

# Spring 2004 Anacostia Tributary System River Herring Monitoring/Reconnaissance and Larval Stocking Project



Prepared for



Potomac Crossing  
Consultants

By



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## **Spring 2004 Anacostia Tributary System Herring Reconnaissance and Larval Stocking**

### **Summary**

A five-year larval river herring stocking program in the Anacostia watershed was initiated in 2000 through the Anacostia Fish Passage Working Group (AFPWG), working in conjunction with the Potomac Crossing Consultants (PCC). This is one of several mitigation projects designed to compensate for environmental impacts in the replacement of the Woodrow Wilson Bridge and attempts to help restore migratory river herring to historical spawning areas in the Anacostia watershed. Each spring since 2000, 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 a larval stocking program. Alewife herring (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) broodstock were captured, egg collected and 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. Over the course of the five consecutive year project, a total of more than 13.1 million river herring larvae were stocked into Anacostia River tributaries, and 0.42 million into Rock Creek. By late 2004, nearly all existing downstream fish blockage(s) on the Northwest Branch Anacostia are scheduled to have been removed and/or modified thereby permitting full upstream migration and utilization of spawning habitat by these fish returning as adults.

### **Project Background and Purpose**

Unavoidable impacts to wetlands and submerged aquatic vegetation will occur as a result of construction of the Woodrow Wilson Bridge replacement. 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 ARCMF 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. By 2005, all of the migratory fish blockages on the mainstem Northwest Branch Anacostia will have been removed. Progress is being made to remove migratory fish blockages on other Anacostia tributaries.

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 each spring between 2000 and 2004, a larval herring monitoring and restocking program was conducted. In coordination with AFPWG, PCC agreed to conduct a Spring 2004 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 2004, the herring monitoring and restocking program continued, returning more than 2.1 million larval herring back to the Anacostia watershed. The final result of restocking efforts between 2000 and 2004 returned a total of more than 13.5 million herring larvae back to the Anacostia and Rock Creek watersheds. This report describes 2004 project results and summarizes progress over the last 5 years.

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 to be stocked into a Rock Creek site when the total number of larval fish stocking quota was reached for the Anacostia watershed.

The spring 2004 Larval Herring Stocking Project involved the following three main tasks:

- I. An electrofishing reconnaissance survey was performed to:
  - measure use and determine impediments to migration 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 tributaries, and possibly one Rock Creek tributary, upstream of existing fish blockages and historical migratory ranges and
  - a target of one to two million alewife/blueback herring larvae.

