1999 Assessment of the Upstream Progress
of Migratory Fishes in the Anacostia Watershed

DRAFT REPORT
Prepared by

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INTRODUCTION

Encouraging progress has occurred in the restoration of the Anacostia River, an important yet abused tributary of the Potomac River. River herring are again entering long-blocked spawning habitat, key urban stormwater management retrofit projects have been completed, and citizens have united to help clean up the resource. Unfortunately, the presence of dozens of partial and complete fish barriers prevent full use of the Anacostia tributary system, especially by anadromous fish. Beginning in 1992, the U.S. Army Corps of Engineers (USACE) began Anacostia Project modifications for the improvement of the environment under Section 1135 of the Water Resource Act of 1986. Removal of three blockages to fish migration and improvement of fish habitat were part of this work. Public interest and momentum for improving the Anacostia River continues to be strong. While both interests and opportunities are again high to continue removing blockages to fish migration, monitoring of migratory fish movements was last performed in the watershed in 1996, and our current understanding of those movements is lacking. There has been an urgent need to monitor the current status of those migrations.

In response to this need the Anacostia Watershed Restoration Committee (AWRC) made spring 1999 anadromous fish surveying of key Anacostia tributaries a high priority. The Anacostia Fish Passage Working Group (AFPWG), originally organized in 1990 by ICPRB and recently reconvened by the Metropolitan Washington Council of Governments (per the AWRC), serves as the lead coordinating body for removal or modification of barriers to fish migration in the Anacostia River. This ad-hoc working group is composed of local, regional, and state personnel from the Maryland National Capital Park and Planning Commission, Montgomery and Prince Georges Counties, Maryland, the Washington Suburban Sanitary Commission, the Metropolitan Washington Council of Governments, the District of Columbia's Fish and Wildlife Program, the Maryland Department of Natural Resources, the Maryland State Highway Administration, the Interstate Commission on the Potomac River Basin, the U.S. Fish and Wildlife Service, the National Park Service, and the National Marine Fisheries Service.

PURPOSE AND SCOPE

The major objectives of this project were to continue to facilitate the restoration of the fisheries in the Anacostia watershed through the evaluation of changes in migratory fish usage of Maryland portions of the Anacostia River tributaries. Electrofishing surveys of adult migratory fishes were conducted during the spring runs. Migratory fish runs in these areas are principally alewife herring (Alosa pseudoharengus), blueback herring (Alosa aestivalis), and white perch (Morone americanus), but include striped bass (Morone saxatilis) and yellow perch (Perca flavescens), American eel (Anquilla rostrata) and sea lamprey (Petromyzon marinus). The

relative strengths of each migratory fish species spawning run are compared to the results of earlier survey activities that have occurred between 1988 and the present.

METHODS

Monitoring for migratory fishes was conducted at fifteen stations (Figure 1, with descriptions in Appendix A) in the study area in order to assess progress and set priorities for removal or modification of structures which limit fish passage. Priority was given to the Northwest Branch and it's tributaries due to AFPWG priorities combined with budget and time constraints. The Northeast Branch and it's tributaries were sampled only as any time permitted. Surveys were conducted twice weekly (weather and flow conditions permitting) from before the start of any migratory run (yellow perch were excluded due to limited funds and grant timing) until no fish were captured in an attempt to document the complete window of time during which migratory fishes are using the resource. Sampling was conducted during daylight hours using a Smith-Root backpack electrofisher employing pulsed direct current. One person operated the electrofisher and one person netted stunned fishes.

Two sampling protocols were employed. In the first, and principal protocol, areas immediately downstream from known or suspected blockages were shocked. The major object of each collection trip was to determine the extent and magnitude of upstream migration occurring on that particular day. Therefore, on each sampling day collections were initiated at the most downstream blockage of the Northwest Branch. Potential blockages are sampled on the downstream side. Sampling will then be repeated at the next upstream blockage until a blockage is reached at which no migratory fishes are captured. Output power was field adjusted to account for variations in stream conductivity.

The second protocol was used in situations where there are no known blockages above the passageway. In this case, "sweep electrofishing" sampling was conducted at various upstream sites in an attempt to document evidence of the extent of migration into the unimpeded stretch. These "sweeps" involved electrofishing in an upstream direction of a long stream stretch (i.e., from 100 to 500 meters) with a focused collection effort aimed at capturing the specific target species mentioned above, although gamefishes or rare fishes encountered will also be collected to augment understanding of their use of the area. Sampling was conducted during daylight hours using a Smith-Root backpack electrofisher as described above. The most upstream locations of any target species and/or concentrations or "hotspot" locations, where large numbers of target species were collected, were identified and the locations noted. Output power was also field adjusted to account for variations in stream conductivity.

Under either method, collected migratory fishes were counted, measured for length and weight, sexed by evidence of row or milt, notes were taken on their general condition, dorsal fins were

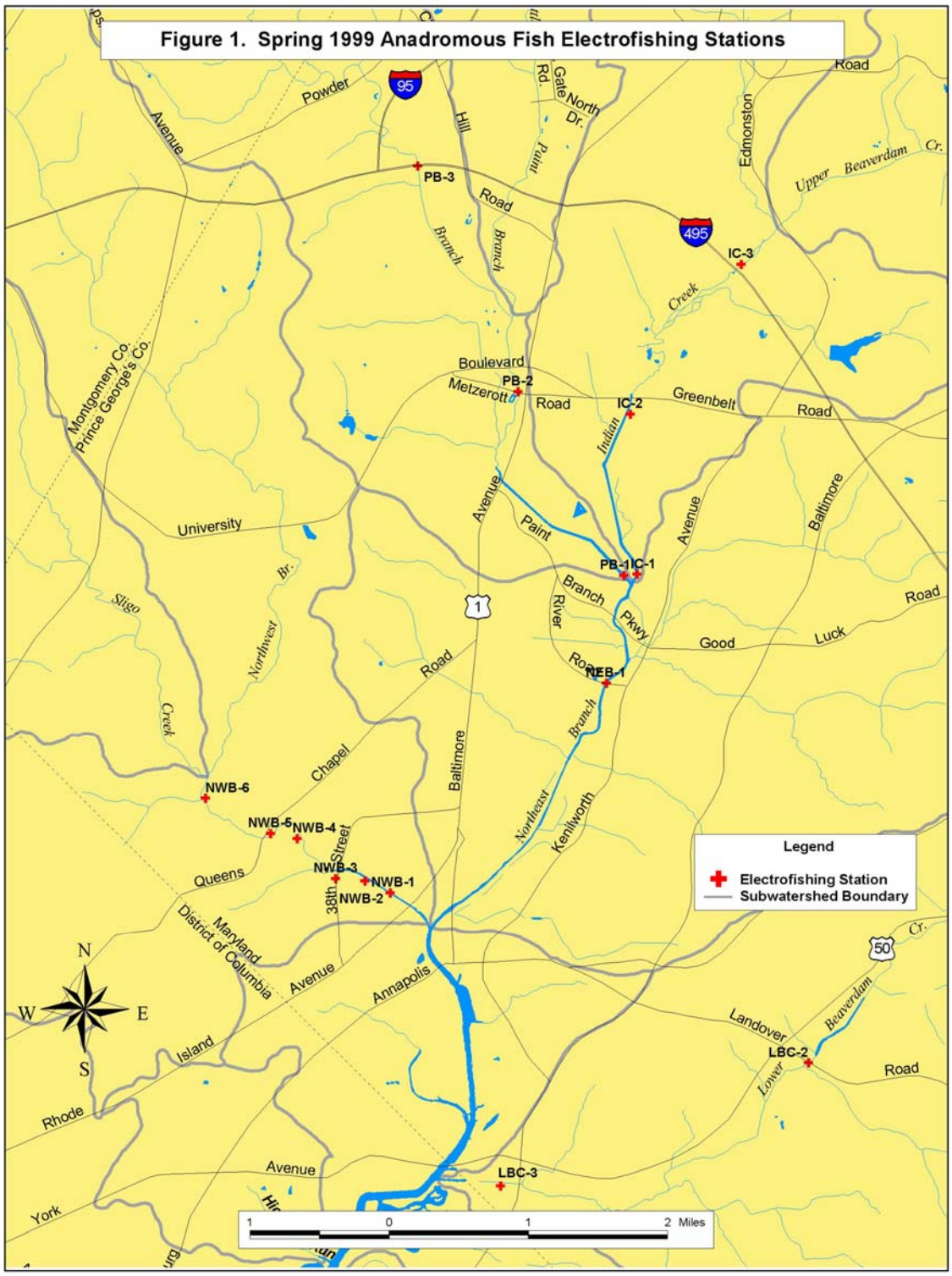


Figure 1. Spring 1999 Anadromous Fish Electrofishing Stations
PB-3
IC-3
PB-2
IC-2
PB-1
IC-1
REB-1
NWB-6
NWB-5
NWB-4
NWB-3
NWB-1
NWB-2
LBC-3
LBC-2
Legend
Electrofishing Station
Subwatershed Boundary
1 0 1 2 Miles
N
S
E
W
Powder Hill Road
Gate North Dr.
Edmonston Road
Upper Beaverdam Cr.
Montgomery Co.
Prince George's Co.
Boulevard
Metzerott Road
Greenbelt Road
Indian Creek
Paint Branch Parkway
Good Luck Road
University Blvd.
Sligo Creek
Northwest Branch
Chapel Road
Baltimore Avenue
Northeast Branch
Kenilworth Avenue
38th Street
Queens Chapel
Maryland
District of Columbia
Avenue
Annapolis Road
Island Avenue
Rhode Island Avenue
York Road
Landover Road
Lower Beaverdam Cr.

