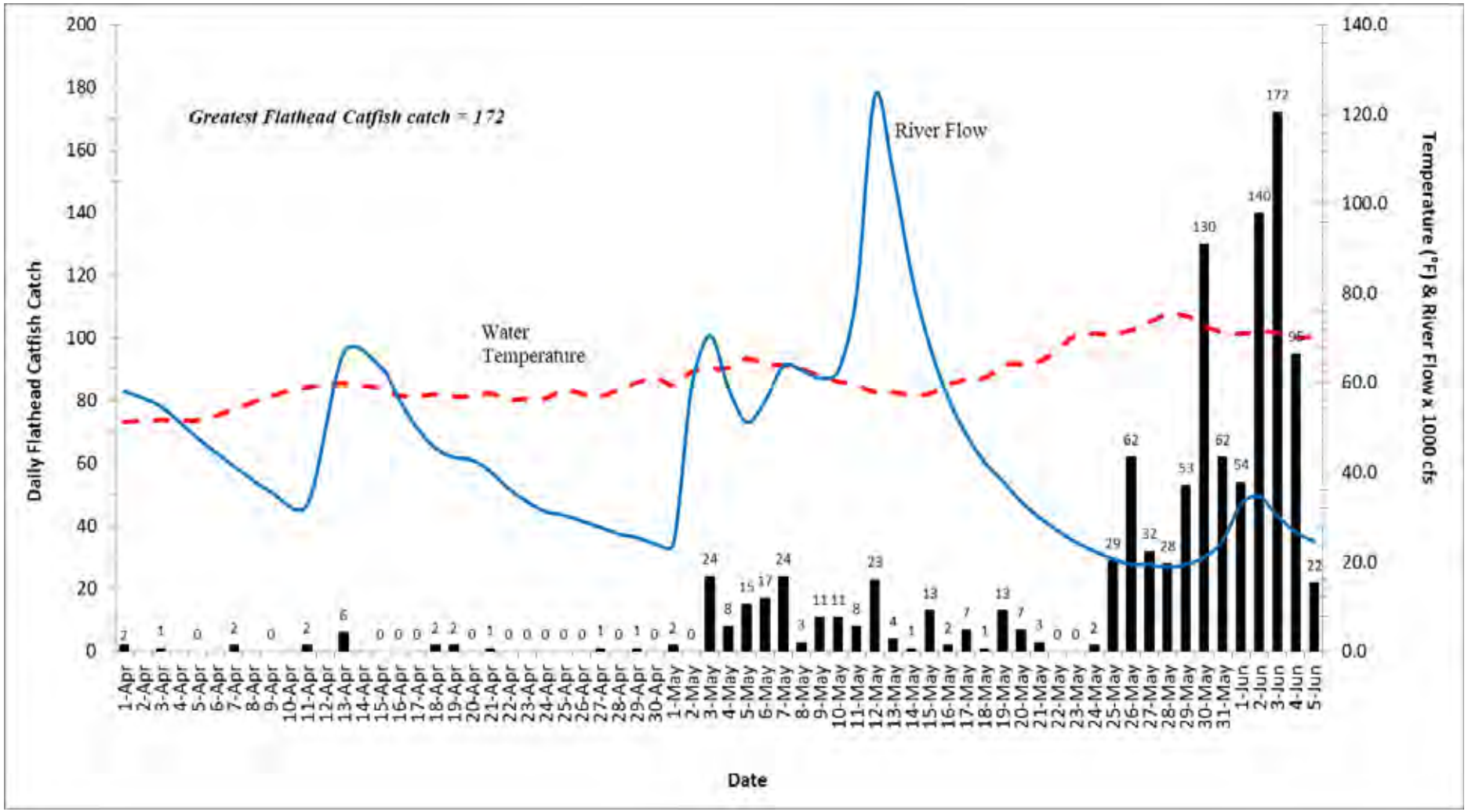

Figure 4. A plot of river flow (x 1000 cfs) as recorded at Marietta and water temperature (°F) recorded at Conowingo Dam versus the daily Flathead Catfish catch at the West Fish Lift, Spring 2021. The West Lift was not operated on April 2, 4, 6, 8, 10, 12, and 14, 2021.