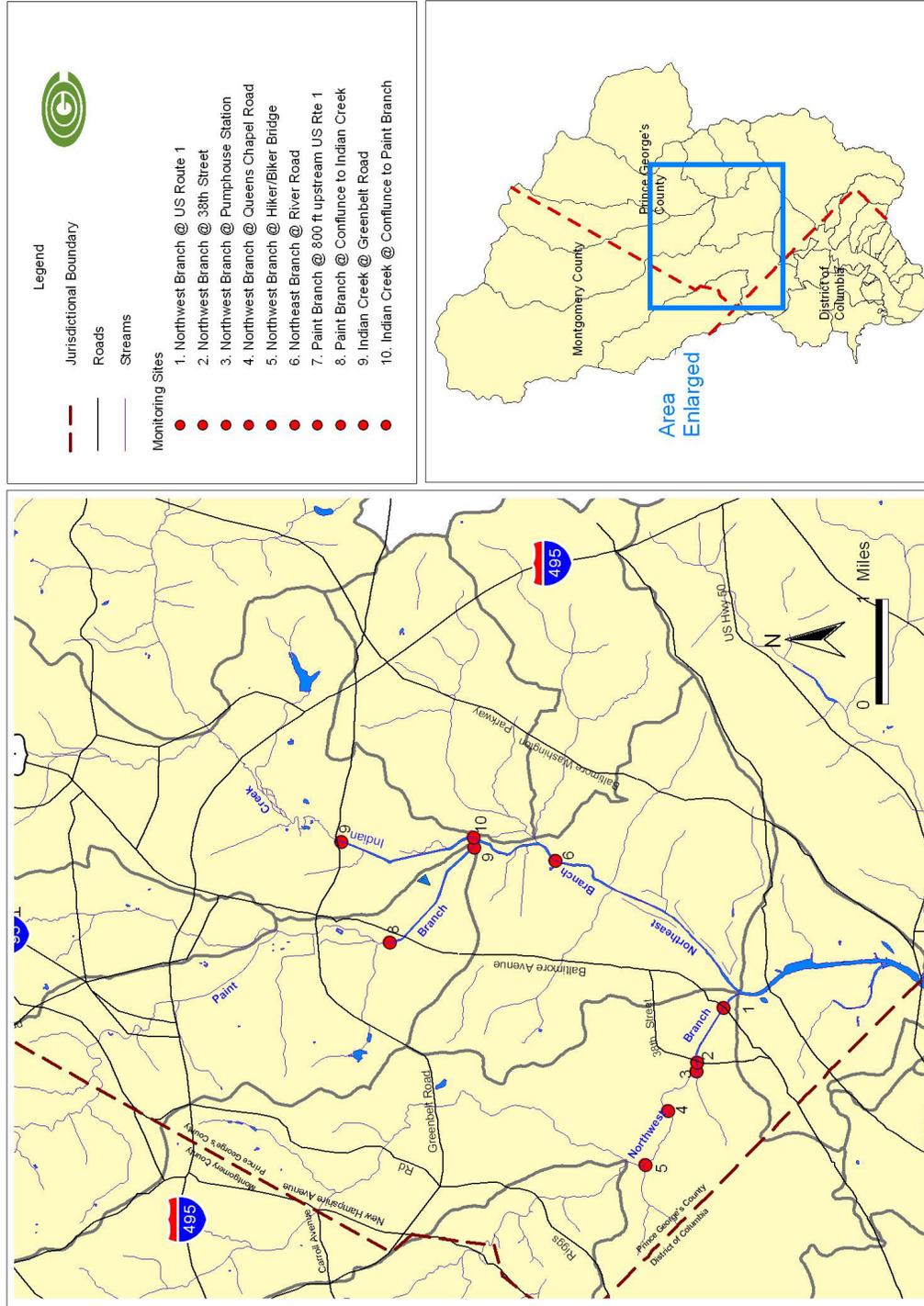
## Methodology

### *Task 1. Electrofishing Reconnaissance Survey*

A reconnaissance survey using electrofishing methods for adult migratory fishes in the Maryland portions of the Anacostia River watershed was conducted during the spring 2004 migratory fish runs. River herring (alewife (*Alosa pseudoharengus*) and blueback (*Alosa aestivalis*)) are the prime fish of concern, but other migratory target species include 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*). Ten stations (Figure 1 and Appendix A) were sampled to determine the presence and strength of the herring run. The stations were located immediately downstream from known, suspected, or former blockages, where migrating herring might 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

**Figure 1. Spring 2004 Anadromous Fish Reconnaissance and Monitoring Sites**



approximately 200 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, as this station has consistently been the most productive. Collected migratory fish were counted, weighed, 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.

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 4-8 week period. The stations designated for broodstock collection were determined from the results of previous 1999 - 2003 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 of broodstock for eggs.**

In preparation for incubation, the adhesive quality of herring eggs was reduced 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, 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