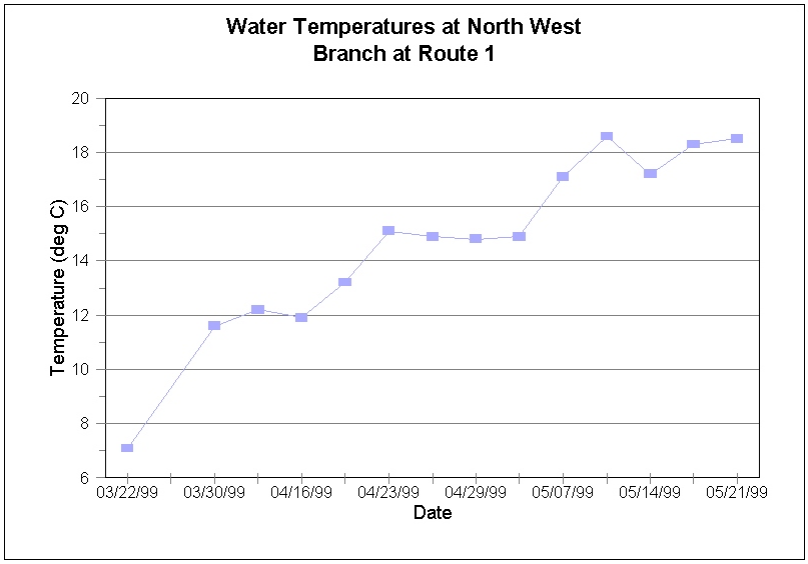
clipped to identify where they were captured, and then they were released. Attempts were made to capture all fish sighted during electrofishing. If schools were so large that capture of all individuals is not possible or desirable, they were subsampled and records were kept on the estimated size of the school observed. Daily water temperature, water clarity, and general flow and weather conditions were recorded. Information obtained from these surveys was used to evaluate and/or prioritize removal or modification of barriers to migratory fish passage.

RESULTS

Sampling started on March 17th and was concluded on May 28. Sampling events occurred on 20 days over the 9-week period. Table 1 provides the number of individual migratory fishes collected at each site for each day sampled in 1999.

The two sampling events for April 12 and 13 on the Northeast Branch included river herring capture and transport operations. During these events, river herrings were captured with extended periods of electrofishing (872 and 841 seconds, respectfully, versus the average of approximately 270 seconds), small notches were cut in their dorsal and left pectoral fins to mark them, and then they were released 25 feet upstream of the fishway. Blueback and alewife herring were captured upstream of Rt 1 during four sampling events. However, no such marked herring were captured at any upstream locations.

Higher storm-related flows occurred only one time, following a significant rainstorm on April 11. Water clarity remained high throughout the season and no significant spikes in water temperature (Figure 2) were observed or known to have occurred.



Field notes included two observations; 1) the abundance of curly pondweed at many sites in the NW Branch. This exotic but beneficial submerged aquatic plant was not found in earlier studies. 2) While there was only one significant storm event (April 11) the streams return to normal flows and water clarity were notable more rapid than experienced in earlier studies.

Table 1 . Anacostia Anadromous Fish Survey Summary – Number of Individuals Collected - Spring 1999

STREAM	Northwest Branch											Northeast Branch	Paint Branch			Indian Creek			Lower Beaverdam Creek	
SITE	NWB11					NWB2		NWB3	NWB4	NWB5	NWB6	NEB1	PB12	PB2	PB3	IC1	IC2	IC3	LBC1	LBC2
Species Observed	Alewife Herring	Blueback Herring	Hickory Shad	White Perch	Yellow Perch	Alewife Herring	Blueback Herring	Blueback Herring	No Anadromous Fish Observed			Alewife Herring	Blueback Herring	No Anadromous Fish Observed		Alewife Herring	Alewife Herring	No Anadromous Fish Observed	Alewife Herring	No Anadromous Fish Observed
DATE																				
3/17/99																				
3/19/99																				
3/22/99	15																			
3/26/99	20											10								
3/30/99	24															1				
4/6/99	4											8								
4/12/99	44	4	1	2	3												3			
4/13/99	64	3		1	1															
4/16/99	13											2								
4/20/99	9	1				4	1													
4/23/99	14	3			1	1														
4/27/99	8																			
4/29/99	8			4	1	7	6													
5/4/99	6											1								
5/7/99	4	8		49				1												
5/10/99	1	4		3	4															
5/14/99		7		2	1															
5/18/99		2		4																
5/21/99		7		8	2															
5/28/99																				

1 Gizard shad observed throughout the study.
2 Sea lampreys observed beginning on 4/16/99.

Totals	233	39	1	73	13	12	7	1	0	0	0	21	0	0	0	1	3	0	0	0

Note: Blank boxes indicate that anadromous fish were not captured during electo-fishing survey. Shaded boxes indicate that electro-fishing survey was not conducted.

DISCUSSION

The drought conditions that prevailed over the duration of study were considered problematic. Storm related increases in flow, often accompanied by increases in temperature, are important occurrences for fish migrations. The higher flows permit easier access over marginal low-head blockages and protection from predators due to increased turbidity. Increased water temperatures stimulate migratory fish movement. The near absence of significant storm events probably failed to induce migrations and held the fishes in deeper water habitats downstream. As an added factor, the resultant high water clarity increased opportunities for predation. Blue herons, blackcapped night herons and kingfishers were constantly observed in the immediate vicinity of the NE Branch fishway. The same water clarity may have inhibited migration into the shallow streams, especially at this last site, simply due to predator avoidance behavior. In addition, the absence of overhanging riparian vegetation on the flood management areas due to maintenance practices severely limits refuge from aerial predators. As in past years, alewife herring dominated the collections. The thirteen yellow perch captured represent a small but encouraging increase in the numbers of yellow perch captured from previous studies. A single hickory shad was captured at the Northwest Branch at Rt. 1. This is the first time that hickory shad have been reported for this upper part of the Anacostia River watershed.

Characterizations of the relative strengths of the river herring (alewife plus blueback) runs are provided with figures 3 (total numbers), 4 (CPUE at NE Branch) and 5 (CPUE at NW Branch)

