Spring 2002 Anacostia Tributary System River Herring Monitoring/Reconnaissance and Larval Stocking Project

Prepared for

Potomac Crossing Consultants

By

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Spring 2002 Anacostia Tributary System Herring Reconnaissance and Larval Stocking

Summary

In order to compensate for impacts to tidal and non-tidal wetlands and submerged aquatic vegetation (SAV) in the replacement of the Woodrow Wilson Bridge, a mitigation package is underway which proposes a number of projects to replace the environmental function of affected resources. One of these mitigation projects involves restoration of migratory river herring to historical spawning areas in the Anacostia watershed. Efforts to remove migratory fish blockages are continuing, and in 2000 a larval river herring-stocking program was initiated through the Anacostia Fish Passage Working Group (AFPWG), working in conjunction with the Potomac Crossing Consultants (PCC). In 2002, the Interstate Commission on the Potomac River Basin (ICPRB), the Metropolitan Washington Council of Governments (MWCOG), and PCC performed a migratory fish reconnaissance survey and larval stocking program. Alewife herring (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) broodstock were collected, the eggs fertilized, then transported to the Maryland Department of Natural Resources (MDDNR) Joseph H. Manning Fish Hatchery at Cedarville State Forest in Charles County, Maryland for incubation and hatching. In 2002, an estimated 3.1 million hatched larval river herring were subsequently stocked back to the Anacostia River tributaries and Rock Creek mainstem, another tributary to the Potomac River. This brings the three consecutive year project total to more than 8.4 million larvae stocked.

Project Background and Purpose

During construction of the Woodrow Wilson Bridge replacement, unavoidable impacts to wetlands and submerged aquatic vegetation will occur. As part of the Aquatic Resource Conceptual Mitigation Plan (ARCMP) of the Environmental Impact Statement for the Woodrow Wilson Bridge Improvement Study, several out-of-kind options to replace the functions and values of the impacted areas will be conducted. One of the out-of-kind replacement options identified in the ARCMP is the removal of migratory fish blockages in the Anacostia River watershed. This option seeks to open historical spawning areas of migratory fish and as a result, mitigate for impacts on fish habitat from bridge construction.

Organized in 1990 by ICPRB and more recently reconvened by the MWCOG, the Anacostia Fish Passage Working Group (AFPWG) has served as the coordinating body for local, state, and federal agencies. As one of the group's priority tasks, fish barriers throughout the Anacostia River watershed were to be identified and subjected to removal/modification to allow resident and anadromous fish migration. Since 1998, the PCC has worked with AFPWG, and in spring 2000 and spring 2001, a larval herring monitoring and restocking program was conducted. The results of the 2000 and 2001 studies returned a total of more than 5.3 million herring larvae back to the Anacostia and Rock Creek watersheds, and recommendations indicated continued efforts were needed to restore fish passage in the Anacostia River tributaries. In coordination with AFPWG, PCC agreed to conduct a Spring 2002 larval-herring stocking program in conjunction with ICPRB, MWCOG, and MDDNR as an out-of-kind option to mitigation for impacts from the Woodrow Wilson Bridge construction. In 2002, the herring monitoring and restocking program continued, returning more than 3.1 million larval herring back to the Anacostia and Rock Creek watersheds. This report describes 2002 project results.

The objective of the project was to continue the restoration of the river herring fisheries in the Anacostia Watershed through the stocking of larval alewife and blueback herrings. These larval fish were stocked at five AFPWG recommended major tributary sites (specific site description are detailed later in the text). Furthermore, river herring larvae were stocked into a Rock Creek site when the total number of larval fish stocking quota was reached for the Anacostia watershed. The spring 2002 Larval Herring Stocking Project involved three main tasks.

I. An electrofishing reconnaissance survey was performed to:

- verify the presence of herring and other migratory fishes in both the Northwest and Northeast Branches of the Anacostia River,
- gauge the river herring relative strength of the run and
- determine which location(s) provide the greatest probability for the collection of broodstock.

II. River herring broodstock collections were performed to:

- remove eggs from approximately 100 or more ripe female alewife or blueback river herring, and fertilize them with milt from an equivalent number of collected spawning male herring and
- transport fertilized eggs to the MDDNR's Manning Fish Hatchery in Cedarville, Maryland for incubation and hatching.

III. Larval stocking was performed to:

- collect hatched larval-stage herring from MDDNR's Manning Fish Hatchery,
- stock larval herring to five Anacostia and one Rock Creek tributaries upstream of existing fish blockages and historical migratory ranges and
- stock a target of one to two million alewife/blueback herring larvae.