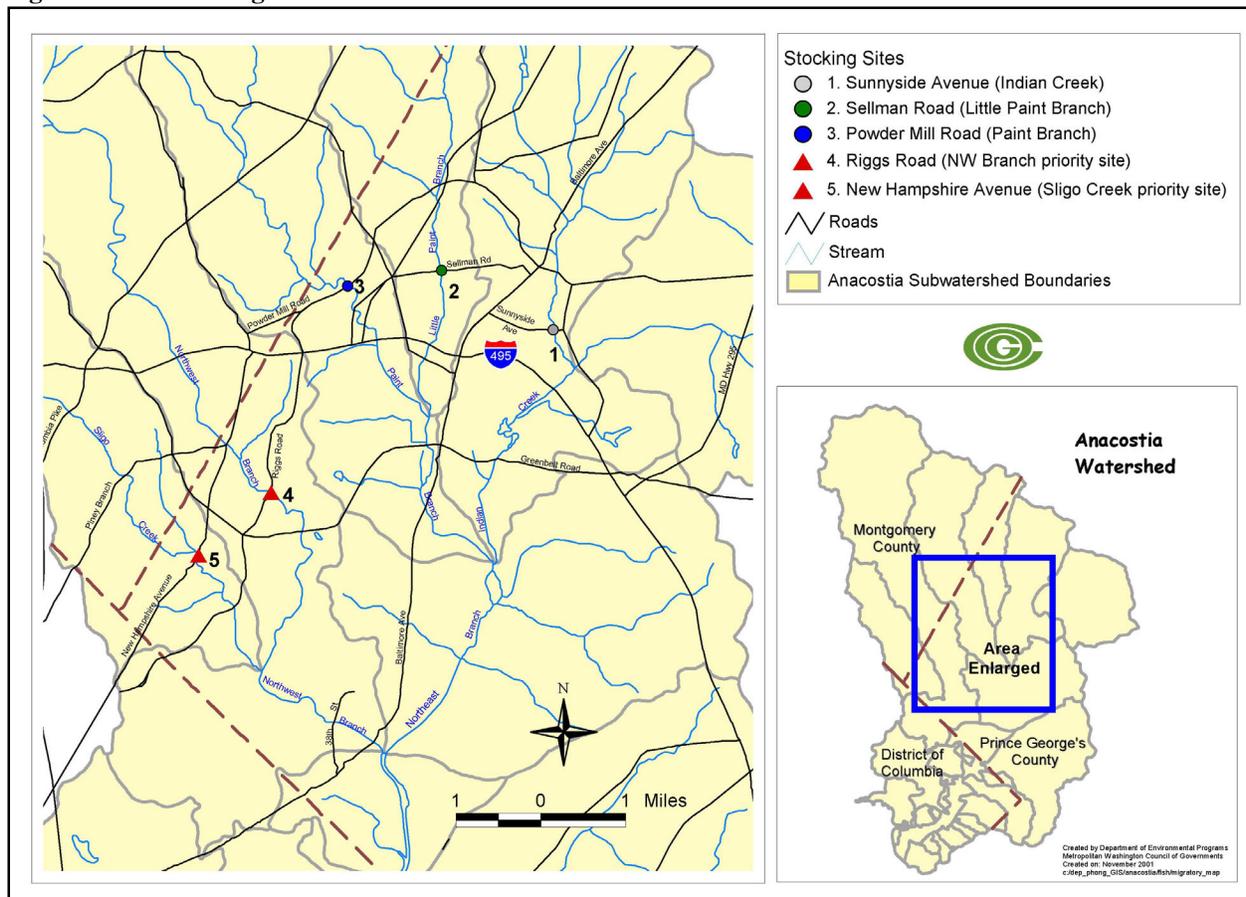
and hatched to a larval stage, after which approximate counts of viable eggs and pre-stock larvae survival rates were determined.

### 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 potential stocking sites. The potential stocking locations are shown in Figure 3 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 3. 2004 Stocking Sites**



All five Anacostia sites are located well upstream of existing modified 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. 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 4-8 week period (approximately March 19 to May 17), a project target of one to two million alewife and blueback herring larvae were to be released in batches at the four locations. As previously mentioned, once the river

herring larval stocking quotas were met for the Anacostia watershed, additional larvae were to be stocked into the Rock Creek mainstem at Garrett Park Road in Montgomery County.

## **Results**

### **Task 1. Reconnaissance Survey**

Reconnaissance sampling throughout the Northwest and Northeast Branch Anacostia River was initiated on March 19, 2004 and occurred, at a minimum, twice a week through May 17, 2004. Table 1 shows the migratory (anadromous) fish species and the total number of each collected during the reconnaissance survey.

On the Northwest Branch, Alewife herring were captured only up to the 38<sup>th</sup> Street station. The total numbers of

Alewife herring captured during monitoring was less than that found in surveys between 2001 and 2003. Only 10 blueback herring were captured throughout the monitoring survey period. As found in all previous years of this five year project, the US Route 1 site below the fishway proved to be an established river herring concentrating area where both monitoring and adult broodstock collections occur (Figure 4). In addition, although the fish barriers between 38<sup>th</sup> street and Queens Chapel Road have been mitigated to allow for the passage of migratory fish; in 2004, herring were not captured above the 38<sup>th</sup> street notched sheet pile metal weir.