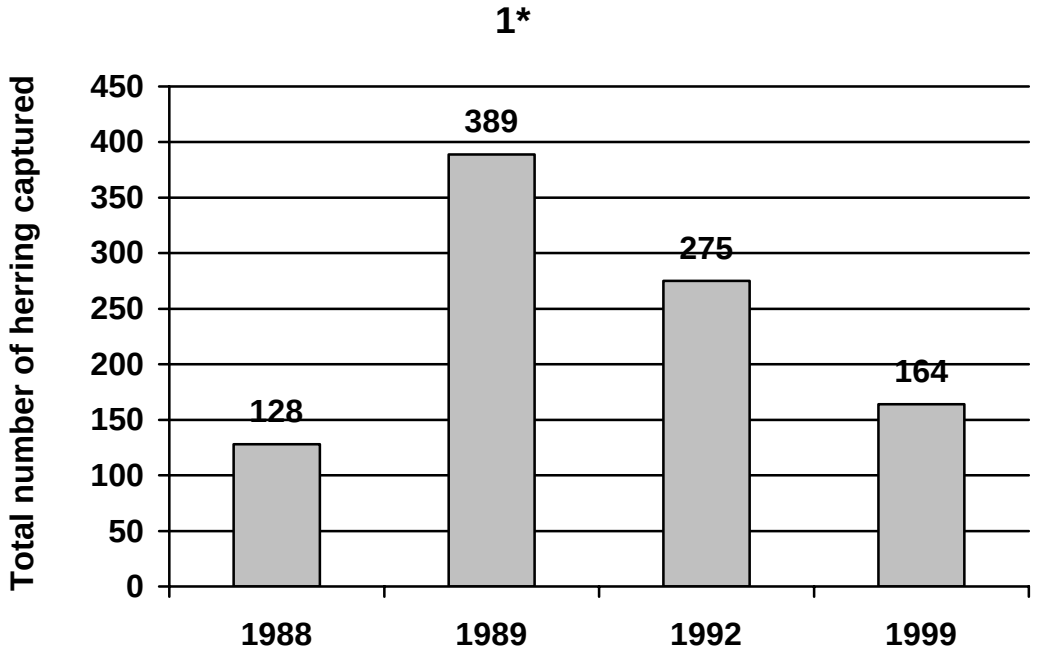


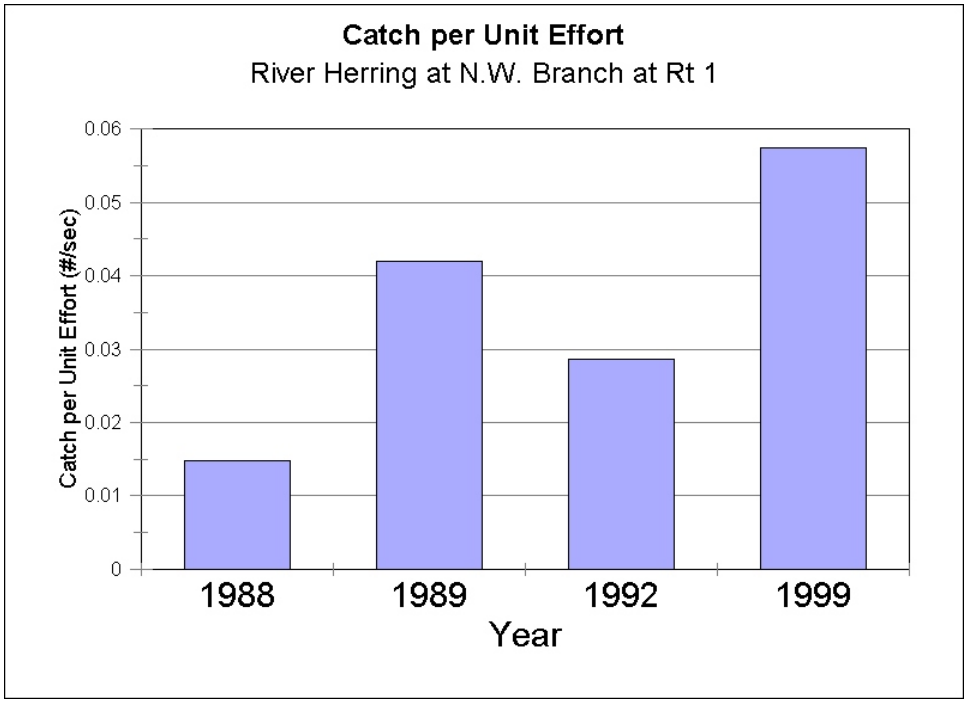
Figure 1. 1988-99 Anacostia Anadromous Fish Electrofishing Survey Summary – Relative Strength of Run[1]

Figure 3 shows the total numbers of herring captured at all sites sampled in the Anacostia for

1 Data provides a rudimentary characterization of the relative strength of run for both blueback and alewife herring for the Anacostia tributaries. It is recognized that a more detailed analysis that may possibly include catch per unit effort, length to weight ratios, sex ratios, etc. is needed.

* Note: 1999 total excludes approximately 100 fish captured as a result of a trap and transport event.

those years with similar levels of sampling effort. Figures 4 and 5 show comparisons of catch per unit effort (CPUE), the number of fish captured per second of electrofishing, with past years at the two primary sampling stations for each major branch of the Anacostia River. The CPUE comparisons were also made between years with similar levels of sampling effort. In addition, CPUE comparisons exclude sampling events at each end of the sampling season when no fish were captured, as they occurred in periods before or after the migratory runs. This exclusion was done to compare CPUE when the fish were actually there, as a means to account for differences that could be attributed to varying water temperatures for these years and therefore varying times of arrival and departure for the migratory fishes. The 1999 Northwest Branch comparisons also exclude the two dates from 1999 that were used as trap and transport events.



Direct comparisons of the strengths of this years runs to past years of similar sampling effort, with most of the later occurring before fishways were installed at three sites in the Northeast and Northwest Branch, is necessarily difficult due to current opportunities for dispersal of the populations into opened stream reaches; i.e., they are less likely to be concentrated at a given location than in the past. However, if we look at the total number of fishes captured at all sites (figure 3) the strength of runs in 1999 is modest compared to past years. CPUE comparisons were mixed regarding the strength of the runs in the NE and NW Branches, lower in the former and higher in the later. If there is a similarity to past collections though, it is that no year to date has had strong runs.

After the first capture of herring (March 22) approximately three weeks passed (to April 12) with no herring being captured upstream of the fishway at Route 1 on the Northwest Branch. This was occuring despite relatively large numbers of herring being captured and observed immediately downstream of the fishway on three sampling events. Under growing concern that the fishway was not working, water velocities were measured in the fishway's four cells. The velocities of the upper end of the most downstream cell of the fishway was found to exceed

design criteria (15 to 22 ft/sec vs a design maximum of 8 ft./sec). These two factors, the absence of migratory fishes and the excessive velocities in the first cell, indicated that the fishway was not operating correctly. If the fishway was not passing fish, as was the case in 1996 after it was apparently damaged by winter storms, a critical year of evaluation would be compromised. If no fish could go upstream from this structure there would be no reliable information gathered on the upstream structures.. Therefore the decision was made to conduct capture and transport of herring at this site. Fish were concentrating below this passageway and were not collected upstream early in the season when measured water velocities in the downstream cell exceeded design capacities. However, herring were collected upstream later in the season. Field observations provide possible explanations for finding herring upstream at these later dates. The fishway is located at the very upper tidal limit with about a 2 foot tidal amplitude, and the water depths of the first three cells are influenced by tides, becoming submerged during the higher tidal cycle. The water depths of the first three cells become much deeper during the higher tidal cycle. Towards the end of the season, as drought conditions produced very low flows, the pressure of the water in the fishway diminished and, in combination with tidal effects, probably enabled fish to pass, either through the vertical slots next to the fishway or through the fishway itself. This year's low flows did provide better conditions to observe the problem. The most downstream cell, one that had a baffle repaired in the Fall of 1996, exceeded water velocities that were the design criteria (measured between 15 to 22 ft/sec versus the design criteria of 8 ft/sec.). This lowest baffle was not as tall as its upstream counterparts. Perhaps in the repair process a shorter baffle was used in this lower cell.

Although one herring was collected at the next upstream site to the 38th Street site on the Northwest Branch demonstrating that it can pass fish. However, the effectiveness of the 38th Street modification is still uncertain due to the limited run that occurred in combination with the related Route 1 fish passage problem.

The higher occurrence of shaded boxes in the Northeast Branch and its tributaries portion of Table 1 visually demonstrates that, following study design, sampling was not as extensive at the sites. Capture of any migratory fish in the Northeast Branches were exceeding rare, even considering reduced sampling effort, except at the most downstream station (NEB1). No migratory fish were captured in Paint Branch. No fish were captured upstream of the Greenbelt Road Bridge crossing over Indian Creek. This structure was not a blockage in past years but downcutting has produced a significant drop in elevation below it's four culverts. The storm event on April 11th produced flows sufficient to open this site, but the extended low flow conditions characterizing season resulted in an 8-12" drop during most of the study period.

In the Northeast Branch no migratory fishes were collected above the USCOE's 1135 modification on Paint Branch. Herring were collected in Indian Creek above its confluence with Paint Branch, yet not as far upstream as in the past. (In 1992, herring were collected above the beltway in Indian Creek.) The reasons for not capturing migratory fishes in these stream reaches are not clear, yet might be related to the previously mentioned dispersal over a larger area. Attempts to locate natural holding areas were not productive, possibly due to limited runs, dispersal or a combination of the two, or simply an absence of fish.

RECOMMENDATIONS

Our findings support the objectives of the Anacostia Fish Passage Workgroup and the fish passage priorities established prior to the season with the following additions;

Repair the fishway at Route 1 on the Northwest Branch. Closer evaluation of this structure needs to be performed during low flow periods. From our observations this Spring it appears that an increase in the downstream cell 1 baffle's height to correspond with the upstream baffle heights is required.

2. Initiate a stocking of river herring fry, principally alewife herring, into the upstream reaches of the Anacostia to imprint the fish to historic spawning ranges and to rebuild the population.

3. Install a concentrator channel and some form of fish passageway, such as an Alaska steep pass, at the Greenbelt Road crossing of Indian Creek.

4. Re-establish overhanging riparian vegetation in the flood management areas.

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. (NWB1 @ Md. Rt. 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.

2. (NWB2 @ 38th St.): The next blockage is above 38th Street and is an assortment of pipelines wrapped in concrete, protected by gabion weirs, or a combination of the two.

3. (NWB3 @ Pumping Station): 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. (NWB4 @): 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. (NWB5 @ Queenstown): 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.

6. (NWB6 @ Blue Tanks): Approximately 400 feet downstream from the confluence with Sligo Creek, this terminal station (identified as Northwest Branch at the Blue tanks) is located near a PEPCO storage facility. A hiker/biker bridge crosses the stream at this location. This site has a sizeable metal weir and eroded concrete apron. Large amounts of rubble are present in and around the hole at the end of the apron. This is a definite blockage that would not be possible for fish to pass this obstacle under their own power.

