

Project Title:

Examining the Recovery of Diadromous Fishes in the Brandywine River, DE from 2020-2024

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Abstract:

Recent coastwide assessments of multiple alosine species including Alewife, Blueback Herring and American Shad have suggested that low levels of abundance persist coastwide for these fishes. However, the relative abundance of these species remains unknown in many small tributaries along the Atlantic coast that contribute to a broader coastwide stock. Further, impediments to fish passage along many of these tributaries, particularly in the northeastern United States including both historic, nonfunctional and currently used dams prevent passage of diadromous fishes that rely on freshwater reaches to successfully reproduce. In order to assess relative juvenile abundance as it relates to dam removal of American Shad in the Brandywine River, a subtributary of the Christina River and the Delaware River, we led a volunteer-based haul seine survey at multiple locations in Brandywine River above the site of a recently removed dam for three years. Our findings demonstrated juvenile and adult American Shad have utilized habitat above the site of a former impediment only one year after dam removal. Further, these results suggest that as impediments to fish passage are removed, successful recolonization of historic habitat is occurring for multiple diadromous fishes (*Alosa sapidissima* and *Alosa pseudoharengus*) demonstrating the need for removal of more barriers in order to enhance currently depressed levels of abundance along the coast by providing additional spawning habitat.

Introduction:

Since 2008, the state of the Delaware river herring (Alewife and Blueback Herring) fishery has remained closed to harvest. However, a small American Shad fishery has persisted since then. In 2020, the coastwide American Shad stock was found to be depleted with a listed adult status of unsustainable in the Delaware River (ASMFC 2020). Unfortunately, very little data are available to assess the current status of multiple alosine populations, including Alewife (*Alosa pseudoharengus*), American Shad (*Alosa sapidissima*), Blueback Herring (*Alosa aestivalis*), and Hickory Shad (*Alosa mediocris*) in the greater Delaware River watershed. Furthermore, Brandywine River had eleven dams (ten presently) impeding diadromous fish passage in this tributary to the Christina River limiting the relative contribution to the broader coastwide stock. Brandywine River begins in Chester County, Pennsylvania, but traverses through the center of Wilmington, Delaware functioning as an urbanized watershed which has suffered environmental impairment in the past. To address this data deficiency and critically evaluate fish passage as dams are removed, we designed and implemented a juvenile American Shad sampling survey that mirrors the sampling frequency and design of another state survey in order to align our sampling methodology with that of the State of Delaware, Department of Natural Resources & Environmental Control, Division of Fish & Wildlife, Fisheries Section (hereafter DFW; Park & Stangl 2020).

In completing a complimentary survey, we have collected valuable data that can be used in other applications such as coast wide assessments of spawning stock biomass, thus enhancing our overall utility to state (DFW), regional (e.g. Atlantic States Marine Fisheries Commission, Delaware River Basin Commission) and national (NOAA, USFWS) fisheries managers and stakeholders assessing the relative performance of diadromous alosine species. However, we designed our seine survey to integrate community involvement of community members by soliciting local volunteers thus serving as a broader effort to aid in environmental education. Further, these relative abundance data will help support ongoing American Shad and river herring restoration efforts and inform planners and managers about the relative abundance and phenological trends of these species in stretches of the Brandywine River, supporting the overall mission of multiple organizations including Brandywine River Restoration Trust, DFW, NOAA and the USFWS. The objectives of our study were to (1) Quantify relative juvenile abundance of alosine fishes including Alewife, American Shad, Blueback Herring, and Hickory Shad, (2) Characterize size frequency for observed alosine fishes, and (3) Estimate relative abundance of other resident and migratory fishes.

Methods:

We sampled with two successive tows at one location above and below Dam #2 in the Brandywine River to quantify relative abundance of juvenile alosine fishes in Brandywine River using a similar modified Swingle Method (Park & Stangl 2020; Swingle 1956; Figure 1), where we anchored one end of the net on shore and conducted a single arc by wading through the water

column. We sampled during the daytime, at a twice monthly frequency (every other week) from mid-July through mid-October with a 22.9-m long x 3.0-m deep haul seine consisting of 6.35-mm nylon netting. All fish were identified and enumerated to the lowest taxonomic level possible and released alive if possible. For all alosine species observed, length data of a random subsample ($n = 20$) of each species was collected, so that we could analyze trends in size frequencies by location and year. In order to validate our sampling methodology, we compared the trends of our survey to those of the DFW surveys in the Christina River, and a single location in the lower Brandywine River, which collects information on alosine abundance.

Results:

We found juvenile and adult American Shad utilized habitat above the location of former Dam #1 near the Washington Street Bridge on Brandywine River in Wilmington, DE, USA consecutively over a four-year period (2020-2024). We collected 160 juvenile American Shad over a two-week period, with 159 fish documented in a single tow in 2020. We collected 8 adults at the same location below Dam #2 over two separate sampling days in 2020 (Figure 1). Unlike our total catch in 2020, we observed juvenile American Shad at our downriver location, below Dam #2 on nine different occasions totaling more than 279 individuals in 2021 (Table 1). However, no adult American Shad were observed in 2021. We documented the presence of 38 individual American Shad at the same location over two sampling days in 2022. We captured a single juvenile American Shad in 2023. In 2024, we captured 93 juvenile American Shad. The average size of juvenile American Shad encountered was 77.3 mm TL (± 4.6 mm SD) on July 28, 2020 and 81.0 mm TL on August 11, 2020. Average sizes of the adults encountered ranged from 436.0 mm TL (± 29.2 mm SD) to 447 mm TL (± 12 mm SD) in 2020. The average size of juvenile American Shad per tow ranged from 60.8 mm TL (± 2.3 mm SD) to 79.0 mm TL in 2021. Whereas, the average size of juvenile American Shad per tow was slightly larger in 2022, ranging from 71.0 mm TL (± 4.3 mm SD) to 80.2 mm TL (± 4.7 mm SD). In 2023, the single juvenile shad was measured to be 79.0 mm TL. In 2024, the average size of juvenile American Shad per tow was slightly lower than 2022 and 2023, with sizes ranging from 71.4 mm TL (± 4.6 mm SD) to 77.3 mm TL (± 2.4 mm SD). The geometric mean of the juvenile catch at the downriver station below Dam #2 was 0.510 in 2020, highest in 2021 at 3.026, 0.920 in 2022 and 0.584 in 2024 (Table 2). The geometric mean for 2023 is undefined, as we only captured a single individual during that sampling period.