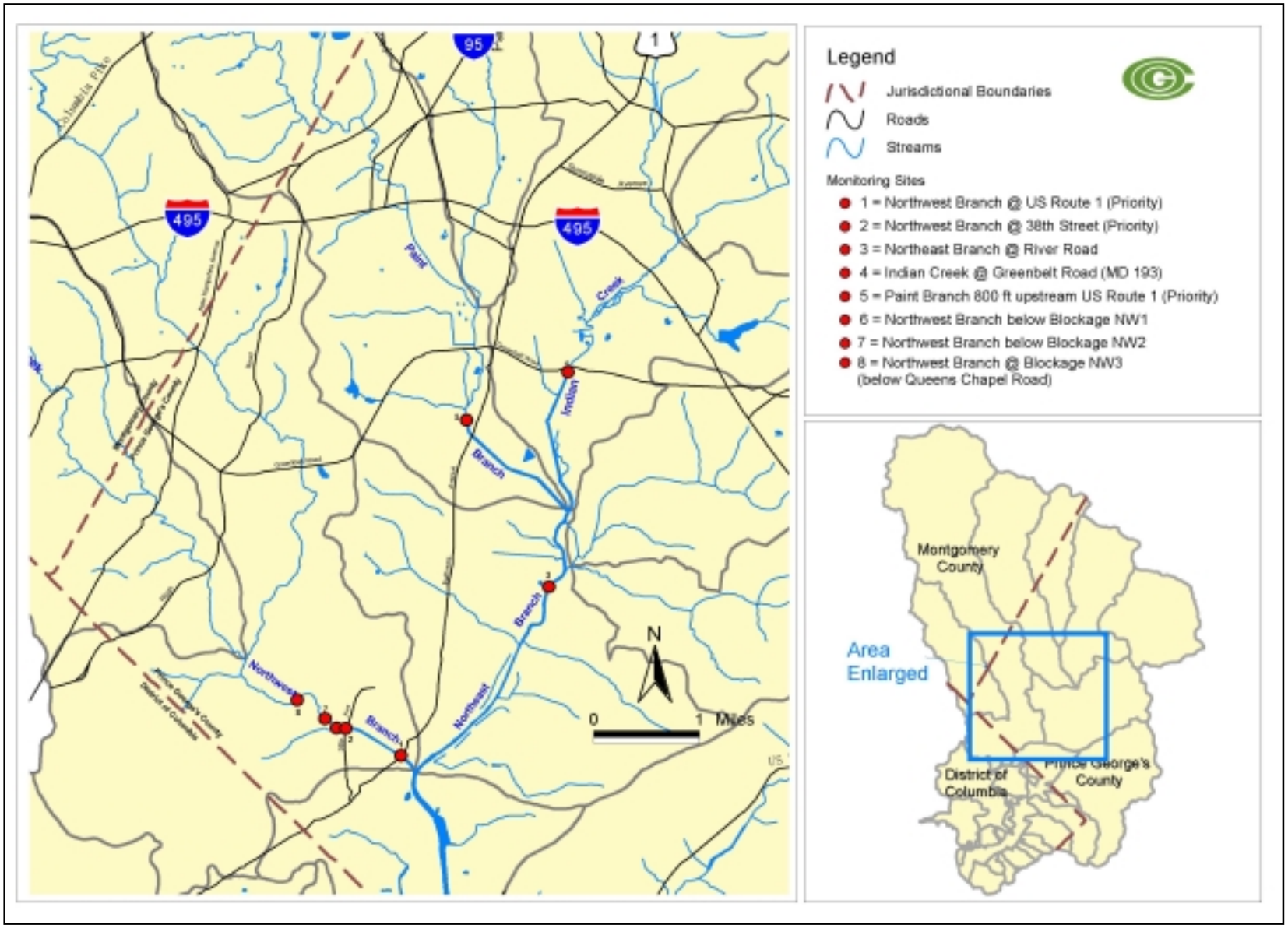
Methodology

Task 1. Electrofishing Reconnaissance Survey

An electrofishing reconnaissance survey of adult migratory fishes in the Maryland portions of the Anacostia River watershed was conducted during the spring 2002 migratory fish runs, which include alewife herring (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), hickory shad (*Alosa mediocris*), white perch (*Morone americanus*), striped bass (*Morone saxatilis*), yellow perch (*Perca flavescens*), American eel (*Anquilla rostrata*), and sea lamprey (*Petromyzon marinus*). Eight stations (Figure 1) were sampled to determine the presence and strength of the herring run. The stations were located immediately downstream from known or suspected blockages, where migrating herring typically concentrate. Sampling was conducted during daylight hours using a Smith-Root backpack electroshocker employing pulsed direct current. Generally, one person operated the electroshocker while two persons netted stunned fishes. The nets used to capture the stunned fish were Smith-Root Model #EDN-83-TD nets with 0.25 inch-mesh.

The major objectives of each collection trip were to determine the extent and magnitude of upstream river herring migration occurring on that particular day, and the spawning condition of the river herring. At each station, a one pass or "sweep-type" electrofishing was performed for an approximately 400 to 600 foot length of stream. Output power was field adjusted to account for variations in stream conductivity. Sampling times through the day were staggered (i.e. starting at mid-morning to mid afternoon) to increase the likelihood of encountering migrating fish. Depending on stream conditions, the Northwest Branch at US Route 1 was surveyed more than once per day. Collected migratory fish were counted, weighted, length measured, and sexed for evidence of row or milt. Notes were taken on their general conditions, dorsal fins were clipped to identify where they were captured, and then they were released. Attempts were made to capture all fish sighted during electrofishing. If schools were so large that capture of all individuals was not possible or desirable, they were sub-sampled and records were kept on the estimated size of the school observed. Daily water temperature, ph, conductivity, turbidity, dissolved oxygen and general flow and weather conditions were recorded. Information was obtained and recorded from these surveys and used to evaluate the best locations for the collection of broodstock.