This site also occasionally included three small structures that are about 100 to 200 meters downstream from this terminal station which have also been sampled sporadically in the past. They did not appear to be major blockages, but were sampled during the height of the spawning run to insure that possible low-flow blockages were not overlooked.

Northeast Branch:

7) (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.

8. (Paint Branch1 @ 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 Branch2 @ 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. (Paint Branch3 @ Metzerott Rd): This area is downstream from the confluence of Paint Branch with it's major tributary, Little Paint Branch, and includes a long glide that has a high potential as a concentrator of migratory fishes.

11. (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.

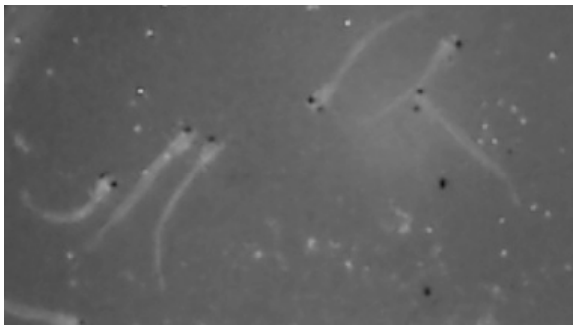
12. (Indian Creek2 @ Greenbelt Road): Downstream from the box culvert crossing.

13. (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.

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

15. (Lower Beaverdam Creek2 @ Landover Road): Immediately below Landover road to downstream of a partial blockage (sewer line) 60 feet below.

Spring 2000 Anacostia Tributary System Herring Reconnaissance and Larval Stocking



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Spring 2000 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. Removal of migratory fish blockages and start of a larval stocking program were priorities set in 1999 by the Anacostia Fish Passage Working Group (AFPWG), working in conjunction with the Potomac Crossing Consultants (PCC). In 2000, the Interstate Commission on the Potomac River Basin (ICPRB), the Metropolitan Washington Council of Governments (MWCOG), and PCC subsequently performed a migratory fish reconnaissance survey and 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. An estimated 2.6 million hatched larvae were subsequently stocked back to the Anacostia River tributaries and Rock Creek, another tributary to the Potomac River.

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 1999 an anadromous fish survey was conducted by ICPRB and MWCOG for PCC to determine the extent of fish migration and evaluate past restoration efforts (1999 Assessment of Migratory Fishes on the Northeast and Northwest Branches of the Anacostia River, PCC, ICPRB, MWCOG, Sept. 1999) . The findings of that study indicated continued efforts were needed to restore fish passage in the Anacostia River tributaries. Important examples of these efforts included the need to repair the fishway on the Northwest Branch at Route 1, and the stocking of river herring into upstream historic spawning ranges in the Anacostia River in order to imprint these migratory species and rebuild the population. In 1999, the AFPWG designated River Herring Larval Stocking Project as a priority. In coordination with AFPWG, PCC agreed to conduct a Spring 2000 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. This report describes the project results.

The objective of the project was to continue restoration of the fisheries in the Anacostia and Rock Creek watersheds through the stocking of larval Alewife (Alosa pseudoharengus) and Blueback Herrings (Alosa aestivalis). The spring 2000 Larval Herring Stocking Project involved two tasks. Under the first task, 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 relative strength of the run, and

- determine which location(s) provide the greatest probability for the collection of broodstock.

Under the second task, herring broodstock collection and restocking was performed to:
- remove eggs from approximately 100 ripe female river herring, fertilize them with milt from an equivalent number of collected male herring, fertilize the eggs in the field,
- transport fertilized eggs to the MDDNR's Manning Fish Hatchery in Cedarville, Maryland for incubation and hatching and
- stock of herring fry into the Northeast and Northwest Branches, Anacostia River and Rock Creek, Potomac River.

Methodology

Task 1. Electrofishing Reconnaissance Survey

Photo 1. Electrofishing the Paint Branch at PB1 Blockage.

An electrofishing reconnaissance survey, as seen in Photo 1, of adult migratory fishes was conducted during the spring 2000 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*). Thirteen stations (shown in 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. Four of these stations were selected for sampling based on their known and/or expected ability to concentrate migrating herring, and were prioritized in the Northwest Branch due to planned concentration of fish passage projects in that watershed. Additional sampling sites were selected to determine their ability to concentrate migrating fish. 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 of two varieties: A Smith-Root Model #EDN-83-TD with 0.25 inch mesh net and a six foot pole, and a wide mouth 2.0 inch mesh net and 4 foot aluminum pole. One of each type of net was used during the sampling event.

The major objectives of each collection trip were to determine the extent and magnitude of upstream 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 was conducted during daylight hours using a Smith-Root backpack electrofisher as described above, and electrofishing times were staggered (i.e. starting at mid-morning to mid-afternoon, at times ending as late as dusk) 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 fishes were counted, measured for length and weight, and sexed for evidence of row or milt. Notes were taken on their general condition, 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, water clarity, 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 threshold. In addition, an overall project target of at least 100 ripe females were estimated necessary to produce 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 and Stocking

Photo 2. Stripping of Herring Eggs

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 surveys and the reconnaissance survey. Collections occurred during daylight hours using electrofishing direct current backpack shockers. Since changing tide and water levels on the Northwest branch at Route 1 make electrofishing capture difficult, a 50 x 4 foot and ¼ inch mesh haul seine was employed to capture broodstock in a sweeping arc across the width of the stream. The use of a haul seine can reduce the stress placed upon the fish compared with the stress on the fish as a result of electrofishing.

During the course of the project it was determined that the seasonal egg collection target (approximately 100 ripe female herring) would not be fully obtained by this method. Therefore, the cooperation of Fletcher's Boathouse in the District of Columbia was enlisted and broodstock were collected at a site on the mainstem Potomac River. In these instances, two 75 foot and one 150 foot long mono-filament gill nets with 2.75-inch stretch mesh were employed for use in capturing fish on the Potomac River. The nets were pulled through the water column until a sufficient number of fish were captured.

Ripe females were collected and stripped of eggs into shaded bowls containing ambient temperature stream water. 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, after which all eggs were transferred to a single darkened container, packaged with supplemental oxygen 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.

Photo 3. Egg incubation at MDDNR hatchery.

In preparation for incubation, the eggs were separated by adding 20 grams of 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 and added to 20 grams of 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 transferred to incubation containers, which are constantly refreshed with cool fresh stream water (Photo 3). Over an approximately 5 to 10 day period, the eggs were incubated and hatched to larvae stage, after which

approximate counts of viable eggs and pre-stock larvae survival rates were determined. The larvae were then transported in covered, black, 5 gallon containers from the hatchery back to the Anacostia and Rock Creek watersheds. The Anacostia watershed stocking locations are shown in Figure 2.

Larval stocking occurred at 5 sites in major tributaries to the Anacostia River:
Indian Creek at Sunnyside Avenue,
Little Paint Branch at Sellman Road,
Paint Branch at Powder Mill Road (MD 212),
Northwest Branch at Riggs Road (MD 212),
Sligo Creek at New Hampshire Avenue (MD 650),
and at one Rock Creek Site:
Rock Creek at Garrett Park Road.

All five Anacostia sites are located well upstream of existing fish blockages and represent what are believed to be 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 4-6 week period (approximately April 14 to May 31), a target of one to two million Alewife and Blueback herring larvae were to be released in batches at the six locations.

Results

Task 1. Reconnaissance Survey

Reconnaissance sampling was initiated on April 4, 2000 and occurred intermittently through May 16, 2000. Results from reconnaissance sampling (Table 1) showed no presence of migratory herring reaching stations on the Northwest Branch Anacostia River above 38th street.

Reconnaissance sampling showed no presence of migratory herring on Indian Creek of the Northeast Branch Anacostia River. Reconnaissance sampling did show migration of herring on Paint Branch of the Northeast Branch, but only up to the concrete dam just upstream from Route 1.

Task 2. Broodstock Collection and Stocking

Broodstock collection containing ripe females occurred from April 11, 2000 through May 12, 2000. A summary of the estimated number of viable eggs and stocked larvae is shown in Table 2. On a few occasions, storm events on previous days resulted in higher flows preventing sampling at some locations. In general, water clarity was good in both the Northwest and Northeast Branches.

By the end of April the collections of herring broodstock on the Northwest and Northeast Branches were producing less than the desired amounts of viable eggs. Therefore, the collection of broodstock was supplemented by fish collected at Fletcher's Boathouse on the mainstem Potomac River. Fletcher's Boathouse has had a long- running collection permit for river herring to be used as bait. Through a cooperative agreement with Fletcher's Boathouse, collections at this site occurred in the early mornings using gillnets and proved successful, producing 40% of the total viable egg harvest and 72% of the final viable larvae stocked.