The observed temporal pattern of juvenile American Shad occurrence was longest in 2021 occurring from July 13, 2021 through September 7, 2021 when compared to 2020 and 2022. Juvenile American Shad were only seen on two sampling dates in both 2020 and 2022. In 2023, the single juvenile American Shad was collected on July 18. In 2024, American Shad were captured successively on July 16, 2024, July 23, 2024, and July 29, 2024. Further, tow specific catches demonstrated differences in catch between years. All American Shad collected in 2020 were caught on the second tow of the day, while juveniles were observed in both tows in 2021, 2022 and 2024 (Table 1). In 2023, the single American Shad was caught in the second tow of the

day following an unsuccessful first tow. No juvenile or adult Alewife or Blueback Herring were collected in 2020, 2022, 2023 or 2024. However, we did collect three Alewife (*Alosa pseudoharengus*) on a single day (August 24) in 2021. In addition to the alosine species collected, one juvenile American Eel (*Anguilla rostrata*) which was 205 mm TL, was collected above Dam #2 at the upriver sampling location in 2020. Another individual 284 mm TL collected above Dam #2 in 2022, and a third individual 101 mm TL was collected below Dam #2 in 2023. No alosines or other diadromous fishes other than American Eel were collected above Dam #2 at the upriver sampling site. Additionally, over the course of these five years, 13 other species were collected among the two locations including Banded Killifish (*Fundulus diaphanous*), Bluegill (*Lepomis macrochirus*), Eastern Silvery Minnow (*Hybognathus regius*), Fallfish (*Semotilus corporalis*), Creek Chub (*Semotilus atromaculatus*), Largemouth Bass (*Micropterus salmoides*), Mosquitofish (*Gambusia holbrooki*), Pumpkinseed (*Lepomis gibbosus*), Redbreast Sunfish (*Lepomis auritus*), Satinfin Shiner (*Cyprinella analostana*), Spottail Shiner (*Notropis hudsonius*), Tesselated Darter (*Etheostoma olmstedii*), White Sucker (*Catostomus commersonii*), and Yellow Perch in 2020 (*Perca flavescens*). In 2021, many of those same species, as well as species not collected in 2020 were identified including Common Shiner (*Luxilus cornutus*), Gizzard Shad (*Dorosoma cepedianum*), Golden Shiner (*Notemigonus crysoleucas*), Northern Hogsucker (*Hypentelium nigricans*), Spotfin Shiner (*Cyprinella spiloptera*) and Smallmouth Bass (*Micropterus dolomieu*). In 2022, only one new species was detected, the Bridle Shiner (*Notropis bifrenatus*; Table 3). In 2023, the only new species detected was the Swallowtail Shiner (*Notropis procne*). In 2024, no new species were detected.

Discussion:

Restoring habitat for diadromous fishes is imperative to help rebuild these species, especially under the context of ongoing landscape modifications through development and other natural stressors. Although fishing remains an important, and in many cases, dominant driver of population abundance, there is now substantial evidence that climate change and decadal variability in weather conditions affect fish and invertebrate populations (Perry et al. 2005). Those impacts can be positive as well as negative and successful fisheries management requires careful consideration of impacts that individual variables have on each species as well as potential multiplicative or synergistic effects on fisheries. As a functional group, diadromous fishes have been identified as one of the most sensitive groups to climate change and have been predicted to experience a negative directional impact from climate change projections (Hare et al. 2016). Rewilding or reopening available habitat will likely offset some of the negative consequences to these species by providing more available habitat for these species to potentially colonize or recolonize.

With the removal of Dam #1 on Brandywine River in 2019, roughly a half mile (Eichman 2019) of habitat was made available to diadromous species including American Shad to use for spawning and juvenile riverine residency. Our results represent the first known scientific

documentation of juvenile American Shad moving above a 115-year-old dam in Brandywine River with the collection of juvenile individuals in 2020, as well as the first known documentation of juvenile Alewife moving above the same location. We observed adult American Shad using this habitat in addition to juveniles (Appendix), demonstrating that multiple life history stages simultaneously benefit from impediment removal. Further, we have found an increase in habitat utilization in subsequent years with an increase in the duration of occupancy, and an increase in the total number caught during our second year of sampling in 2021. Beyond our findings for American Shad, we also documented a small number of Alewife in our second year of sampling, suggesting that recovery in other species may increase as time since the removal of the first dam increases. Further, we found that species richness is much higher at the downriver location ($S = 26$ species) compared to the upriver site ($S=12$) with all years combined, suggesting that reopened river sections may similarly increase biodiversity.

American Shad have historically migrated into freshwater stretches of rivers from Florida to Newfoundland (Bigelow and Schroeder 1953) and contributed millions of pounds of landings to commercial fisheries in the tributaries and coastal waters of the northwestern Atlantic Ocean (Scott and Crossman 1973; Haro & Castro-Santos 2012). Overfishing, pollution and impediments to fish passage have all been suggested to have contributed to the relative decline of diadromous fishes, however, the degree of significance for each of these parameters relative to the others remains unknown (Stevenson 1897; MacKenzie et al. 1985; Haro & Castro-Santos 2012). Despite the relatively unknown scale impediments that diadromous fish passage have on the coastwide levels of population abundance of many species including Alewife, American Shad, and Blueback Herring, restoring fragmented habitat corridors via the removal of these obstructions coupled with the complete rewilding of river systems will enhance ecosystem performance (Brown et al. 2013). Our results demonstrate that recolonization of American Shad, as well as Alewife can occur within relatively rapid time scales following impediment removal. Further, subsequent years may result in a general increase in the relative contribution of these habitats to relative abundance along broader spatial scales.