Figure 1 - Spring 2002 Anadromous Fish Reconnaissance and Monitoring Sites



During each day of the reconnaissance survey period, efforts were made to determine whether the herring run was weak, i.e. not likely to yield the daily targeted minimum of 0.15 liters of eggs necessary for hatchery incubation, or strong, i.e. likely to meet or exceed the daily volume of egg threshold. In addition, an overall project target of at least 100 ripe females was estimated necessary to produce the project target of one to two million stocked larvae. If the overall herring run was not found to be strong enough in the Anacostia River system to support these targets, then the protocol for collection of broodstock was to be modified to include supplemental herring collection in the Potomac River.

Task 2. Herring Broodstock Collection

The protocol for collecting Alewife and Blueback broodstock involved a targeted collection of approximately 100 ripe females over an estimated 4-6-week period. The stations designated for broodstock collection were determined from the results of previous 1999 - 2001 reconnaissance surveys. Collections occurred during daylight hours using a 50 x 4 foot and ¼ inch mesh haul seine, and was employed to capture broodstock in a sweeping arc across the width of the stream. The use of a haul seine can dramatically reduce the stress placed upon the fish, compared with the stress on the fish as a result of electrofishing or gillnetting.

At all broodstock collections, ripe females were collected and stripped of eggs into shaded bowls containing ambient stream water temperature (Figure 2). Eggs from alewife herring were kept separate from blueback herring and each set of eggs was fertilized by milt from males of the appropriate species. A minimum of 0.15 L of fertilized eggs per sampling event was required for incubation. Fertilized eggs were allowed to sit in darkened buckets for approximately 45 minutes, then packaged with battery powered aerators at ambient stream temperature, and delivered promptly to the Maryland Department of Natural Resource's (MDDNR's) Joseph H. Manning Fish Hatchery, at Cedarville State Park, located approximately 40 miles away in Charles County, Maryland. Through a cooperative agreement with MDDNR, the fertilized eggs were incubated to yolk sac-stage larvae before they were released.

Figure 2. Stripping female herring

Figure 3. Separation and clearing

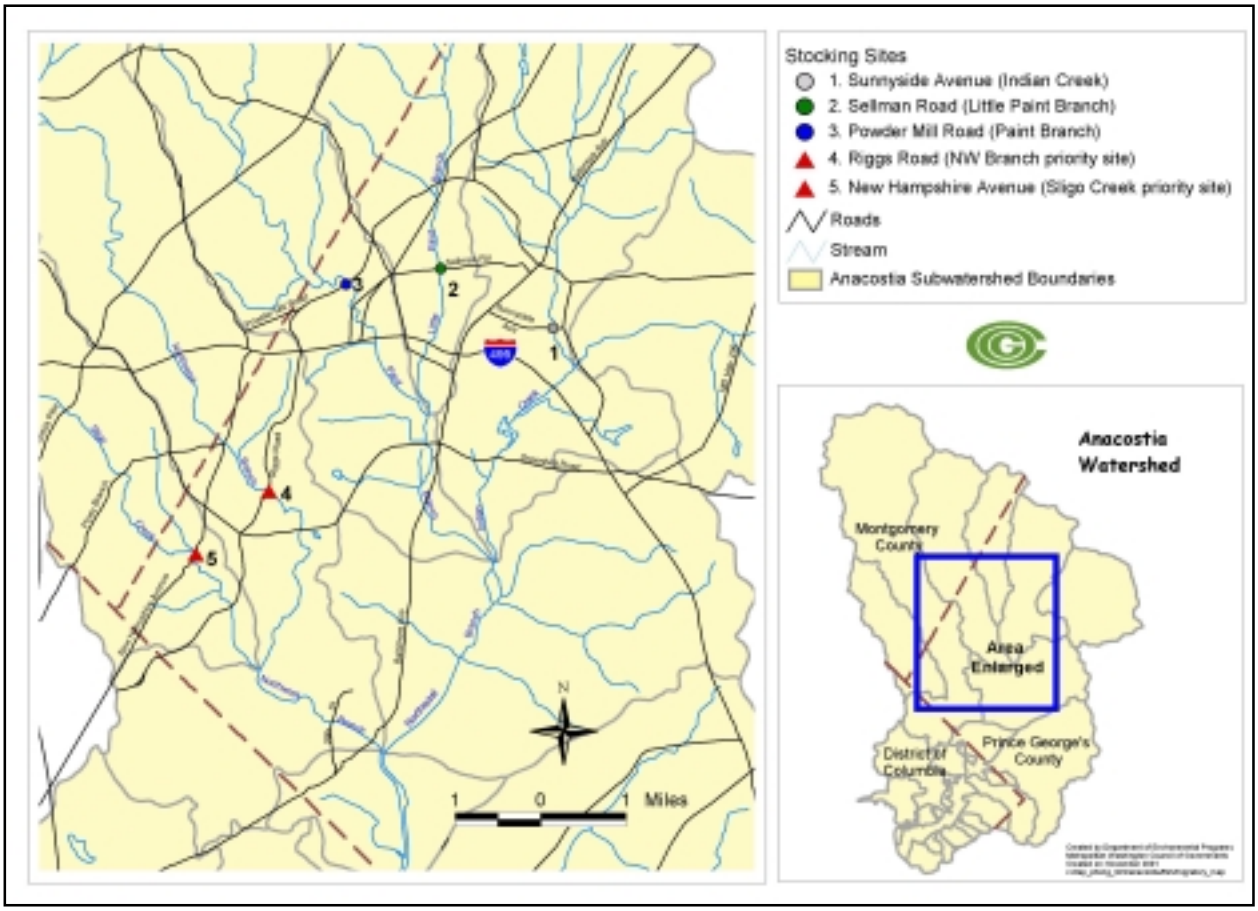
In preparation for incubation, the eggs were separated by adding 20 grams of salt (NaCl) and 0.375 grams of tannic acid into 5 liters of water. A few drops of de-foamer were added and the mixture agitated and aerated for 6-7 minutes. To clear the eggs, they were extracted from the above mixture (Figure 3), rinsed with well-water and then were added to another solution of 20 grams of Salt (NaCl), 15 grams of Urea, and 5 liters of water. De-foamer was added, and the mixture agitated/aerated for 6-7 minutes more. The eggs were then rinsed and transferred to incubation containers, which are constantly refreshed with cool fresh well water. Over an approximately 5 to 10 day period, the eggs were incubated and hatched to a larval stage, after which approximate counts of viable eggs and pre-stock larvae survival rates were determined.