The Anacostia and Rock Creek watershed-stocking schedule is shown in Table 3. Approximately 2.4 million Alewife and Blueback herring larvae were stocked to five locations located in the Anacostia Watershed.

Approximately 0.2 million herring larvae were stocked at one site in the Rock Creek Watershed. The estimated total of 2.6 million stocked larva exceeded the original projected target stocking numbers of 1-2 million.

Table 3. Year 2000 Anacostia and Rock Creek Watershed Stocking Schedule and total number of viable larvae stocked

Year 2000	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	
04/20/2000		68,137.2				68,137.2		68,137.2
05/01/2000	749,509.2	749,509.2	0.0	374,754.6	374,754.6	2,248,527.6		2,248,527.6
05/09/2000			75,708.0			75,708.0	94,635.0	170,343.0
05/18/2000							104,477.0	104,477.0
Totals	749,509.2	817,646.4	75,708.0	374,754.6	374,754.6	2,392,372.8	199,112.0	2,591,484.8

Shaded area indicates no stocking.

Discussion

As in past years, Alewife herring dominated the herring collections. A significant number of White Perch were also captured on the Northwest Branch, which is consistent with previous years. The capture of one Hickory Shad and four Striped Bass in the Northwest Branch at Route 1 is noteworthy, since these species primarily spawn in the Potomac River mainstem. Hickory Shad were first captured in 1999 in the Northwest Branch. Only one Yellow Perch was captured and represented a smaller number than those collected in previous studies.

Electroshocking reconnaissance of the Northwest Branch showed a strong run up to the fishway at Route 1. In many instances, herring were observed swimming in the channel of the fishway or on the concrete pad just above the fishway and not migrating further upstream. Very few herring were captured at the next upstream fishway at 38th street, and none were captured at the next blockages upstream of 38th street. As was determined from the previous 1999 study, the baffle on the most downstream cell of the Route 1 fishway is still in need of repair, and therefore this fishway is not effectively allowing the herring to run through at all flow velocities.

A comparison of the catch per unit effort (CPUE) at US Route 1 with previous years is shown in Figure 3,

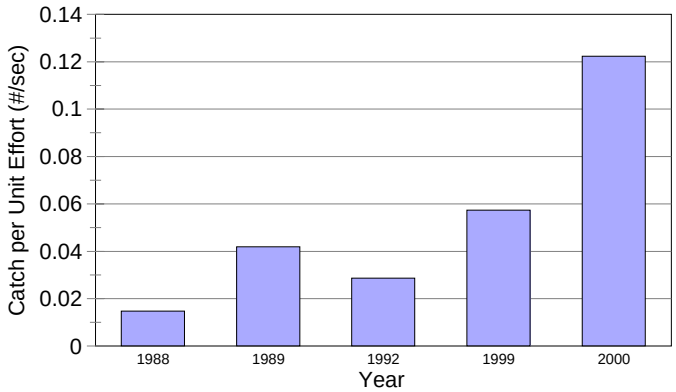


Figure 3. Electrofishing Catch per Unit Effort of River Herring on Northwest Branch at US Route 1.

and indicates an increase in the strength of the herring run. However, the project was not specifically designed to determine CPUE. The larger CPUE in 2000 for this station is complicated by the extended effort that was made to capture as many fish as possible for the collection of broodstock, as well as the use of two netters instead of one to capture stunned fish. A larger and more efficient collection net employed for broodstock capture may also have contributed to this apparent increase. There are inherent conflicts in a study requiring both reconnaissance and capture of a migratory species in the short time span of several weeks, and therefore direct comparisons of 2000 data with previous years data can not be made.

Results of the electroshocking reconnaissance showed that the best locations for collection of herring broodstock in the Anacostia watershed were the Northwest Branch below Route 1 and in the Northeast Branch at the Paint Branch blockage above Route 1. Information gathered from previous studies (Cummins, 1988, 1989) show the current blockage on Paint Branch at Route 1 did not exist. Thus, this structure, a utility line crossing with a concrete cap, is a recent blockage to river herring that may have developed as a result of urban sediment movement.

Initially, electroshocking collections at these locations resulted in a low number of individuals , and few ripe females were captured. It was determined that, when feasible, some collections of broodstock would occur in conjunction with herring collections made by Fletcher's Boathouse on the mainstem Potomac River. This change in collection protocol proved advantageous and provided the largest number of eggs collected at any one sampling event. However, the collection of broodfish by gillnet was performed after the loaded net was brought to shore which resulted in the premature mortality of captured fish. Even though more ripe females were captured using the gillnet, the premature mortality may have reduced the number of females producing viable eggs. Despite this problem, the success in harvesting such a large number females and eggs seems to indicate a need to continue collection efforts at this station in the future.

Overall, collection efforts at all stations using all collection methods resulted in the capture of more than 1700 alewife and blueback herring individuals (total includes 402 alewife herring caught from the Potomac River), with 108 ripe females bearing eggs. As Table 2 shows, pre-stocking survival rate ranged from 50 to 92 percent. 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.

Table 3 shows the herring-stocking schedule to the Anacostia and Rock Creek watersheds. Between April 20th 2000 and May 18th 2000, nearly 2.6 million herring larvae were released, thereby surpassing the stocking targets for this project. This stocking should promote the return of spawning adult herring (in approximately four to five years) to these currently blocked reaches by chemically imprinting these fishes to their historic spawning streams. By that time, 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. As per the AFPWG's restoration priorities, larval stocking was proportional to stream size, habitat quality and expected herring utilization, and the Northwest Branch, including Sligo Creek, received a greater proportion (65%) of stocked fry than other Anacostia streams.

Recommendations

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

1. Repair the fishway at US Route 1 on the Northwest Branch. As determined in 1999, the baffle on the lowest cell of this fishway is in need of repair. While the fishway probably needs to be dewatered before a final determination can be made, it appears that this baffle needs to be brought to a similar relative elevation to the height of the baffles in the other cells.

2. Continue the broodstock collection 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 the their populations.

3. Future broodstock collections in the Anacostia Watershed should employ the use of haul seines.

4. Continue collection of broodstock from the Potomac River through the collaborative arrangement with Fletchers Boat House. These nets should be tended and herring removed as soon as they are captured.

5. The Paint Branch blockage located upstream of Route 1 should be modified to permit fish passage and added to the reconnaissance survey and monitored for river 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.

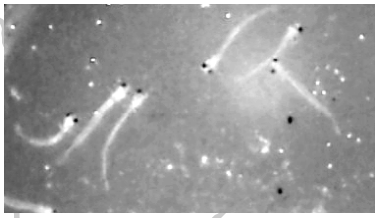
12. (Indian Creek3 @ I-495): at and immediately upstream from I-495 (Washington Beltway) bridge, along a glide where fish tend to congregate. This is the furthest upstream that herring have been found in the recent past (1992). At that time a large beaver dam created a blockage that made monitoring more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

Spring 2001 Anacostia Tributary System River Herring Monitoring/Reconnaissance and Larval Stocking



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Spring 2001 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) resulting from 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 the 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 Work Group (AFPWG), working in conjunction with the Potomac Crossing Consultants (PCC). In 2001, the Interstate Commission on the Potomac River Basin (ICPRB), the Metropolitan Washington Council of Governments (MWCOG), and PCC completed 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 2001, an estimated 2.7 million hatched larval river herring were subsequently released into the Anacostia River tributaries and the Rock Creek mainstem. This brings the two-year project total to 5.3 million larvae stocked.

Project Background and Purpose

During construction of the replacement Woodrow Wilson Bridge, 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 projects 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 the 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. The PCC has worked with AFPWG since 1998 and in 2000 embarked on a larval herring monitoring and restocking program. The 2000 program resulted in the stocking of nearly 2.6 million herring larvae into the Anacostia and Rock Creek watersheds, and recommendations indicated that continued efforts were needed to restore fish passage in the Anacostia River tributaries. In coordination with AFPWG, PCC agreed to conduct a Spring 2001 larval herring stocking program in cooperation with ICPRB, MWCOG, and MDDNR as an out-of-kind option to mitigate for impacts from the Woodrow Wilson Bridge construction. In 2001, the herring monitoring and restocking program continued, returning nearly 2.7 million larval herring to the Anacostia and Rock Creek watersheds. This report describes the 2001 project results the objective of which 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 descriptions are provided later in the text). River herring larvae were also stocked into Rock Creek only when the larval fish stocking quota was reached for the Anacostia watershed. The spring 2001 Larval Herring Stocking Project involved two tasks:

Task 1. 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 relative strength of the river herring run, and
- determine which location(s) provide the best opportunity for broodstock collection.

Task 2. Herring broodstock collection and restocking was performed to:

- remove eggs from approximately 100 or more ripe(e.g., egg bearing) female river herring, fertilize them with milt from an equivalent number of spawning male herring in the field,
- transport fertilized eggs to the MDDNR's Manning Fish Hatchery in Cedarville, Maryland for incubation and hatching, and
- stock larval herring into the five major tributary locations in the Anacostia Watershed.