Our survey was similar to other surveys in documenting the presence of juvenile American Shad in Brandywine River. While we did not collect any other alosine species in our sampling efforts in 2020, 2022, 2023 or 2024, we did see Alewife in our 2021 collections. In 2020, the DFW survey encountered 65 American Shad total at their lower Brandywine River sampling station below the site of former Dam #1, over seven sampling events. The DFW survey had a lower variability with more consistent smaller catches (e.g. $n \leq 7$), than what was observed in our study in 2020. However, the frequency of occurrence in our study did suggest a higher degree of habitat utilization in the upper Brandywine River in 2021 compared to 2020 and 2022. The DFW Brandywine River geometric mean was 3.32 in 2020, 13.29 in 2021, 26.48 in 2022, 1.78 in 2023, and 18.30 in 2024. The geometric mean of American Shad collected by the DFW survey in the Brandywine and Christina Rivers combined was 2.70 in 2020, 14.44 in 2021, 17.54 in 2022, 1.42 in 2023, and 11.41 in 2024. However, in 2019 the DFW did not collect any American Shad at the Brandywine River sampling location and found higher catches in 2018 and

2017 relative to 2020. No juvenile Alewife or Blueback Herring were collected at the lower Brandywine River sampling station by DFW in 2019 (Park & Stangl 2021). Similar data were requested from the New Jersey Marine Fisheries Administration (NJMFA), which conducts a seine survey in the Delaware River across from the mouth of the Christina River. However, that information was not available in 2020 because NJMFA did not sample due to restrictions resulting from COVID-19 safety protocols, so we chose to omit 2021 and 2022 as well. Given the confirmation of juvenile and adult American Shad above the site of former Dam #1 and relative performance of our survey (e.g. total number and variability of catch through time) relative to another similar survey in Brandywine River using a net that is two times longer in length than the one used in our study, our survey methodology adequately reflects the relative trends in abundance and habitat use of American Shad in the stretch of Brandywine River between the location of former Dam #1 and Dam #2.

Interestingly, we found our largest catch of juvenile American Shad coincided with the lowest average discharge ($\text{ft}^3 \cdot \text{s}^{-1}$) and turbidity (Form Neph) observed at Wilmington, DE (USGS 01481500) throughout the time series in 2020. Similarly, in 2021, we documented our highest total number collected coincident with the second lowest average discharge for the year. Discharge was unique in 2022, in that the average discharge for all of our sampling events was $238.68 \text{ ft}^3 \cdot \text{s}^{-1}$, substantially less than the average $331.31 \text{ ft}^3 \cdot \text{s}^{-1}$ observed in 2021 and $395.40 \text{ ft}^3 \cdot \text{s}^{-1}$ detected in 2020. Our results suggest that water discharge rate may affect relative abundance and habitat usage of American Shad in the upper reaches of the Brandywine River. Specifically, lower seasonal average discharge rates may not provide optimal flow conditions. However, high frequencies of relatively stronger discharge events may similarly inhibit the presence of juvenile American Shad, as was observed in the first year of this study. Future work should focus on targeting similar collections of alosine species in the Brandywine River and other nearby tributaries, as well as standardizing an index of abundance with significant environmental covariates affecting abundance and occupancy, such as water temperature, discharge rates, as well as aim to make broader spatial comparisons with similar surveys. Further, additional sites along Brandywine River and methodologies including electroshocking should be examined to determine if other suitable locations or capture methods may be used to augment our growing body of information on diadromous fishes in the area. Finally, determining the degree of connectivity of American Shad between the Delaware River stock and Brandywine River is needed to critically address the question of stock status and contributions in tributaries of the Delaware River, i.e. does the depleted status of American Shad in the Delaware River match stock status in Brandywine River.

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Tables and Figures:

Table 1. Average fork length (FL AVG) in mm with the standard deviation of fork length (FL SD) in mm, as well as total length (TL AVG) in mm with the standard deviation of total length (TL SD) in mm.

Date	Time	Station	Tow	Genus species	Common Name	Stage	Count	FL AVG	FL SD	TL AVG	TL SD
7/14/20	10:40	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Adult	5	-	-	436	29.2
7/28/20	11:15	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Adult	3	401.7	16.5	447	12
7/28/20	11:25	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	159	70.9	4	77.3	4.6
8/11/20	11:15	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	1	74	0	81	0
7/13/21	10:50	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	3	61.3	4.5	66.7	4.2
7/13/21	11:00	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	13	57	5.1	64.1	5.4
7/31/21	9:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	46	56.5	4	63.8	5.1
7/31/21	9:55	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	183	58.4	5.7	64.6	6.2
8/10/21	10:30	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	10	57.2	5.2	63.7	6.1
8/10/21	10:50	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	3	54	1.7	60.8	2.3
8/24/21	9:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	13	60.2	4	67.1	3.7
8/24/21	10:00	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	7	58.6	2.8	64.9	4
8/24/21	10:00	Dam 2-DR	2	<i>Alosa pseudoharengus</i>	Alewife	Juvenile	3	59.7	3.3	66.3	3.9
9/7/21	10:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	1	70	0	79	0
7/12/22	11:00	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	13	64.7	4.1	72.4	5
7/12/22	11:30	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	4	63.8	4.3	71	4.3
7/26/22	10:20	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	11	65.8	2.3	76.6	2.6

7/26/22	10:41	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	10	64.2	4.2	80.2	4.7
7/18/23	8:00	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	1	70	Na	79	Na
7/16/24	8:25	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	1	67	Na	74	Na
7/16/24	8:35	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	11	66.9	3.22	74	2.14
7/23/24	8:25	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	14	69.3	4.26	71.3	4.62
7/23/24	8:35	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	40	66.5	2.75	73.6	3.67
7/30/24	8:25	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	7	69	2	77.3	2.36
7/30/24	8:35	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	20	67.7	3.05	75.5	3.65

Table 2. The geometric mean number of juvenile American Shad per haul in Brandywine River in 2020, 2021, 2022 and 2023 at the downriver location only.

Juvenile American Shad Index										
	2020		2021		2022		2023		2024	
Geometric Mean	0.510		3.026		0.920		NaN		0.584	
Standard Error	0.672		1.807		0.599		NaN		0.187	
95% Confidence Interval	0.000	2.276	0.847	7.587	0.187	2.322	NaN	0.099	1.285	

Table 3. Species and number observed during the Brandywine River survey in 2020, 2021, 2022, and 2023. Tows with no species listed are indicative of a haul that landed no species.