Figure 4. Electroshocking Northwest Branch at US Route 1 fishway.

Monitoring and reconnaissance surveys in the mainstem Northeast Branch showed the presence of herring only up to the station at River Road (NEB1@M-NCPPC). No herring have been captured upstream of this site since the last successful capture in 2001 at the Paint Branch priority site 800 feet upstream of US Route 1 (PB@ US Rte 1). Since 2000, migratory herring have been absent from the station in Indian Creek at Greenbelt Road (Indian Creek 2@GreenbeltRoad). However, since the upstream habitat has been opened on Indian Creek at Greenbelt road and no downstream blockages were observed during the 2004 fish blockage walking survey; fish migration through this stream area is expected and may explain the absence of herring during the 2004 monitoring portion of this project.

A total of 177 river herring were captured via electro-fishing from all the survey sites with roughly 70 percent of these fish captured from the Northwest Branch sites. In addition to alewife and blueback herring, the other anadromous fish species collected included hickory shad, white perch, yellow perch and striped bass. All of these species were only observed on the Northwest Branch at US Route 1, and as in previous years, most of the capture of hickory shad occurred while using haul seines.

Removal of most blockages to fish migration in the Northwest Branch began in 2002 and are projected for completion in 2004. By spring 2004, most complete blockages had been removed or modified up to NW6 at the hiker-biker bridge, although no herring were captured during monitoring efforts just below this site.

Table 1. Year 2004 Anacostia Watershed River Herring Monitoring/Reconnaissance Survey

Stream	Northwest Branch								Northeast Branch	Paint Branch		Indian Creek					
	US Route 1				38 <sup>th</sup> St.		NW1 at Pump House	NW3 at Queens Chapel		NW6 at Hiker Biker Footbridge	NEB1 at MNCPPC / River Road	PB @ US Rte 1	PB @ Indian Cr	IC2 @ Green -belt	Indian Cr @ Paint Br		
Species Observed	Alewife Herring	Blueback Herring	Hickory Shad	White Perch	Yellow Perch	Striped Bass	Alewife Herring	Hickory Shad	Alewife Herring	Anadromous Fish Observed	Anadromous Fish	Anadromous Fish	Anadromous Fish	Anadromous Fish	Anadromous Fish	Anadromous Fish	Anadromous Fish
3/19/04	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
3/22/04	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
3/25/04	12	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
3/29/04	18	0	0	0	0	0	2	0	6	0	0	0	0	0	0	0	0
4/5/04	38	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0
4/7/04							0	0									
4/15/04	26	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
4/19/04	13	0	7*	0	0	0											
4/22/04							0	0									
4/28/04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/29/04							0	0	2	0	0	0	0	0	0	0	0
5/4/04	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
5/6/04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/10/04	6	10	0	2	0	1											
5/13/04	1	0	0	Ob*	1*	1*	0	0	0	0	0	0	0	0	0	0	0
5/17/04	0	0	0	0	0	0											
Total	114	10	7	Ob	1	2	2	0	51	0	0	0	0	0	0	0	0

Note: Except where otherwise noted, number of migratory fish captured for monitoring/reconnaissance survey does not include migratory herring captured by use of haul seine for broodstock collection.

Notes: Gizzard Shad were observed throughout the study. ob indicates species were observed but not counted. \* Indicates this migratory species was captured using haul seine

### ***Task 2. Broodstock Collection***

Successful collection of both mature male and ripe female alewife broodstock occurred from April 7, through May 10, 2004. A summary of the estimated number of eggs collected and hatched larva is shown in Table 2. The number of ripe females collected was 113, which was more than the project annual-minimum target number of 100, but less than the 219 collected in 2001 and the 127 collected in 2002. Only 85 ripe females were collected in 2003. The total volume of fertilized eggs was 4.6 liters, which was similar to the number of liters of eggs (4.7) collected in 2003. The percentage of viable larva produced from egg stage to hatched larva was lower in 2004 (53%) than in 2003 (73%) but higher than in 2002 (40%). As Table 2 shows, the eggs collected from two sampling events produced the bulk of the 2.1 million larva stocked, and occurred between mid april and early May. Of the 16 total days of sampling events, only five of those produced eggs viable for collection. As expected, blueback herring were captured in early May, but significant numbers of eggs were collected only during one sampling event. (Figure 5, Figure 6). Water temperatures for periods during which viable eggs were collected ranged from 10-18 degrees celsius.