Methodology

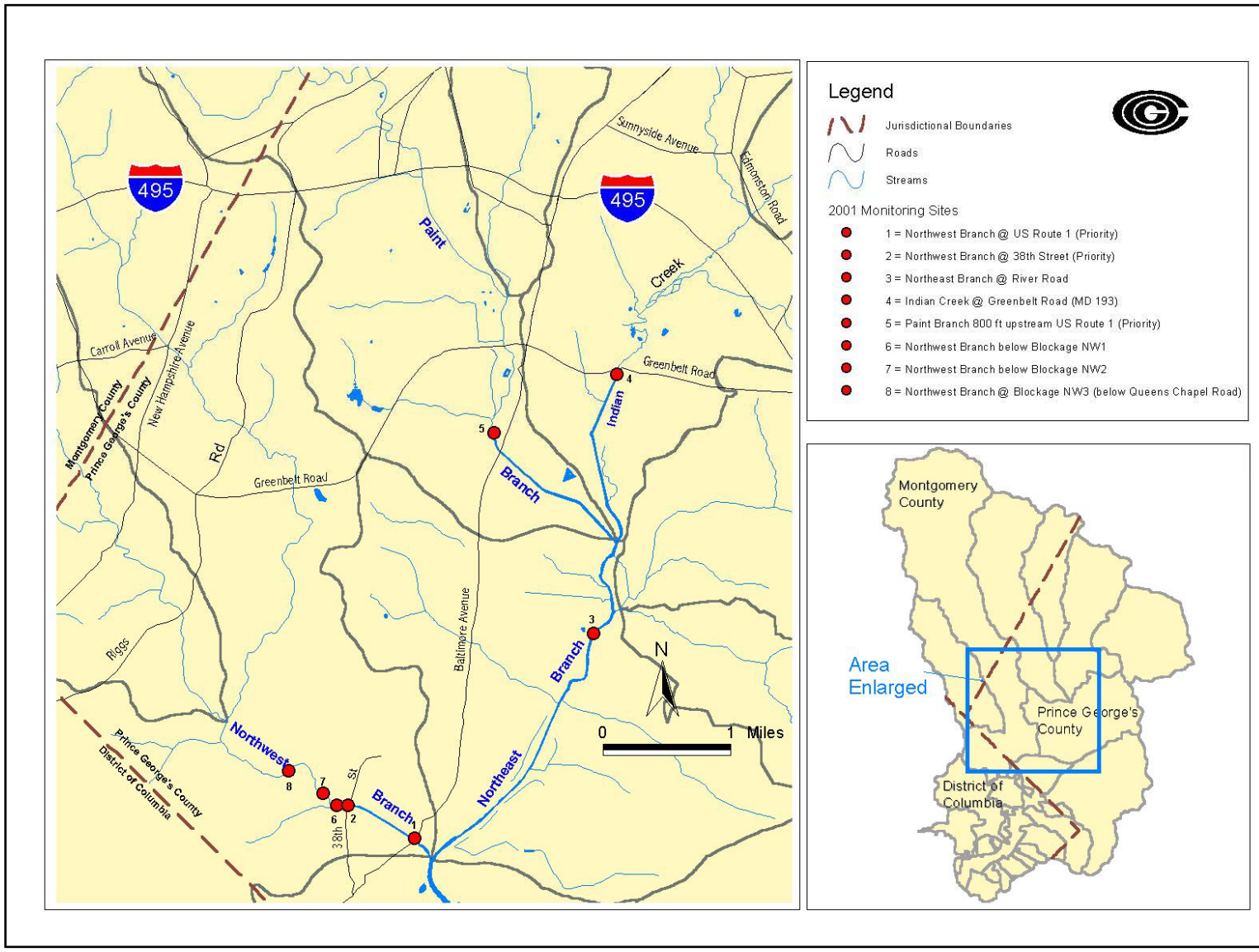
Task 1. Electrofishing Reconnaissance Survey

An electrofishing reconnaissance survey of adult migratory fishes was conducted during the spring 2001 migratory fish runs, which include Alewife Herring (*Alosa pseudoharengus*), Blueback herring (*Alosa aestivalis*), Hickory shad (*Alosa mediocris*), White perch (*Morone americanus*), American eel (*Anquilla rostrata*), and Sea lamprey (*Petromyzon marinus*). Eight stations (Figure) 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. Two Smith-Root Model #EDN-83-TD with 0.25 inch mesh nets were used to capture the stunned fish.

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 fish. At each station, a one pass or "sweep-type" electrofishing survey 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 one or more times per day. Collected migratory fish were counted, weighed, length measured, sexed and examined for evidence of row or milt. Notes were taken on their general condition, dorsal fins were clipped to identify capture location, 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. This information and other was used to determine 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

Figure 1. Spring 2001 Anadromous Fish Reconnaissance and Monitoring Sites



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 stripped was considered 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 and Stocking

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 initially from the results of previous 1999, 2000 and refined to this year's reconnaissance survey. 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 captured fish, compared to the stress on the captured fish as a result of electrofishing.

During the course of the project, an attempt was made to supplement river herring egg collections of the Anacostia watershed with a collection of eggs from the Potomac River. With the cooperation of Fletcher's Boathouse staff in the District of Columbia, broodstock were collected at a site on the mainstem Potomac River. In these instances, collections occurred in pre-dawn hours using two 75 foot and one 150 foot long mono-filament gill nets with 2.75-inch stretch mesh for use in capturing herring. The nets were pulled through the water column until a sufficient number of fish were captured.

Figure 2. Stripping female herring

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 placed in darkened buckets for approximately 45 minutes, then packaged with battery powered aerators at ambient stream temperature, and delivered promptly to the 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 3. Separation and clearing of herring eggs

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 again 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 the approximate number of viable eggs and pre-stock larvae survival rates were determined. The larvae were then transported in covered, black, 5-gallon containers from the hatchery to the five Anacostia stocking sites. The Anacostia stocking locations are shown in Figure 4 and included the following five major Anacostia tributary sites: Indian Creek at Sunnyside Avenue, Little Paint Branch at Sellman Road, Paint Branch at Powder Mill Road (MD 212), Northwest Branch at Riggs Road (MD 212) and Sligo Creek at New Hampshire Avenue (MD 650). Per the stocking priorities established by the AFPWG, Northwest Branch and Sligo Creek mainstems were among the first to be stocked and received the highest total number of stocked fish.

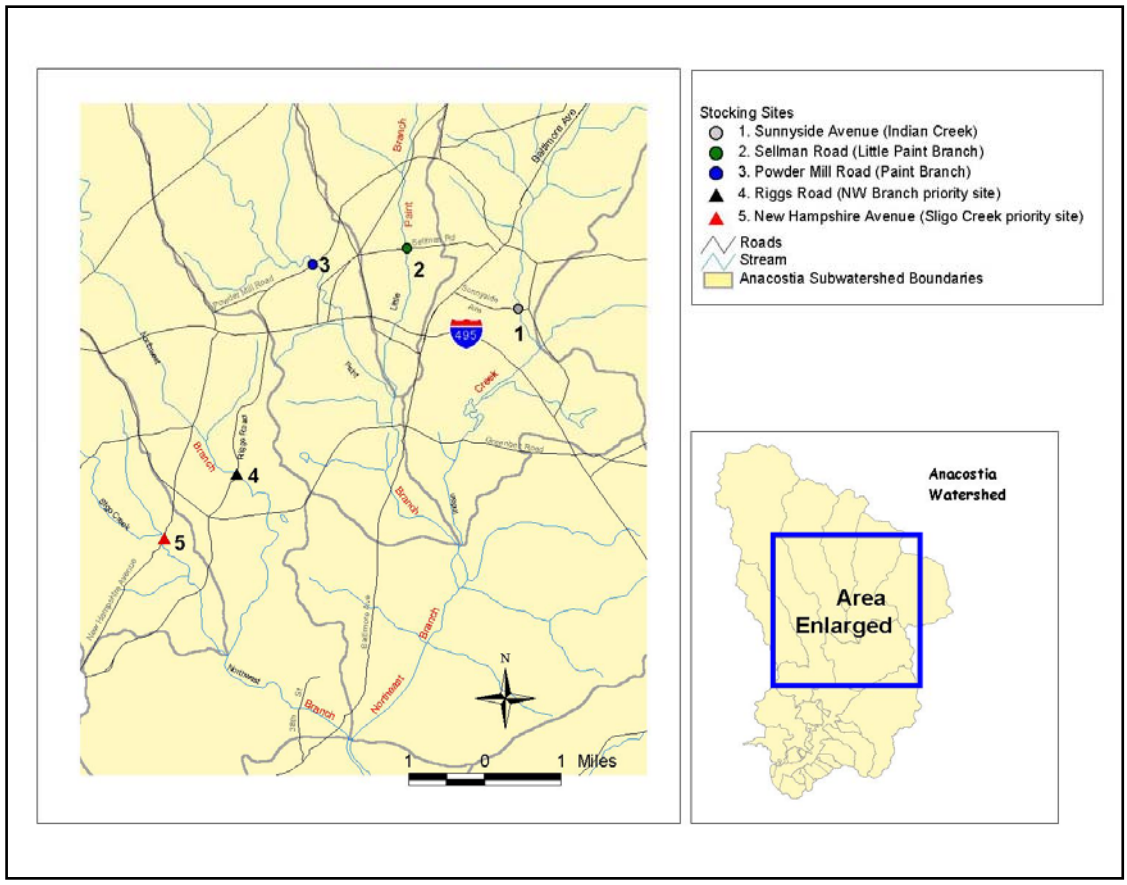


Figure 4. 2001 Stocking Sites

Over a 4-6 week period (approximately April 6 to May 31), a project target of one to two million Alewife and Blueback herring larvae were released in batches at the five locations. All five Anacostia sites are located well upstream of existing fish blockages near what is believed to be the upper historical range of river herring in the Anacostia tributary system. Prior to releasing the larval herring into the stream, the container holding the larvae was first placed into the stream for 5-10 minutes 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). The river herring larvae were then released into a