Date	Time	Station	Tow	Genus Species	Common Name	Stage	Count
7/14/2020	10:00	Dam 2-UR	1	<i>Lepomis macrochirus</i>	Bluegill		2
7/14/2020	10:00	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		5
7/14/2020	10:15	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		3
7/14/2020	10:15	Dam 2-UR	2	<i>Anguilla rostrata</i>	American Eel		1

7/14/2020	10:15	Dam 2-UR	2	<i>Etheostoma olmstedii</i>	Tessellated Darter		2
7/14/2020	10:15	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		12
7/14/2020	10:40	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Adult	5
7/14/2020	10:40	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		1
7/28/2020	10:10	Dam 2-UR	1	<i>Lepomis macrochirus</i>	Bluegill		5
7/28/2020	10:10	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		4
7/28/2020	10:10	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
7/28/2020	10:30	Dam 2-UR	2	<i>Lepomis macrochirus</i>	Bluegill		3
7/28/2020	10:30	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		2
7/28/2020	10:30	Dam 2-UR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1
7/28/2020	11:00	Dam 2-DR	1				
7/28/2020	11:15	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Adult	3
7/28/2020	11:25	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	159
8/11/2020	10:00	Dam 2-UR	1	<i>Lepomis macrochirus</i>	Bluegill		2
8/11/2020	10:00	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		5
8/11/2020	10:00	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth Bass		3
8/11/2020	10:15	Dam 2-UR	2	<i>Etheostoma olmstedii</i>	Tessellated Darter		1
8/11/2020	10:15	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/11/2020	11:00	Dam 2-DR	1	<i>Cyprinella analostana</i>	Satinfin Shiner		6
8/11/2020	11:00	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
8/11/2020	11:00	Dam 2-DR	1	<i>Gambusia holbrooki</i>	Mosquitofish		1
8/11/2020	11:00	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
8/11/2020	11:15	Dam 2-DR	2	<i>Lepomis macrochirus</i>	Bluegill		4
8/11/2020	11:15	Dam 2-DR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/11/2020	11:15	Dam 2-DR	2	<i>Lepomis gibbosus</i>	Pumpkinseed		2
8/11/2020	11:15	Dam 2-DR	2	<i>Catostomus commersonii</i>	White Sucker		3
8/11/2020	11:15	Dam 2-DR	2	<i>Cyprinella analostana</i>	Satinfin Shiner		4
8/11/2020	11:15	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		5

8/11/2020	11:15	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded Killifish		1
8/11/2020	11:15	Dam 2-DR	2	<i>Micropterus salmoides</i>	Largemouth Bass		2
8/11/2020	11:15	Dam 2-DR	2	<i>Perca flavescens</i>	Yellow Perch		3
8/11/2020	11:15	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	1
8/24/2020	13:00	Dam 2-UR	1				
8/24/2020	13:00	Dam 2-UR	2				
8/24/2020	13:50	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		186
8/24/2020	13:50	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
8/24/2020	13:50	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		4
8/24/2020	13:50	Dam 2-DR	1	<i>Gambusia holbrooki</i>	Mosquitofish		1
8/24/2020	13:50	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		1
8/24/2020	13:50	Dam 2-DR	1	<i>Etheostoma olmsted</i>	Tesselated Darter		3
8/24/2020	13:50	Dam 2-DR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1
8/24/2020	13:50	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		6
8/24/2020	13:50	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		2
8/24/2020	13:50	Dam 2-DR	2	<i>Etheostoma olmsted</i>	Tesselated Darter		4
9/8/2020	12:00	Dam 2-UR	1	<i>Perca flavescens</i>	Yellow Perch		12
9/8/2020	12:00	Dam 2-UR	1	<i>Lepomis macrochirus</i>	Bluegill		2
9/8/2020	12:20	Dam 2-UR	2	<i>Perca flavescens</i>	Yellow Perch		9
9/8/2020	12:40	Dam 2-DR	1				
9/8/2020	12:50	Dam 2-DR	2	<i>Semotilus corporalis</i>	Fallfish		6
9/22/2020	10:00	Dam 2-UR	1				
9/22/2020	10:15	Dam 2-UR	2				
9/22/2020	10:45	Dam 2-DR	1	<i>Dorosoma cepedianum</i>	American Gizzard Shad		5
9/22/2020	11:15	Dam 2-DR	2	<i>Dorosoma cepedianum</i>	American Gizzard Shad		3
9/22/2020	11:15	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		3
10/6/2020	10:00	Dam 2-UR	1				
10/6/2020	10:10	Dam 2-UR	2				
10/6/2020	10:30	Dam 2-DR	1				
10/6/2020	10:45	Dam 2-DR	2				

7/13/2021	10:00	Dam 2-UR	1	<i>Lepomis gibbosus</i>	Pumpkinseed		1
7/13/2021	10:20	Dam 2-UR	2	<i>Lepomis macrochirus</i>	Bluegill		4
7/13/2021	10:20	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		1
7/13/2021	10:20	Dam 2-UR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		2
7/13/2021	10:50	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
7/13/2021	10:50	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		29
7/13/2021	10:50	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
7/13/2021	10:50	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	3
7/13/2021	10:50	Dam 2-DR	1	<i>Catostomus commersonii</i>	White Sucker		1
7/13/2021	11:00	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		9
7/13/2021	11:00	Dam 2-DR	2	<i>Catostomus commersonii</i>	White Sucker		1
7/13/2021	11:00	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	13
7/31/2021	9:00	Dam 2-UR	1	<i>Hypentelium nigricans</i>	Northern Hogsucker		1
7/31/2021	9:00	Dam 2-UR	1	<i>Lepomis macrochirus</i>	Bluegill		3
7/31/2021	9:00	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		1
7/31/2021	9:15	Dam 2-UR	2	<i>Lepomis macrochirus</i>	Bluegill		1
7/31/2021	9:35	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		16
7/31/2021	9:35	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		1
7/31/2021	9:35	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		3
7/31/2021	9:35	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		1
7/31/2021	9:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	46
7/31/2021	9:55	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
7/31/2021	9:55	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	183
8/10/2021	10:00	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/10/2021	10:00	Dam 2-UR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1
8/10/2021	10:00	Dam 2-UR	2	<i>Lepomis gibbosus</i>	Pumpkinseed		1