Task 3. Larval Stocking

After eggs had hatched, the larvae were transported in covered, black, 5-gallon containers from the hatchery back to the Anacostia five stocking sites. The Anacostia stocking locations are shown in Figure 4 and included the following five major Anacostia tributary sites:

1. Indian Creek at Sunnyside Avenue,
2. Little Paint Branch at Sellman Road,
3. Paint Branch at Powder Mill Road (MD 212),
4. Northwest Branch at Riggs Road (MD 212) and
5. Sligo Creek at New Hampshire Avenue (MD 650).

Figure 4. 2002 Stocking Sites



All five Anacostia sites are located well upstream of existing fish blockages and represent what are believed to be near the upper historical range of river herring in the Anacostia tributary system. When placing the larval herring into the stream, the container holding the larvae was first placed into the stream to help the contents acclimate to the ambient temperature of the stream, with additional amounts of stream water slowly poured into the container (Figure 5). After 5-10 minutes of acclimating to the stream temperature, the herring fry were released into a slow moving portion of riffle habitat. Over a 4-6 week period (approximately March 15 to May 31), a project target of one to two million alewife and blueback herring larvae were to be released in batches at the five locations. As previously mentioned, once the river herring larval stocking quotas were met for the Anacostia watershed, additional larvae were stocked into the Rock Creek mainstem at Garrett Park Road in Montgomery County.

Figure 5. Release of herring larvae

Results

Task 1. Reconnaissance Survey

Reconnaissance sampling in the Northwest Branch Anacostia River was initiated on March 15, 2002 and occurred, at a minimum, twice a week through May 14, 2002. Results from reconnaissance sampling (Table 1) showed both alewife and blueback herring migrating up to all expected stations in the Northwest Branch (i.e., US Route 1, 38th street and the gabion basket weir immediately below the NW1 "pump house" blockage) as previously documented in past surveys.

Reconnaissance sampling in the Northeast Branch Anacostia River showed no presence of migratory herring in Indian Creek. In fact, migratory herring have been absent from this survey site, since the year 2000. A walking stream survey conducted in 2002 revealed no new fish blockage between the confluence of the Paint Branch and Indian Creek up to the monitoring station in Indian Creek at Greenbelt Road.

A total of 14 survey dates were conducted at the Paint Branch priority site to detect migrating herring on Paint Branch at the blockage caused by a concrete utility line capping approximately 800 feet upstream from US Route 1, since previous year surveys showed strong presence at this site. However, no herring were observed at this site. A limited walking stream survey conducted in 2002 revealed no new fish blockage between the confluence of the Paint Branch and Indian Creek up to the Metro rail line bridge on the Paint Branch.

At the Northeast Branch site, NEB1, lower numbers of alewife herring were observed compared to previous years' studies. Blueback herring were not collected nor observed at the Northeast Branch sampling sites.

Table 1 lists the migratory (anadromous) fish species and the total number of each collected during the reconnaissance survey. A total of 198 river herring were captured via electro-fishing from all the survey sites with roughly 89 percent of the fish captured from the Northwest Branch sites. The higher total number of river herring captured in the Northwest Branch (US Route 1 Site) is a direct result of the highest number of electrofishing surveys (19) purposely conducted at that site. This site is an established river herring concentrating area where both monitoring and broodstock adult collections regularly occur.