Figure 5. Release of herring larvae

slow moving portion of riffle habitat 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.

Results

Task 1. Reconnaissance Survey

Reconnaissance sampling in the Northwest Branch of the Anacostia River was initiated on March 22, 2001 and occurred intermittently through May 14, 2001. Results from reconnaissance sampling (Table 1) showed that both Alewife and Blueback herring were migrating up to three (i.e., US Route 1, 38th street and the immediately below the NW1 "pump house" blockage) of the five total stations as documented in the 1999 and 2000 surveys. Presence of river herring was observed in greater numbers and more frequently immediately below the NW1 "pump house" blockage during sampling days in 2001 than previous surveys.

Reconnaissance sampling in the Northeast Branch Anacostia River and its tributaries revealed the absence of migratory herring in Indian Creek. However, it did show large groups of migrating Alewife herring in the Paint Branch on multiple sampling dates (i.e., approximately 300 individuals for sampling date April 9, 2001), but only up to the blockage caused by a concrete utility line approximately 800 feet upstream from US Route 1. Blueback herring were neither collected nor observed at the Northeast Branch sampling sites.

Table 1 lists the migratory anadromous fish species and the total number of each species collected during the reconnaissance survey. A total of 377 river herring were captured via electro-fishing from all the survey sites. Roughly 70 percent of the fish captured from the Northwest Branch sites as a result of the higher number of electrofishing surveys (12) conducted at this sampling site. As stated earlier, this is an established river herring concentrating area where both monitoring and broodstock adult collections regularly occur.

Additional migratory fish species captured in the 2001 survey included three other anadromous fish species. As in the previous two years, Hickory shad (Figure 6) were collected in very low numbers. In contrast, White perch were collected and observed to be abundant throughout the survey area. Absent from this year's survey were Striped bass and Yellow perch. It should be noted that in past years, juvenile Striped bass were collected immediately below the US Route 1 fishway site.

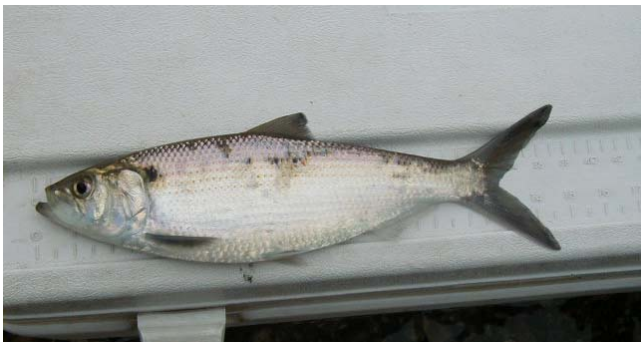


Figure 6. Hickory Shad Captured at Northwest Branch US Route 1

Table 1. Year 2001 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	Sea Lamprey	Alewife Herring	Blueback Herring	Alewife Herring	Blueback Herring	No Anadromous Herring observed		Alewife Herring	Alewife Herring	Blueback Herring	American eel	Sea lamprey	Alewife Herring	Sea Lamprey
2001 Sampling Date																		
3/22	0	0	0	0	0													
3/28	39	0	0	0	0	0	0					15	0	0	0	0		
4/02	7	0	0	0	0	0	0				0	17	0	0	0	0	0	0
4/06	19	0	1	0	0													
4/9	1	0	0	0	0	39	0	25	0	0	0						0	0
4/16	22	0	0	0	0							29	16	0	0	0	0	0
4/20	0	0	1	0	0							6	30	0	0	0		
4/26	66	0	1	ob	0							0	0	0	0	0	0	0
5/3	0	9	0	ob	0													
5/4	1	5	0	ob	1							0						
5/10	0	8	0	ob	1													
5/14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total	155	22	3	ob	2	39	0	25	0	0	0	67	46	0	0	0	0	0

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

In 2001 reconnaissance survey, there were two non-anadromous fish species collected that in prior year's surveys have not been documented. These include the Silverside (*Menidia sp.*) and the Quillback (*Carpiodes cyprinus*) both collected in the Northwest Branch. A young Quillback was also captured at the Paint Branch site.

Figure 7. Silverside (*Menidia sp.*)

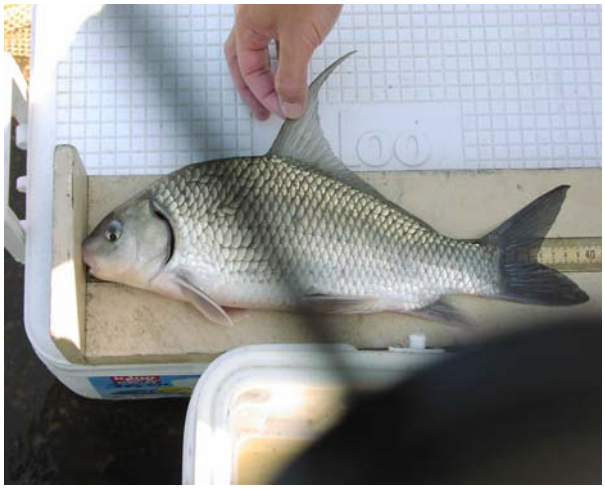


Figure 8. Quillback (*Carpiodes cyprinus*)

Task 2. Broodstock Collection and Stocking

Broodstock collection occurred from April 6, 2001 through May 10, 2001 for a total of 11 days. A summary of the estimated number of viable eggs and stocked larvae is shown in Table 2. A total 219 ripe females was collected (a number more than double the proposed target) and stripped for eggs. The total volume of fertilized eggs was 10.6 liters, representing a 1.6-liter increase over the 2000 total. It should be noted that the 2001 total volume of fertilized eggs were exclusively collected from the Northwest Branch, whereas the 2000's total included supplemental eggs from the Potomac River. In 2001, an attempt was made to supplement Anacostia eggs with Potomac River eggs collected at Fletcher's Boathouse through a cooperative agreement with Fletcher's Boathouse and D.C. Fish and Wildlife program. Collections at this site occurred in the early mornings using gillnets and the harvesting viable eggs at this site proved unsuccessful.

Table 2. Year 2001 Estimated Number of Viable Eggs and Stocked River Herring Larvae

Sample Date	Collection Site[1]	Collection Technique[2]	Number of Ripe Female Herring Stripped of Eggs	Volume of Fertilized[3] River Herring Eggs Collected (L)				Range of Number of Viable Eggs Collected[4]			Volume of Pre–Stock Larva		Estimated No. of Pre-Stock Larva/ml[5]	Estimated Number of Viable Larva Stocked
								Low Range	Median Range	High Range				
				Blueback	Alewife	Total	Viable Eggs				L	Gal		
4/6/01	Northwest Branch @ US Route 1	Seined	56	0.0	2.5	2.5	2.5	1,000,000	2,162,500	3,325,000	63	17	20	1,249,182
4/12/01	Northwest Branch @ US Route 1	Seined	18	0.0	1.5	1.5	1.5	600,000	1,297,500	1,995,000	57	15	20	1,158,332
4/16/01	Northwest Branch @ US Route 1	Seined	4	0.0	<0.2	0.0	0.0	0	0	0	0	0	0	0
4/20/01	Northwest Branch @ US Route 1	Seined	0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
4/21/01	Northwest Branch @ US Route 1	Seined	0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
4/23/01	Northwest Branch @ US Route 1	Seined	22	1.3	<0.2	1.3	1.3	520,000	1,124,500	1,729,000	20	5	1	130,000
4/26/01	Northwest Branch @ US Route 1	Seined	0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
4/27/01	Northwest Branch @ US Route 1	Seined	1	<0.2	0.0	0.0	0.0	0	0	0	0	0	0	0
5/3/01	Northwest Branch @ US Route 1	Seined	36	1.6	0.3	1.9	1.9	740,000	1,600,250	2,460,500	38	10	3	129,030
5/4/01	Northwest Branch @ US Route 1	Seined	1	<0.2	0.0	0.0	0.0	0	0	0	0	0	0	0
5/10/01	Northwest Branch @ US Route 1	Seined	81	3.4	0.0	3.4	3.4	1,340,000	2,897,750	4,455,500	38	10	2	75,708
Totals		-----	219	6.3	4.3	10.6	10.6	4,200,000	9,082,500	13,965,000	---	---	---	2,742,252

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 were not collected for broodstock from the Northeast Branch at River Road (behind the Maryland-National Capital Park and Planning Commission parking lot) due to relatively low abundance of ripe fish.
[2] River herring collection technique employed the following sampling equipment: Model 15-D Smith-Root Backpack Electrofisher, 50 and 25 foot-long seine haul nets.
[3] Generally, three male herrings were used to remove milt for every one female stripped of eggs.
[4] 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.
[5] Estimated number of pre–stock larvae per milliliter were calculated from a 220-ml sub-sample collected from the 5-gallon stocking buckets.