Figure 5. Broodstock collection using haul seine.



Figure 6. Measuring volume of eggs collected.

### ***Task 3. Larval Stocking***

The Anacostia watershed stocking schedule is shown in Table 3. More than 2.1 million alewife herring larvae were stocked to four locations in the Anacostia Watershed (Figure 3). Near the end of the herring run, an insufficient number of successful broodstock collection days prevented additional larval stocking in Rock Creek. Overall, the estimated total of 2.1 million stocked larva exceeded the original projected target stocking numbers of 1-2 million. The total for the five year stocking effort is approximately 13.1 million river herring larvae stocked in the Anacostia Watershed (Figure 7) and 0.42 million stocked in the Rock Creek mainstem. It should be noted that Little Paint Branch was not stocked this year.



Figure 7. Larval stocking.

**Table 2. Year 2004 Estimated Number of Viable Eggs and Stocked River Herring Larvae**

Sample Date	Collection Site	Collection Technique <sup>1</sup>	Number of Ripe Female Herring Stripped of Eggs	Volume of Fertilized <sup>2</sup> River Herring Eggs Collected (Liters of eggs)			Estimated Number of Viable Eggs Collected <sup>3</sup>	Estimated Number of Viable Larva Stocked <sup>4</sup>
				Blueback	Alewife	Total		
4/7/04	Northwest Branch @ US Route 1	Seined	4		0.2	0.2	173,000	44,000
4/9/04	Northwest Branch @ US Route 1	Seined	4		0.25	0.25	216,250	150,000
4/16/04	Northwest Branch @ US Route 1	Seined	45		2	2	1,730,000	1,309,000
4/19/04	Northwest Branch @ US Route 1	Seined	17		0.65	0.65	562,250	394,000
5/10/04	Northwest Branch @ US Route 1	Seined	43	0.5	1	1.5	1,297,500	227,673
	<b>Totals</b>	-----	113	0.5	5.9	4.6	3,979,000	2,124,673

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.

<sup>1</sup> River herring collection technique employed the following equipment: 50 and 25 foot-long haul seine nets.

<sup>2</sup> Generally, three male herrings were used to remove milt for every one female stripped of eggs.

<sup>3</sup> Per correspondence with MDDNR, Alewife herring generally broadcast in the range of 400 to 1030 total number of eggs per milliliter. Additionally, the 865 eggs per milliliter was used as the median range value.

<sup>4</sup> Estimated numbers of larvae stocked were calculated from multiple 200-ml sub-samples collected from the 400-L or the 1000-L rearing tanks.

**Table 3. Year 2004 Anacostia Watershed Stocking Schedule and total number of viable larvae stocked**

Date	Anacostia Watershed Tributaries and Stocking Sites				Totals
	Sligo Creek	Northwest Branch	Paint Branch	Indian Creek	
	New Hampshire Avenue	Riggs Road/Adelphi Park	Powder Mill Road	Sunnyside Avenue	
4/16/04		44,000			44,000
4/19/04		150,000			150,000
4/22/04	327,250	327,250		654,500	1,309,000
4/27/04	131,333	131,333		131,333	394,000
5/17/04	56,918	56,918	56,918	56,918	227,673
Total	<b>515,501</b>	<b>709,501</b>	<b>56,918</b>	<b>842,751</b>	<b>2,124,673</b>

**Discussion**

The spring of 2004 was the final year of a planned five year migratory herring restocking project which began in 2000. In 2004, as well as previous years, the alewife herring dominated all herring collections, with the majority being captured on the Northwest Branch at US Route 1, and on the Northeast Branch at River Road. Even though somewhat larger numbers of blueback herring were collected in 2004 than in 2003, overall far fewer blueback herring have been captured than alewife herring.