Table 1. Year 2002 Anacostia Watershed River Herring Monitoring/Reconnaissance Survey

Stream	Northwest Branch											Northeast Branch	Paint Branch	Indian Creek
Site	US Route 1						38th St.		NW1	NW2	NW3	NEB1	PB @ US Rte 1	IC2 @ Green-belt
Species Observed	Alewife Herring	Blueback Herring	Hickory Shad	White Perch	Yellow Perch	Striped Bass	Alewife Herring	Hickory Shad	Alewife Herring	Anadromous Fish Observed		Alewife Herring	Anadromous Fish Observed	Anadromous Fish Observed
2002 Sampling Date														
3/15/2002	0	0	0	0	0	0						0	0	
3/19/2002	4	0	0	0	0	0	0	0				1	0	
3/21/2002	3	0	0	0	0	0	0	0	0	0		1	0	
3/27/2002	25	0	0	0	0	0						0	0	
3/29/2002	18	0	ob	0	0	0						0	0	
4/1/2002	20	0	ob	0	0	0	16	1	7	0				
4/2/2002	0	0	ob	0	0	0								
4/4/2002	13	0	0	0	0	0	5	2	0	0		5	0	0
4/8/2002	1	0	1	0	0	0	0	0	0				0	
4/11/2002	32	0	0	ob	0	0							0	0
4/15/2002	0	0	0	0	0	0	0	0	0			12	0	0
4/18/2002	0	1	0	0	0	0						2		
4/22/2002	0	0	0	0	0	0	0	0					0	
4/25/2002	3	2	0	0	0	0	0	0				0	0	
4/26/2002	0	0	0	0	0	0								
4/29/2002	6	0	0	1	0	1	0	0	0				0	0
5/6/2002	1	1	0	0	1	2						0		0
5/10/2002	0	1	0	0	0	0						0	0	0
5/14/2002	1	17	0	ob	0	0	0	0	0				0	
Total	127	22	1	1	1	3	21	3	7			21		

Note: Number of migratory fish captured for monitoring/reconnaissance survey does not include migratory herring captured by use of haul seine for broodstock collection.

- Gizzard Shad observed throughout the study.
- Shaded areas indicate that electrofishing survey was not conducted.
- ob indicates white perch were observed in large numbers but not counted

Additionally, there were a total of four other anadromous fish species captured in the 2002 survey. As in the previous three years, hickory shad (Figure 6) were collected in relatively low numbers compared to the river herring (It should be noted however, that since the employment of the haul seine to collect broodstocks, the highest concentration of hickory shad was observed, in 2002, in the haul seine nets at the NW Branch Route 1 site. For example, a single haul seine pull on April 1 netted over 15 hickory shad and the following day from a single haul seine pull, 54 individuals were collected. Previous years' single haul seine pulls yielded two to three hickory shad at most.). Furthermore, hickory shad were captured for the first time above the fishway at the 38th street site (Figure 7) since migratory species monitoring began in 1988. White perch were collected at Route 1 on the NW Branch and observed to be present there through much of the survey period. A total of three (3) striped bass and one (1) yellow perch were captured, both at the NW Branch US Route 1 site.

Figure 6 - Hickory shad

Figure 7- Jim Cummins holding a Hickory Shad captured at Northwest Branch 38th Street site

Task 2. Broodstock Collection

Broodstock collection for both mature males and ripe females occurred from March 27, 2002 through April 29, 2002 for a total of 7 days. A summary of the estimated number of viable eggs and stocked larvae is shown in Table 2. The number of ripe females collected was 127, more than the project annual-minimum target number of 100, but significantly less than total of 219 collected in 2001. The total volume of fertilized eggs was 9.1 liters, an amount 1.4 liters less than 2001's total. However, although fewer ripe herring females and fewer liters of eggs were collected than in 2001, a higher percentage of viable eggs were produced in 2002, resulting in a higher total of 3.1 million larva stocked.

Table 2. Year 2002 Estimated Number of Viable Eggs and Stocked River Herring Larvae

Sample Date	Collection Site	Collection Technique[1]	Number of Ripe Female Herring Stripped of Eggs	Volume of Fertilized[2] River Herring Eggs Collected (Liters of eggs)				Range of Number of Viable Eggs Collected[3]			Estimated Number of Viable Larva Stocked[4]
								Low Range	Median Range	High Range	
				Blueback	Alewife	Total	Viable Eggs				
3/27/02	Northwest Branch @ US Route 1	Seined	6	0.0	0.3	0.3	0.3	120,000	259,500	399,000	0
3/29/02	Northwest Branch @ US Route 1	Seined	2	0.0	0.3	0.3	0.3	120,000	259,500	399,000	0
4/01/02	Northwest Branch @ US Route 1	Seined	44	0.0	4.0	4.0	4.0	1,600,000	3,460,000	5,320,000	2,700,000
4/02/02	Northwest Branch @ US Route 1	Seined	28	0.0	1.3	1.3	1.3	520,000	1,124,500	1,729,000	0
4/11/02	Northwest Branch @ US Route 1	Seined	25	0.0	1.5	1.5	1.5	600,000	1,297,500	1,995,000	0
4/26/02	Northwest Branch @ US Route 1	Seined	12	0.3	0.8	1.1	1.1	440,000	951,500	1,463,000	350,000
4/29/02	Northwest Branch @ US Route 1	Seined	10	0.0	0.6	0.6	0.6	240,000	519,000	798,000	100,000
	Totals	-----	127	0.3	8.8	9.1	9.1	3,640,000	7,871,500	12,103,000	3,150,000

Note:Fertilized eggs that totaled to less than 0.15 liters were not transported to the hatchery. Rather they were released back in the stream.