8/10/2021	10:30	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	10
8/10/2021	10:50	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		2
8/10/2021	10:50	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	3
8/24/2021	9:00	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass		1
8/24/2021	9:15	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/24/2021	9:35	Dam 2-DR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/24/2021	9:35	Dam 2-DR	1	<i>Lepomis gibbosus</i>	Pumpkinseed		1
8/24/2021	9:35	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
8/24/2021	9:35	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		5
8/24/2021	9:35	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		2
8/24/2021	9:35	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		164
8/24/2021	9:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	13
8/24/2021	10:00	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	7
8/24/2021	10:00	Dam 2-DR	2	<i>Alosa pseudoharengus</i>	Alewife	Juvenile	3
8/24/2021	10:00	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		3
8/24/2021	10:00	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded Killifish		1
9/7/2021	10:00	Dam 2-UR	1	<i>Luxilus cornutus</i>	Common Shiner		1
9/7/2021	10:15	Dam 2-UR	2	<i>Notropis hudsonius</i>	Spottail Shiner		1
9/7/2021	10:35	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		42
9/7/2021	10:35	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		1
9/7/2021	10:35	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	1
9/7/2021	10:55	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		2
9/7/2021	10:55	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		5
9/7/2021	10:55	Dam 2-DR	2	<i>Etheostoma olmsted</i>	Tessellated Darter		1
9/21/2021	10:00 AM	Dam 2-UR	1				
9/21/2021	10:15 AM	Dam 2-UR	2				

9/21/2021	10:30 AM	Dam 2-DR	1	<i>Notemigonus crysoleucas</i>	Golden Shiner		7
9/21/2021	10:30 AM	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common Shiner		7
9/21/2021	10:30 AM	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		83
9/21/2021	10:30 AM	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		45
9/21/2021	10:30 AM	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		2
9/21/2021	10:30 AM	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		1
9/21/2021	11:00	Dam 2-DR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1
9/21/2021	11:00	Dam 2-DR	2	<i>Notemigonus crysoleucas</i>	Golden Shiner		10
9/21/2021	11:00	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common Shiner		3
9/21/2021	11:00	Dam 2-DR	2	<i>Catostomus commersonii</i>	White Sucker		4
9/21/2021	11:00	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		32
9/21/2021	11:00	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		203
9/21/2021	11:00	Dam 2-DR	2	<i>Etheostoma olmstedii</i>	Tesselated Darter		1
10/5/2021	10:00 AM	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		2
10/5/2021	10:15 AM	Dam 2-UR	2	<i>Notropis hudsonius</i>	Spottail Shiner		1
10/5/2021	10:15 AM	Dam 2-UR	2	<i>Etheostoma olmstedii</i>	Tesselated Darter		1
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Notemigonus crysoleucas</i>	Golden Shiner		1
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common Shiner		2
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		98
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		9
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth Bass		1
10/5/2021	10:45 AM	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		1
10/5/2021	11:15 AM	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		2

10/5/2021	11:15 AM	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		2
10/19/2021	10:00 AM	Dam 2-UR	1				
10/19/2021	10:15 AM	Dam 2-UR	2				
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		35
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		79
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common Shiner		5
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		1
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		1
10/19/2021	10:30 AM	Dam 2-DR	1	<i>Cyprinella spiloptera</i>	Spotfin Shiner		1
10/19/2021	10:45 AM	Dam 2-DR	2	<i>Dorosoma cepedianum</i>	Gizzard Shad		2
10/19/2021	10:45 AM	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common Shiner		2
10/19/2021	10:45 AM	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		1
10/19/2021	10:45 AM	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		4
7/12/2022	10:00 AM	Dam 2-UR	1				0
7/12/2022	10:15 AM	Dam 2-UR	2				0
7/12/2022	11:00 AM	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	13
7/12/2022	11:30 AM	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	4
7/26/2022	10:00	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth Bass	Juvenile	1
7/26/2022	10:15	Dam 2-UR	2				0
7/26/2022	10:20	Dam 2-DR	1	<i>Lepomis gibbosus</i>	Pumpkinseed		1
7/26/2022	10:20	Dam 2-DR	1	<i>Alosa sapidissima</i>	American Shad	Juvenile	11
7/26/2022	10:41	Dam 2-DR	2	<i>Alosa sapidissima</i>	American Shad	Juvenile	10
8/9/2022	10:00	Dam 2-UR	1				0
8/9/2022	10:15	Dam 2-UR	2				0
8/9/2022	10:30	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		80

8/9/2022	10:30	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		11
8/9/2022	10:30	Dam 2-DR	1	<i>Unknown Unknown</i>	Unknown Catfish		1
8/9/2022	10:30	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		4
8/9/2022	10:30	Dam 2-DR	1	<i>Perca flavescens</i>	Yellow Perch		1
8/9/2022	10:30	Dam 2-DR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		1
8/9/2022	11:00	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		66
8/9/2022	11:00	Dam 2-DR	2	<i>Notropis bifrenatus</i>	Bridle Shiner		3
8/9/2022	11:00	Dam 2-DR	2	<i>Hypentelium nigricans</i>	Northern Hogsucker		1
8/9/2022	11:00	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
8/23/2022	10:00	Dam 2-UR	1				0
8/23/2022	10:20	Dam 2-UR	2	<i>Anguilla rostrata</i>	American Eel		1
8/23/2022	10:45	Dam 2-DR	1	<i>Notropis bifrenatus</i>	Bridle Shiner		51
8/23/2022	10:45	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		200
8/23/2022	10:45	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		2
8/23/2022	10:45	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		13
8/23/2022	11:20	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		18
8/23/2022	11:20	Dam 2-DR	2	<i>Notropis bifrenatus</i>	Bridle Shiner		4
8/23/2022	11:20	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		2
9/6/2022	10:00	Dam 2-UR	1				0
9/6/2022	10:20	Dam 2-UR	2	<i>Hypentelium nigricans</i>	Northern Hogsucker		1
9/6/2022	11:00	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		41
9/6/2022	11:00	Dam 2-DR	1	<i>Notropis bifrenatus</i>	Bridle Shiner		32
9/6/2022	11:00	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		30
9/6/2022	11:00	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common Shiner		5
9/6/2022	11:00	Dam 2-DR	1	<i>Hypentelium nigricans</i>	Northern Hogsucker		1
9/6/2022	11:00	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		1
9/6/2022	11:20	Dam 2-DR	2	<i>Morone americana</i>	White Perch		1
9/6/2022	11:20	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		30