Despite recent removal/modifications to many blockages to fish migration on the Northwest Branch, the reconnaissance monitoring showed migration only up to the 38<sup>th</sup> street station. However, since many of the modifications have only recently been completed, full utilization of migratory extent may not yet be fully attained. On the Northeast Branch, herring have not been documented upstream from the River Road bridge since 2001. Changes in the fishway structure immediately upstream of this bridge (consisting of a notch in metal energy dissipating weir with downstream boulders, modifications made in the early 1990s), such as movement of the rock as a result of high flows, may account for hydrologic changes which now prevent fish passage.

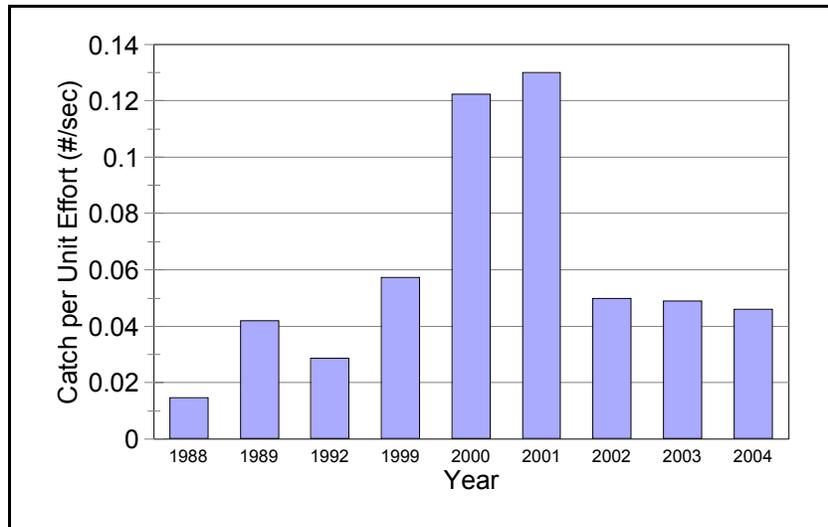
The electroshocking reconnaissance showed that the best locations for collection of herring broodstock in the Anacostia watershed continued to be the Northwest Branch at US Route 1. The strength of the 2004 herring run, as measured by catch per unit effort (CPUE)<sup>1</sup> on the Northwest Branch was nearly equal to that in 2003 and 2002, but the weakest of all herring runs since the start of this restocking project in 2000. (Figure 8). The total number of herring captured in the reconnaissance survey at the Northeast Branch (51) at River Road (NEB1@MNCPPC) was lower than that in 2003 (134) and 2001 (68), but higher than in 2002 (21). Other migratory species, such as striped bass, yellow perch, white perch, and hickory shad, were also collected in 2004.

Weather during 2004 consisted of a cool early spring, followed by few warm rain events. Annual rainfall (recorded at Washington National Airport) through the end of May 2004 showed a total of 12.54 inches,

<sup>1</sup> Direct comparisons of CPUE with surveys, which occurred earlier than 1999, are difficult. These earlier surveys, conducted by ICPRB, were performed to monitor the herring run and document fish blockage locations. The recent surveys were not designed solely to determine CPUE, but also to determine the best locations for the capture of broodstock. Direct comparisons are further 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. 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.

which was 3.49 inches below the 30-year normal rainfall amount for this period. While high flow conditions are generally believed to be the best conditions for herring migration upstream, opening more spawning habitat and reducing bird predation, abrupt changes in temperature, especially quick warming, can be detrimental to the runs.

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



The broodstock collection efforts at all stations resulted in the capture of more than 1800 alewife and blueback herring individuals with 113 ripe females bearing eggs. The use of haul seines remains the most successful method for collection of broodstock and reduces the amount of stress placed on captured fish. As Table 2 shows, five collections were made which resulted in viable larva. Every effort was made to minimize egg mortality; however, egg mortality is inherent with the “field strip/spawn” technique. Egg mortality can 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. These factors combine to create variable results in the number of viable larva produced.