[1] River herring collection technique employed the following sampling equipment: Model 15-D Smith-Root Backpack Electrofisher, 100, 50 and 25 foot-long haul seine nets.
[2] Generally, three male herrings were used to remove milt for every one female stripped of eggs.
[3] Per correspondence with MDDNR, mature Blueback female herrings generally broadcast 800 to 1330 total number of eggs per milliliter. Alewife herrings generally broadcast in the range of 400 to 1030 total number of eggs per milliliter. Since both Blueback and Alewife herring eggs were combined into a hatching jar, the range of 400 to 1330 total number of eggs per milliliter was used to consistently estimate the total number of viable eggs collected. Additionally, the 865 eggs per milliliter was used as the median range value.
[4] Estimated numbers of larvae stocked were calculated from multiple 200-ml sub-samples collected from the 400-L or the 1000-L rearing tanks.

Task 3. Larval Stocking

The Anacostia and Rock Creek watersheds-stocking schedule is shown in Table 3. More than 3.1 million alewife and blueback herring larvae were stocked to five locations in the Anacostia Watershed (Figure 4). Approximately 0.1 million herring larvae were stocked in the Rock Creek mainstem near Garret Park in Montgomery County, Maryland. The estimated total of 3.1 million stocked larvae exceeded the original projected target stocking numbers of 1-2 million. The total for the three-year stocking effort is approximately 8.0 million river herring larvae stocked in the Anacostia Watershed and 0.42 million stocked in the Rock Creek mainstem.

Table 3. Year 2002 Anacostia and Rock Creek Watershed Stocking Schedule and total number of viable larvae stocked

Year 2002	**Anacostia Watershed Tributaries and Stocking Sites**						**Rock Creek Watershed**	
	Sligo Creek	Northwest Branch	Paint Branch	Little Paint Branch	Indian Creek	Totals	Mainstem	Totals
	New Hampshire Avenue	Riggs Road	Powder Mill Road	Selman Road	Sunnyside Avenue		Garrett Park Road	
4/8/02	300,000.0	900,000.0	600,000.0	300,000.0	600,000.0	2,700,000.0		2,700,000.0
5/2/02			175,000.0		175,000.0	350,000.0		350,000.0
5/6/02							100,000.0	100,000.0
	300,000.0	**900,000.0**	**775,000.0**	**300,000.0**	**775,000.0**	**3,050,000.0**	**100,000.0**	**3,150,000.0**

Discussion

As has occurred in previous surveys, alewife herring dominated the herring collections. An equal number of ripe, female blueback herring were captured in 2002 and 2001, however fewer total blueback herring (non-ripe females and males) were observed. Large numbers of white perch were also captured in the Northwest Branch downstream from the fishway at the Route 1 Bridge, which is consistent with surveys from previous years. There was an increase in the number of striped bass captured compared to previous surveys, and in early May a group of 10 to 15 juvenile striped bass were observed. For the third consecutive year, hickory shad were captured in the Northwest Branch at Route 1. However this year's hickory shad strength of run was observed to be stronger than previous years (It should be noted that hickory shad were present in early April and absent from late April through the end of the project period.). A notable difference in the 2002 survey is the capture of hickory shad at the 38th street site, as this is the first record of them for this tributary above the Route 1 fishway since monitoring began in 1988. This finding is significant since it shows that the fishway at the Route 1 site is capable of passing hickory shad as well as river herring. One (1) yellow perch was captured at the Northwest Branch at Route 1.

As of the end of the Northwest and Northeast Branches of the Anacostia River 2002 migratory season (May 2002), the annual rainfall (recorded at Ronald Reagan National Airport) through May totaled 10.8 inches which is 5.2 inches less than the 30-year[1] normal rainfall amount for this period. Thus, low river flows was observed throughout the major migratory period collections in 2002 and may have contributed

[1] NORMALS BASED ON PERIOD 1971-2000

to the lower numbers of herring migrating upstream. Notably, low stream flow conditions from late April through middle of May at Northwest Branch US Route 1 site may have contributed to what was observed to have been a weaker than previous years' strength of run for blueback herring.

Low dissolved oxygen (DO) in mid April in the tidal portion of the Anacostia River may have limited the river herring as well as other anadromous species from migrating up to the tributaries. District of Columbia Department of Health Anacostia River Conrail automated water quality sampling station recorded hourly DO levels less than 5.0 mg/L from April 20 through April 24. Such low DO levels are not favorable conditions for juvenile/adult fish survival. Thus anadromous fish from the Potomac River may have been deterred from entering the Anacostia River during the unfavorable DO level periods.

The electroshocking reconnaissance found that the herring run appeared[2] weaker this year than in the recent past. Fewer river herring were captured at the fishway at the Route 1 Bridge than in the past three years of the survey, i.e., since 1999, as seen in a comparison of the catch per unit efforts (CPUE) at US Route 1 shown in Figure 8.