9/6/2022	11:20	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		23
9/6/2022	11:20	Dam 2-DR	2	<i>Lepomis macrochirus</i>	Bluegill		1
9/6/2022	11:20	Dam 2-DR	2	<i>Notropis bifrenatus</i>	Bridle Shiner		31
9/6/2022	11:20	Dam 2-DR	2	<i>Lepomis auritus</i>	Red Breast Sunfish		2
9/6/2022	11:20	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common Shiner		1
9/20/2022	10:30	Dam 2-UR	1				0
9/20/2022	10:50	Dam 2-UR	2				0
9/20/2022	11:00	Dam 2-DR	1	<i>Lepomis macrochirus</i>	Bluegill		1
9/20/2022	11:00	Dam 2-DR	1	<i>Dorosoma cepedianum</i>	Gizzard Shad		2
9/20/2022	11:00	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		97
9/20/2022	11:00	Dam 2-DR	1	<i>Notropis bifrenatus</i>	Bridle Shiner		21
9/20/2022	11:00	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		6
9/20/2022	11:00	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		3
9/20/2022	11:25	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		98
9/20/2022	11:25	Dam 2-DR	2	<i>Notropis bifrenatus</i>	Bridle Shiner		47
9/20/2022	11:25	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common Shiner		4
9/20/2022	11:25	Dam 2-DR	2	<i>Lepomis macrochirus</i>	Bluegill		1
9/20/2022	11:25	Dam 2-DR	2	<i>Lepomis auritus</i>	Read Breast Sunfish		1
9/20/2022	11:25	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
9/20/2022	11:25	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded Killifish		2
10/11/2022	10:00	Dam 2-UR	1				0
10/11/2022	10:11	Dam 2-UR	2				0
10/11/2022	10:45	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		9
10/11/2022	10:45	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		71
10/11/2022	10:45	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common Shiner		36
10/11/2022	10:45	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		62
10/11/2022	10:45	Dam 2-DR	1	<i>Notropis bifrenatus</i>	Bridle Shiner		8
10/11/2022	11:10	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common Shiner		22

10/11/2022	11:10	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		30
10/11/2022	11:10	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		52
10/11/2022	11:10	Dam 2-DR	2	<i>Notropis bifrenatus</i>	Bridle Shiner		3
10/11/2022	11:10	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded Killifish		1
10/11/2022	11:10	Dam 2-DR	2	<i>Gambusia holbrooki</i>	Mosquitofish		1
7/7/2023	7:45	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass		3
7/7/2023	7:45	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		5
7/7/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		17
7/7/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		25
7/7/2023	8:25	Dam 2-DR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass		2
7/7/2023	8:35	Dam 2-DR	2	<i>Micropterus dolomieu</i>	Smallmouth Bass		1
7/7/2023	8:25	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		1
7/7/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		9
7/7/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		5
7/7/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely Shiner		2
7/7/2023	8:25	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely Shiner		2
7/7/2023	8:25	Dam 2-DR	1	<i>Catostomus commersonii</i>	White sucker		1
7/7/2023	8:35	Dam 2-DR	2	<i>Hypentelium nigricans</i>	Northern hogsucker		1
7/7/2023	8:35	Dam 2-DR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1
7/7/2023	8:35	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common shiner		1
7/7/2023	8:35	Dam 2-DR	2	<i>Etheostoma olmstedii</i>	Tessellated darter		1
7/14/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		2
7/14/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		1
7/14/2023	7:50	Dam 2-UR	1	<i>Etheostoma olmstedii</i>	Tessellated darter		1

7/14/2023	8:25	Dam 2-DR	1	<i>Notropis procne</i>	Swallowtail shiner		4
7/14/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		2
7/14/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		2
7/14/2023	8:00	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast sunfish		1
7/14/2023	8:00	Dam 2-UR	2	<i>Micropterus dolomieu</i>	Smallmouth bass		2
7/14/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		18
7/14/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		8
7/14/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		1
7/14/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		7
7/14/2023	8:35	Dam 2-DR	1	<i>Hypentelium nigricans</i>	Northern hogsucker		1
7/14/2023	8:35	Dam 2-DR	1	<i>Catostomus commersonii</i>	White sucker		1
7/14/2023	8:35	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1
7/14/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		2
7/14/2023	8:35	Dam 2-DR	2	<i>Lepomis macrochirus</i>	Bluegill		2
7/18/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		2
7/18/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		2
7/18/2023	8:00	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast sunfish		1
7/18/2023	8:00	Dam 2-UR	2	<i>Micropterus dolomieu</i>	Smallmouth bass		1
7/18/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		18
7/18/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		8
7/18/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		1
7/18/2023	8:25	Dam 2-DR	1	<i>Hypentelium nigricans</i>	Northern hogsucker		1
7/18/2023	8:25	Dam 2-DR	1	<i>Catostomus commersonii</i>	White sucker		1
7/18/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1

7/18/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		7
7/18/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		2
7/18/2023	8:35	Dam 2-DR	2	<i>Lepomis macrochirus</i>	Bluegill		1
7/28/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		4
7/28/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		2
7/28/2023	8:00	Dam 2-UR	2	<i>Gambusia holbrooki</i>	Eastern mosquitofish		3
7/28/2023	8:00	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		6
7/28/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		3
7/28/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		2
7/28/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		1
7/28/2023	8:25	Dam 2-DR	1	<i>Lepomis auritus</i>	Redbreast sunfish		1
7/28/2023	8:35	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common shiner		2
7/28/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		5
7/28/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		2
8/4/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		1
8/4/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		1
8/4/2023	8:00	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast sunfish		2
8/4/2023	8:25	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		12
8/4/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		1
8/4/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		16
8/4/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		12
8/4/2023	8:25	Dam 2-DR	1	<i>Hypentelium nigricans</i>	Northern hogsucker		1
8/4/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1
8/4/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		1