In this five year project, 13.5 million larval river herring have been reared and stocked in the larval stocking program. Of that amount, 13.1 million have been stocked into the major tributaries of the Anacostia watershed with the remainder (0.42 million) stocked into the Rock Creek mainstem. As per the AFPWG’s restoration priorities, larval stocking has been proportional to stream needs, size, habitat quality and expected herring utilization. As a result, the Northwest Branch, including Sligo Creek, have received a greater proportion (58%) of the total stocked fry for the Anacostia watershed than the other three Anacostia stocking sites combined in each of the past three years. This stocking scheme is meant to promote the return of spawning adult herring by chemically imprinting larval river herring to their historic spawning stream reaches. By the end of 2004, all existing downstream fish blockage(s) on the Northwest Branch are scheduled to have been removed and/or modified, thereby permitting full upstream migration and utilization of spawning habitat by these fish returning as adults. In contrast, the Paint Branch blockage located upstream of US Route 1 has no immediate plans for removal/modification. Thus, due to the limited number of larvae available for stocking, as well as the delayed removal of this blockage, no stocking events in 2004 occurred at the Little Paint Branch site.

## ***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. As a top priority, the Northeast Branch fish weir at River Road should be repaired to allow fish passage. Most of the boulder field structure is functional. We recommend the placement of several larger rocks immediately downstream from the notch to create a higher elevation plunge pool which would submerge more of the notch.
2. The monitoring/tracking program for Anacostia anadromous fish should be conducted for at least five more years. In addition, the survey should be expanded to include the stream reaches upstream of the recent modified/removed Anacostia fish blockages to help determine the extent of upstream migration. Such a program would also measure the success of the 2000-2004 stocking project and whether the modification/removal of Anacostia fish blockages have improved the upstream migration of herring species.
3. If the final modifications to NW0 do not occur prior to the 2005 migration period, a trap and transport program during the herring run should be performed followed by upstream monitoring of herring presence.
4. The Paint Branch blockage located approximately 150 meters upstream of Route 1 near the University of Maryland should be modified to permit fish passage.
5. A great opportunity to install educational signage exist near the fishway at Route 1 and the Northwest Branch. This is a major anadromous fish concentration area. Signage should include “Fishway - No fishing or dip-netting,” as substantial harvest of migrating fish occurs at this site which is detrimental to recovery efforts. There also needs to increased enforcement in this area. In addition, there are highway safety concerns caused by dip-netters working along the Route 1 Bridge. “No Fishing From Bridge” signs might help reduce this concern. Work with the respective agencies (USACE, and M-NCPPC) and local government (Prince George’s County) to install this signage.

## Appendix A: Sampling Sites

The following are descriptions of the sampling sites, both used in 2004 as well as sites sampled in previous years of this project. 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. Some of the sampling station locations are shown in Figure 1.

### Northwest Branch:

1. (Us Route 1 ): 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, and as of spring 2004, it has been temporarily repaired.
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. ( Pumphouse station/NW1 ): Northwest Branch at the Pumping Station is approximately 400 feet upstream from 38th Street. In 2002, extensive stream channel modification produced hydrologic changes, which submersed the previously protruding gabion weir. Hence, this site is no longer a barrier to upstream fish migration.
4. (NW2): Approximately 2850 feet above the pumping station site. This site was modified in 2002 to eliminate barriers to fish passage.
5. (NW3): This site was modified in 2003 to eliminate barriers to fish passage. Previously, approximately 500 feet below Queens Chapel Road were two large concrete and gabion capped pipes that crossed close to one another, with a deep, narrow pool between the two pipes and a large deep pool below the second pipe.
6. (Queens Chapel Road): A large deep pools exists just below a fast riffle area 20 meters downstream from the Queens Chapel Road bridge.
7. (Hiker-Biker bridge/NW6): This large concrete blockage is slated for modification to eliminate it as a barrier to fish passage in 2004.

### 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. Some movement of the boulders just below the weir seems to have occurred since 1991.

7. (Paint Branch 1 @ US Route 1): This blockage is located approximately 800 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): In 2003, modifications to the box culvert crossing were completed eliminating this site as a barrier to fish migration.
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.