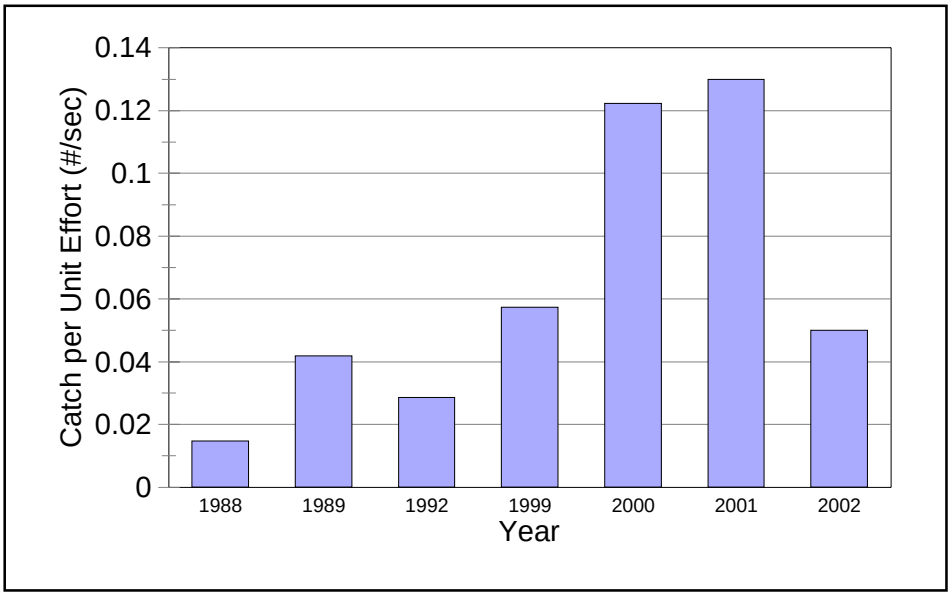


Figure 8 - 2002 Electrofishing Catch per Unit Effort of River Herring on Northwest Branch at US Route 1

The total number herring captured at 38th street was lower than the previous year but the ratio of herring captured between the 38th street and the US Route 1 site was higher in 2002. The success of the fishway in passing herring is consistent with results found in previous years when temporary repairs were made to the fishway.

[2] Direct comparisons of CPUE with surveys which occurred earlier than 1999 is difficult, complicated by differences in effort due to the number of people used to net stunned fish in the earlier surveys. The surveys conducted prior to 1999 used one person to net stunned fish. These surveys, conducted by ICPRB, were performed to monitor the herring run and document fish blockage locations. Since the renewed restoration effort began in 1999, with the combined staffing of additional personnel needed for the stocking components, two netters have been used to capture fish. It should also be noted that the project was not designed solely to determine CPUE and there are inherent conflicts comparing surveys, which required both reconnaissance and capture of broodstock.

As in pervious years, herring were observed swimming in the attractant channel of the fishway or on the concrete pad located immediately upstream from the fishway. Also, as per the recommendations in the 2001 study, the lowest baffle on the Northwest Branch fishway at Route 1 had been temporarily repaired since last year. This repair seemed to effectively allow river herring to pass through the fishway, was capable of passing hickory shad, and therefore would have reduced the number of fish captured downstream from what in past years was a malfunctioning fishway.

Results of the electroshocking reconnaissance showed that the best locations for collection of herring broodstock in the Anacostia watershed continued to be the Northwest Branch below Route 1. Unlike the last two years of surveys, no herring were captured in the Northeast Branch at the Paint Branch blockage above Route 1.

In the 2001 study, broodstock collections were attempted using gillnets on the mainstem Potomac River at Fletcher's Boathouse. In 2002, attempts were not made to collect broodstock from this location since adequate numbers were obtained from the Northwest branch. Future attempts of broodstock collections may still occur at the Fletcher's Boathouse site if needed.

Overall, the broodstock collection efforts at all stations resulted in the capture of more than 1500 alewife and blueback herring individuals with 127 ripe females bearing eggs. As in the previous year, such collections on the Northwest Branch at Route 1 using haul seines (Figure 9) proved successful and provided ample spawning herring with the least amount of collection effort and placed the least amount of stress on captured fish. All attempts were made to minimize egg mortality, however egg mortality is inherent with the "field strip/spawn" technique. Egg mortality may be due to several factors, such as variations in sunlight, water temperature, oxygen saturation and time allowed for fertilization or transport. Larval mortality may include such factors as limited food supply in hatchery holding tanks, the exchange of larvae from holding tank to the stocking containers and transport time.

Figure 9 – Broodstock collection using a haul

As stated earlier, for the past three years an approximate total of 8.4 million larval river herring has been reared under the larval stocking program and of that total, 8 million have been stocked into the major tributaries of the Anacostia watershed with the remainder stocked into the Rock Creek mainstem. As per the AFPWG's restoration priorities, larval stocking was proportional to stream needs, size, habitat quality and expected herring utilization and thus the Northwest Branch, including Sligo Creek, received a greater proportion (>60%) of the total stocked fry for the Anacostia watershed than the other three stocking sites combined in each of the past two years.

The specific intention of this stocking program is to promote the return of spawning adult herring by chemically imprinting larval river herring to their historic spawning stream reaches. By the end of the 5-year stocking program, it is envisioned that existing downstream fish blockage(s) will have been removed and/or modified thereby permitting full upstream migration and utilization of spawning habitat by these fish returning as adults.

Recommendations

The findings of this study support the priorities and objectives of the Anacostia Fish Passage Workgroup with the following modifications and/or additions:

1. Continue the broodstock collections and stocking of river herring larvae into the upper reaches of the Anacostia Watershed to continue to restore these fish to historic spawning ranges and rebuild their populations.

2. Future broodstock collections in the Anacostia Watershed should continue to employ the use of haul seines.

3. Should the need arise; attempts should still be made to collect broodstock from the Potomac River through the collaborative arrangement with Fletchers Boat House.