8/4/2023	8:35	Dam 2-DR	2	<i>Semotilus corporalis</i>	Fallfish		6
8/4/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		13
8/4/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		9
8/4/2023	8:35	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common shiner		1
8/11/2023	7:50	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth bass		1
8/11/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		1
8/11/2023	8:00	Dam 2-UR	2	<i>Micropterus dolomieu</i>	Smallmouth bass		3
8/11/2023	8:00	Dam 2-UR	2	<i>Ictalurus punctatus</i>	Channel catfish		1
8/11/2023	8:00	Dam 2-UR	2	<i>Notropis hudsonius</i>	Spottail shiner		1
8/11/2023	8:00	Dam 2-UR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		4
8/11/2023	8:00	Dam 2-UR	2	<i>Luxilus cornutus</i>	Common shiner		3
8/18/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		1
8/18/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		1
8/18/2023	8:00	Dam 2-UR	2	<i>Micropterus dolomieu</i>	Smallmouth bass		1
8/18/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		1
8/18/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		41
8/18/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		13
8/18/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		22
8/18/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1
8/18/2023	8:35	Dam 2-DR	2	<i>Lepomis auritus</i>	Redbreast sunfish		1
8/24/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		1
8/24/2023	8:00	Dam 2-DR	2	<i>Lepomis auritus</i>	Redbreast sunfish		1
8/24/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		317
8/24/2023	8:25	Dam 2-DR	1	<i>Notropis procne</i>	Swallowtail shiner		36

8/24/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		44
8/24/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		2
8/24/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		6
8/24/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1
8/24/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		1
8/24/2023	8:25	Dam 2-DR	1	<i>Ictalurus punctatus</i>	Channel catfish		1
8/24/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		2
8/24/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		4
9/1/2023	7:50	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth bass		2
9/1/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		2
9/1/2023	7:50	Dam 2-UR	1	<i>Lepomis auritus</i>	Redbreast sunfish		1
9/1/2023	8:00	Dam 2-UR	2	<i>Micropterus salmoides</i>	Largemouth bass		1
9/1/2023	8:00	Dam 2-UR	2	<i>Micropterus dolomieu</i>	Smallmouth bass		1
9/1/2023	8:00	Dam 2-UR	2	<i>Lepomis auritus</i>	Redbreast sunfish		2
9/1/2023	8:25	Dam 2-DR	1	<i>Micropterus salmoides</i>	Largemouth bass		1
9/1/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		25
9/1/2023	8:25	Dam 2-DR	1	<i>Notropis procne</i>	Swallowtail shiner		44
9/1/2023	8:25	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		2
9/1/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		4
9/1/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		13
9/1/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		1
9/1/2023	8:35	Dam 2-DR	2	<i>Micropterus salmoides</i>	Largemouth bass		1
9/1/2023	8:35	Dam 2-DR	2	<i>Semotilus corporalis</i>	Fallfish		20
9/1/2023	8:35	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely shiner		8

9/1/2023	8:35	Dam 2-DR	2	<i>Notropis procne</i>	Swallowtail shiner		32
9/1/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		14
9/1/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		4
9/1/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		1
9/8/2023	7:50	Dam 2-UR	1	<i>Micropterus salmoides</i>	Largemouth bass		2
9/8/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		3
9/8/2023	8:00	Dam 2-UR	2	<i>Micropterus salmoides</i>	Largemouth bass		1
9/8/2023	8:00	Dam 2-UR	2	<i>Semotilus corporalis</i>	Fallfish		1
9/8/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		3
9/8/2023	8:25	Dam 2-DR	1	<i>Cyprinella spiloptera</i>	Spotfin shiner		1
9/8/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		1
9/8/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		1
9/8/2023	8:35	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely shiner		1
9/8/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		1
9/22/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		4
9/22/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		2
9/22/2023	8:35	Dam 2-DR	2	<i>Dorosoma cepedianum</i>	Gizzard shad		1
9/22/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		7
9/22/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		3
9/22/2023	8:35	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely shiner		1
9/22/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		1
9/29/2023	7:50	Dam 2-UR	1	<i>Etheostoma olmsted</i>	Tessellated darter		1
9/29/2023	8:00	Dam 2-UR	2	<i>Etheostoma olmsted</i>	Tessellated darter		1
9/29/2023	8:25	Dam 2-DR	1	<i>Fundulus diaphanus</i>	Banded killifish		11

9/29/2023	8:25	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		32
9/29/2023	8:25	Dam 2-DR	1	<i>Cyprinella spiloptera</i>	Spotfin shiner		30
9/29/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		41
9/29/2023	8:25	Dam 2-DR	1	<i>Notropis amoenus</i>	Comely shiner		15
9/29/2023	8:25	Dam 2-DR	1	<i>Notropis procne</i>	Swallowtail shiner		23
9/29/2023	8:25	Dam 2-DR	1	<i>Hybognathus regius</i>	Eastern silvery minnow		7
9/29/2023	8:25	Dam 2-DR	1	<i>Notropis hudsonius</i>	Spottail shiner		4
9/29/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		6
9/29/2023	8:35	Dam 2-DR	2	<i>Lepomis auritus</i>	Redbreast sunfish		1
9/29/2023	8:35	Dam 2-DR	2	<i>Hybognathus regius</i>	Eastern silvery minnow		32
9/29/2023	8:35	Dam 2-DR	2	<i>Semotilus corporalis</i>	Fallfish		17
9/29/2023	8:35	Dam 2-DR	2	<i>Notropis hudsonius</i>	Spottail shiner		12
9/29/2023	8:35	Dam 2-DR	2	<i>Cyprinella spiloptera</i>	Spotfin shiner		11
9/29/2023	8:35	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common shiner		7
9/29/2023	8:35	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely shiner		3
10/6/2023	7:50	Dam 2-UR	1	<i>Micropterus dolomieu</i>	Smallmouth bass		1
10/6/2023	7:50	Dam 2-UR	1	<i>Etheostoma olmstedii</i>	Tessellated darter		1
10/6/2023	8:25	Dam 2-DR	1	<i>Semotilus corporalis</i>	Fallfish		2
10/6/2023	8:25	Dam 2-DR	1	<i>Luxilus cornutus</i>	Common shiner		1
10/6/2023	8:25	Dam 2-DR	1	<i>Notropis procne</i>	Swallowtail shiner		2
10/6/2023	8:25	Dam 2-DR	1	<i>Cyprinella spiloptera</i>	Spotfin shiner		2
10/6/2023	8:35	Dam 2-DR	2	<i>Anguilla rostrata</i>	American eel		1
10/6/2023	8:35	Dam 2-DR	2	<i>Cyprinella spiloptera</i>	Spotfin shiner		
10/6/2023	8:35	Dam 2-DR	2	<i>Fundulus diaphanus</i>	Banded killifish		1