The Anacostia and Rock Creek watershed-stocking schedule is shown in Table 3. Approximately 2.6 million Alewife and Blueback herring larvae were released at five Anacostia locations (Figure 4) with approximately 0.13 million larval herring released into the Rock Creek mainstem near Garret Park in Montgomery County, Maryland. The estimated annual total of 2.7 million stocked larvae exceeded the original projected stocking target range of 1-2 million. The total released for the two-year stocking effort is five million stocked in the Anacostia watershed and 0.33 million into the Rock Creek mainstem.

Table 3. Year 2001 Anacostia and Rock Creek Watershed Stocking Schedule and total number of viable larvae stocked

Year 2001	**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	Sellman Road	Sunnyside Avenue		Garrett Park Road	
4/12/01	378,540	378,540	378,540		113,562	1,249,182		1,249,182
4/16/01	386,111	386,111	386,111			1,158,332		1,158,332
4/30/01				130,000		130,000		130,000
5/10/01							129,030	129,030
5/16/01		75,708				75,708		75,708
Totals	764,651	840,359	764,651	130,000	113,562	**2,613,222**	129,030	**2,742,252**

Shaded area indicates no stocking.

Discussion

As in past years, Alewife herring dominated the herring collections. A significant number of White perch were also captured on the Northwest Branch, which is consistent with previous years. As previously mentioned, neither Yellow perch nor Striped bass were captured in 2001. For the third consecutive year, Hickory shad were captured in the Northwest Branch at US Route 1.

Electroshocking reconnaissance of the Northwest Branch showed a strong run up to the fishway at US Route 1. In many instances, herring were observed swimming in the channel of the fishway or on the concrete pad just above the fishway. Strong runs of herring were observed at the next upstream survey site (38th street), as well as at the first blockage upstream of 38th street (NW1). During the early course of the migratory period, the lowest baffle on the Northwest Branch fishway at US Route 1 was temporarily repaired (Figure 9) as recommended in the 2000 study. This seemed to effectively allow the herring to swim through the fishway at all flow velocities. The success of this repair was evidenced in the large number of herring captured both at 38th street and immediately below the first blockage (NW1) on April 9th (Table 1). Such large numbers of river herring were not observed as early in the migratory periods during past surveys.

Figure 9. Temporary Repair at the Lowest Downstream Baffle on the Northwest Branch fishway at US Route 1

A comparison of the catch per unit effort (CPUE) at US Route 1 with previous years is shown in Figure 10, and indicates an increase in the strength of the herring run. However, the project was not specifically designed to determine CPUE. The larger CPUE in 2000 and 2001 for this station is complicated by the extended effort made to maximize the collection of broodstock, as well as the use of two netters instead of one to capture stunned fish. These are inherent conflicts in a study requiring both reconnaissance and capture of a migratory species in the short time span of several weeks, and therefore a more detailed comparison of 2000 and 2001 data with previous years data cannot be made.

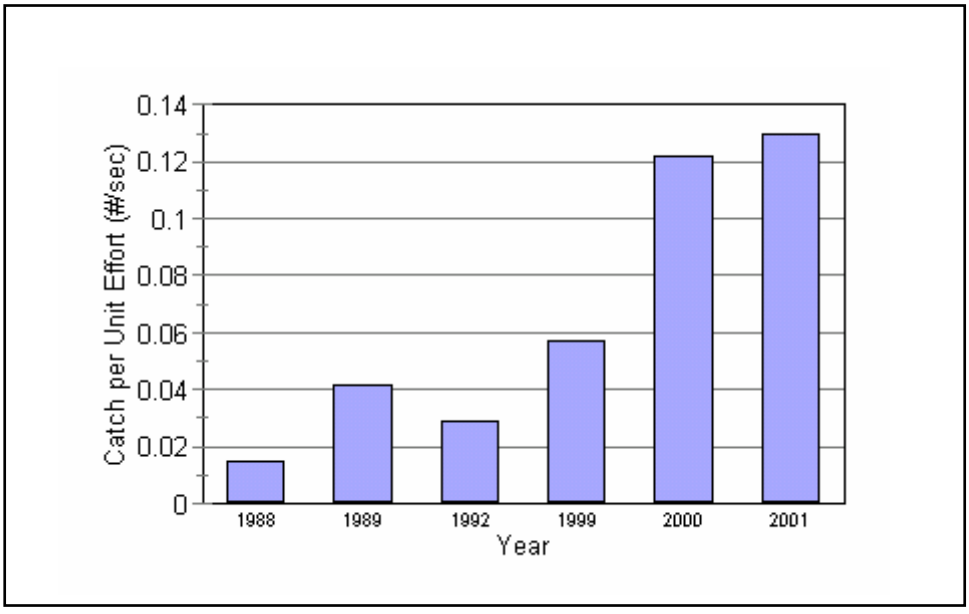


Figure 10. 2001 Electrofishing Catch per Unit Effort of River Herring on Northwest Branch at US Route 1.

The results of the electroshocking reconnaissance showed that the best locations for collection of herring broodstock in the Anacostia watershed were the Northwest Branch below US Route 1 and in the Northeast Branch at the Paint Branch blockage above US Route 1. The blockage on Paint Branch above US Route 1 was first discovered in 2000. This structure is a utility line crossing with a concrete cap, which developed into a fish blockage as a result of urban sediment movement and channel downcutting. It remains a blockage to river herring migration.

In the 2000 study, broodstock collections using gillnets in the mainstem Potomac River at Fletcher's Boathouse proved highly successful and provided large numbers of viable eggs. In 2001, attempts were made to duplicate this success and to supplement collections from the Anacostia watershed. Unfortunately, in 2001, too few ripe females were collected, and no viable eggs were produced from this site. Future attempts of broodstock collections may still occur at this site since past success showed much promise.

Overall, the broodstock collection efforts at all stations resulted in the capture of more than 2000 Alewife and Blueback herring including 219 ripe females. Such collections on the Northwest Branch at US Route 1 using haul seines proved successful and yielded ample spawning herring with the least amount of collection effort while reducing the amount of stress among captured fish. While every effort was made to minimize egg mortality, some mortality is inherent in the "field strip/spawn" technique. This may be due to several factors, such as variations in sunlight, water temperature, oxygen saturation and time allowed for fertilization or transport. Larval mortality can also result from such factors as limited food supply in hatchery holding tanks, the exchange of larvae from holding tank to the stocking containers and transport time.

As stated earlier, for the past two years approximately 5.3 million larval river herring have been reared under the larval stocking program. Five million of those have been stocked into the major tributaries of the Anacostia watershed with the remainder stocked into the Rock Creek mainstem. This number easily surpasses the two-year stocking target range of 2 to 4 million. According to the AFPWG's restoration priorities, larval stocking was proportional to stream needs, size, habitat quality and expected herring utilization. As a result, the Northwest Branch, including Sligo Creek, received a greater proportion (>60%) of the total stocked river herring larvae for the Anacostia watershed than the other three stocking sites combined in each of the past two years.

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

Recommendations

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

1. Continue the broodstock collection and stocking of river herring larvae into the upper reaches of the Anacostia Watershed to continue the restoration of these fish to historic spawning ranges and to rebuild their population sizes.

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

3. Attempts should be made to continue collection of broodstock from the Potomac River through the collaborative arrangement with Fletchers Boathouse.

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

5. Work with the respective agencies (USACE, and M-NCPPC) and local government (Prince George's County) to install a "No Fishing" sign at the Northwest Branch US route 1 USACE fishway site.

6. If possible, preparations are needed to begin checking for hatchery marks on returning herring.

Appendix A: Sampling Sites

The following are descriptions of all known sampling sites for migratory anadromous fish. 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. 2001 sampling station locations are shown in Figure 1, Page 3

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.