4. The Paint Branch blockage located upstream of Route 1 should be modified to permit fish passage.

5. The fishway at Route 1 and the Northwest Branch should be permanently repaired.

6. Work with the respective agencies (USACE, and M-NCPPC) and local government (Prince George's County) to install educational signage about the fishway at Route 1 and the Northwest Branch. As this is a fish concentration area and substantial harvest of migrating fish was observed, there also needs to be "Fishway - No fishing or dip-netting" signs posted at this area and some increased enforcement. In addition, there are highway safety concerns caused by dip-netters along Route 1 at the Bridge and "No Fishing From Bridge" signs might help reduce this concern as well.

7. Preparations are needed to begin checking for hatchery marks on returning herring.

Appendix A: Sampling Sites

The following are descriptions of the sampling sites. These sites are based on historic migratory fish sampling study areas in the Anacostia River watershed. The Northwest Branch, identified by the Anacostia Fish Passage Workgroup as the area of highest priority for fish passage, received the study's highest priority. Sampling station locations are shown in Figure 1, Page x

Northwest Branch:

1. (Us Route 1 fishway): The structure supporting the MD Route 1 Bridge crossing the Northwest Branch has, at times, had an adverse affect on fish migration. This area was modified in the fall of 1995, and the glide leading under the bridges was replaced with a notched weir and Denil fish passage. The area below the weir was designated as the furthest downstream point. This point was used to assess the strength of the migratory run and to establish the abundance and species that might employ the fish passage. In 1999 and 2000, it was determined that the baffle on the lowest cell of this fishway is in need of repair.

2. (38th Street V-notched sheet pile weir): The blockage is immediately upstream of 38th Street and is a sheet pile weir notched to allow fish passage. A small boulder field lies downstream of the weir to concentrate baseflow and provide an approach channel to the V-notch.

3. (NW1): Northwest Branch at the Pumping Station is approximately 400 feet upstream from 38th Street. It is a severely deteriorating gabion weir with two large pools below it.

4. (NW2): Approximately 2850 feet above the pumping station site. This site is a gabion weir 10 meters downstream from a tot lot. This weir might pass fish near a cascade on the right side (looking upstream) during high flows. During lower flows, it becomes a 6- to 18-inch cascade.

5. (NW3): Approximately 500 feet below Queens Chapel Road are two large concrete and gabion capped pipes that cross close to one another, with a deep, narrow pool between the two pipes and a large deep pool below the second pipe.

Northeast Branch:

6. (NEB1 @ MNCPPC): The furthest downstream point in the Northeast Branch to be sampled for this study is under River Road, near the Maryland National Capital Park and Planning Commission Offices (identified as Northeast Branch at MNCPPC), where a large metal weir spills over boulders and chunks of concrete into a deep pool. In the past this weir was a complete blockage to migration but in 1991 was modified to permit fish passage. Large numbers of herring can usually be spotted just below this weir during the peak of the run.

7. (Paint Branch 1 @ US Route 1): This blockage is located approximately 500 feet upstream of the Route 1 crossing. A large pool below a concrete rubble dam seems to have concentrated migrating herring in 2000.

8. (Paint Branch 2 @ Indian Creek): Two sweep sampling stations are located closely together upstream at the junction of Paint Branch and Indian Creek (see below, Indian Creek1). Monitoring was performed in a sweep section above the confluence with Indian Creek.

9. (Paint Branch 3 @ I-495): Paint Branch at I-495, to determine whether fish had migrated that far upstream. Both Alaska steep-pass and concrete step-pool fish passages have been installed at this site by the Maryland State Highway Administration to assist fish in bypassing blockages. The first, just on the south end of the inner loop, is a two-tier concrete step-pool that allows the fish to make three small attainments rather than one large one. Downstream of the outer loop of I-495, a small Denil fish passage has been built to help fish make the attainment over the foundation of the bridge. A previous blockage just below the Washington Beltway on Paint Branch has ceased to function as a blockage. The concrete casing for the pipe has continued to erode to a point where the flow is smooth, laminar, and slow when going over the structure. This area will be visually examined to ensure that this situation did not change.

10. (Indian Creek1 @ Paint Branch): Two sweep sampling stations are located closely together upstream at the junction of Paint Branch and Indian Creek (see above, Paint Branch1). Monitoring was performed in a sweep section above the confluence with Paint Branch. Turbidity in Indian Creek is typically much higher than Paint Branch.

11. (Indian Creek2 @ Greenbelt Road): Downstream from the box culvert crossing.

12. (Indian Creek3 @ I-495): at and immediately upstream from I-495 (Washington Beltway) bridge, along a glide where fish tend to congregate. This is the furthest upstream that herring have been found in the recent past (1992). At that time a large beaver dam created a blockage that made monitoring more conclusive. The beaver dam was removed in 1993 and sweep electrofishing was performed here on occasion.

13. (Lower Beaverdam Creek1 @ Kenilworth Avenue): Immediately below the concrete channel

Potomac River

14. (Fletcher's Boathouse) Gill net sampling site located in the mainstem Potomac River approximately 5000 feet downstream of Chain Bridge, and approximately 400 ft downstream of Fletchers Boathouse landing.