10/6/2023	8:35	Dam 2-DR	2	<i>Semotilus corporalis</i>	Fallfish		8
10/6/2023	8:35	Dam 2-DR	2	<i>Cyprinella spiloptera</i>	Spotfin shiner		1
10/6/2023	8:35	Dam 2-DR	2	<i>Luxilus cornutus</i>	Common shiner		1
10/6/2023	8:35	Dam 2-DR	2	<i>Notropis amoenus</i>	Comely shiner		1
10/6/2023	8:35	Dam 2-DR	2	<i>Cyprinella spiloptera</i>	Spotfin shiner		1
7/2/24	8:25	Dam 2- DR	1	<i>Semotilus corporalis</i>	Fallfish	Juvenile	29
7/2/24	8:25	Dam 2- DR	1	<i>Notropis procne</i>	Swallowtail Shiner		64
7/2/24	8:25	Dam 2- DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		94
7/2/24	8:25	Dam 2- DR	1	<i>Hypentelium nigricans</i>	Northern Hogsucker		22
7/2/24	8:25	Dam 2- DR	1	<i>Notropis amoenus</i>	Comely Shiner		3
7/2/24	8:25	Dam 2- DR	1	<i>Etheostoma olmstedii</i>	Tessellated Darter		2
7/2/24	8:25	Dam 2- DR	1	<i>Fundulus diaphanus</i>	Banded Killifish		14
7/2/24	8:35	Dam 2- DR	2	<i>Semotilus corporalis</i>	Fallfish	Juvenile	7
7/2/24	8:35	Dam 2- DR	2	<i>Notropis procne</i>	Swallowtail Shiner		12
7/2/24	8:35	Dam 2- DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		12
7/2/24	8:35	Dam 2- DR	2	<i>Notropis amoenus</i>	Comely Shiner		3
7/9/24	8:00	Dam 2- UR	2	<i>Micropterus dolomieu</i>	Smallmouth Bass		1
7/9/24	8:25	Dam 2- DR	1	<i>Semotilus corporalis</i>	Fallfish	Juvenile	21
7/9/24	8:25	Dam 2- DR	1	<i>Notropis procne</i>	Swallowtail Shiner		12
7/9/24	8:25	Dam 2- DR	1	<i>Notropis hudsonius</i>	Spottail Shiner		104
7/9/24	8:25	Dam 2- DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow		4
7/9/24	8:25	Dam 2- DR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass		1
7/9/24	8:25	Dam 2- DR	1	<i>Luxilus cornutus</i>	Common Shiner		1
7/9/24	8:25	Dam 2- DR	1	<i>Lepomis auritus</i>	Redbreast Sunfish		1
7/9/24	8:25	Dam 2- DR	1	<i>Notropis amoenus</i>	Comely Shiner		6
7/9/24	8:35	Dam 2- DR	2	<i>Notropis hudsonius</i>	Spottail Shiner		3
7/9/24	8:35	Dam 2- DR	2	<i>Hybognathus regius</i>	Eastern Silvery Minnow		1
7/16/24	7:50	Dam 2- UR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass		2
7/16/24	7:50	Dam 2- UR	1	<i>Fundulus diaphanus</i>	Banded Killifish		2
7/16/24	8:00	Dam 2- UR	2	<i>Micropterus dolomieu</i>	Smallmouth Bass		10
7/16/24	8:00	Dam 2- UR	2	<i>Micropterus salmoides</i>	Largemouth Bass		1

7/16/24	8:00	Dam 2- UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish	2
7/16/24	8:00	Dam 2- UR	2	<i>Fundulus diaphanus</i>	Banded Killifish	4
7/16/24	8:00	Dam 2- UR	2	<i>Lepomis spp.</i>	Lepomis spp.	1
7/16/24	8:25	Dam 2- DR	1	<i>Dorosoma cepedianum</i>	Gizzard Shad	5
7/16/24	8:25	Dam 2- DR	1	<i>Lepomis auritus</i>	Redbreast Sunfish	1
7/23/24	7:50	Dam 2- UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish	4
7/23/24	7:50	Dam 2- UR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass	4
7/23/24	7:50	Dam 2- UR	1	<i>Lepomis spp.</i>	Lepomis spp.	1
7/23/24	8:00	Dam 2- UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish	1
7/23/24	8:00	Dam 2- UR	2	<i>Micropterus salmoides</i>	Largemouth Bass	1
7/23/24	8:25	Dam 2- DR	1	<i>Hybognathus regius</i>	Eastern Silvery Minnow	1
7/23/24	8:25	Dam 2- DR	1	<i>Cyprinella Spiloptera</i>	Spotfin Shiner	1
7/23/24	8:25	Dam 2- DR	1	<i>Lepomis auritus</i>	Redbreast Sunfish	2
7/23/24	8:35	Dam 2- DR	2	<i>Cyprinella Spiloptera</i>	Spotfin Shiner	2
7/30/24	7:50	Dam 2- UR	1	<i>Micropterus dolomieu</i>	Smallmouth Bass	2
7/30/24	7:50	Dam 2- UR	1	<i>Lepomis auritus</i>	Redbreast Sunfish	1
7/30/24	8:00	Dam 2- UR	2	<i>Fundulus diaphanus</i>	Banded Killifish	2
7/30/24	8:00	Dam 2- UR	2	<i>Micropterus dolomieu</i>	Smallmouth Bass	1
7/30/24	8:00	Dam 2- UR	2	<i>Lepomis auritus</i>	Redbreast Sunfish	4

Figure 4. Sampling locations above and below Dam #2, as well as the DFW sampling location in Brandywine Creek, DE



8/13/24	8:25	Dam 2- DR	1	<i>Cyprinella Spiloptera</i>	Spotfin Shiner	11
8/13/24	8:25	Dam 2- DR	1	<i>Notropis hudsonius</i>	Spottail Shiner	1

Appendix:

Picture 1. An adult American Shad collected at the Brandywine River downriver sampling location in 2020. Photo credit: Mrs. Kim Hachadoorian of The Nature Conservancy.



Picture 2. A juvenile American Shad collected at the Brandywine River downriver sampling location in 2020. Photo credit: Mrs. Kim Hachadoorian of The Nature Conservancy.



Picture 3. Sampling at the Brandywine River downriver sampling location on July 28, 2020.
Photo credit: Mrs. Kim Hachadoorian of The Nature Conservancy.

