AMERICAN SHAD RESTORATION
POTOMAC RIVER:
YEAR 2000
STOCKING EFFORT
ASSISTANCE TO SCHOOLS-IN-SCHOOLS
MONITORING

By

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Living Resources Section

Conducted in cooperation with:

U.S. Fish & Wildlife Service

Chesapeake Bay Foundation

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Acknowledgments

Since this project started in 1995 it has been the fortunate recipient of a significant amount of volunteer help. The following individuals assisted the project in 2000, they worked into the late hours of night, in all kinds of weather, and deserve special praise. This list also includes a few who were scheduled but missed due to weather and other cancellations:

> Sandy Burk, Pamela Rowe, Janet Norman, Monica Noble, Steve Sarri, John Karwoski, Derek Orner, Melanie Fields, Kevin Luebke, Dana and Diana Mueller, Walter Rissmeyer, Phyllis and Sam Frucht, Ilene Braddock, Phil Bangert, Steve Funderburk, Roger Ballentine, Sandi Geddis, Yuji Ujihashi, Andrew McDonald and Steve Pugh.

Steve Smith of the US Geological Survey, Reston and Ed Enamait, of the Maryland Department of Natural Resources provided important agency support to the project's monitoring for migratory fishes at Mather Gorge, Great Falls. Mike Hendricks of the Pennsylvania Fish and Boat Commission was again extremely valuable in the analysis of the American shad otoliths and scales. Similarly, recognition extends to staff at the National Park Service's George Washington Memorial Parkway, Great Falls Park and Chesapeake and Ohio National Historic Park for their assistance with various aspects of this project, including access and safety.

For the fifth year, much appreciation goes to the Chesapeake Bay Foundation, and in particular Jamie Baxter, for the Schools-in-Schools program conducted in conjunction with this project.

Funding Support

In 2000 this project received funding support from the Virginia Chesapeake Bay Restoration Fund, the National Fish and Wildlife Foundation, and the US Army Corps of Engineers and the U.S. Fish & Wildlife Service. Since the project began in 1995 it has been supported by a number of collaborating agencies and organizations including the US EPA's Chesapeake Bay Program, the Chesapeake Bay Trust, the Potomac River Fisheries Commission, Maryland's Department of Natural Resources, and private donations from members of the Congressional Sportsmens Caucus.

REPORT ON THE POTOMAC RIVER YEAR 2000 SHAD RESTORATION PROJECT

Interstate Commission on the Potomac River Basin
January 12, 2001

Project Summary

This project is part of an effort by a coalition of federal, state, regional and local agencies and nonprofit groups, organized as a Task Force[1], to open historic spawning and nursery habitat for native and anadromous fishes in the Potomac River. The American shad stocking project, now in its sixth year of an anticipated eight year stocking program[2], is designed to imprint shad to the historic spawning and nursery waters and to help rebuild Potomac River shad stocks. While one million stocked shad fry is the annual goal, approximately 3.2 million shad fry were stocked into the Potomac River in 2000 bringing the six year total for this project to over 10.7 million. The project incorporated the help of twenty volunteers during the Spring collections of adult shad. The Schools-in-Schools partnership with the Chesapeake Bay Foundation was again successful with 15 schools and hundreds of students participating. Through the student efforts and additional 30,000 fry were estimated to have been released.

The ICPRB also works with the USFWS to monitor the progress of the project. Springtime monitoring of the Little Falls fishway was performed by boat-electrofishing at Mather Gorge, an area approximately one mile downstream from Great Falls. Three American shad were collected, no other migratory fishes were captured. Summer and Fall monitoring for young-of-the-year (YOY) American shad was also conducted in the tidal freshwater Potomac River. Night-time push net surveys were conducted at nine stations between Chain Bridge and Ft. Belvoir. One hundred and eleven YOY American shad were collected, eleven of these had hatchery marks.

Background

An important milestone for this project was accomplished this past January (2000) with the completion of the fishway at the Little Falls (Brookmont) Dam by the US Army Corps of Engineers (See Appendix I, US ACE Press Release, 2/4/2000). However, the fishway alone is not all that is required. Migratory fishes have been excluded from the ten mile area from Little Falls upstream to Great Falls for over fifty years and they need to be re-imprinted to that area to

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[1]Members of the Little Falls Fish Passage Task Force come from Virginia, Maryland, the District of Columbia, the Interstate Commission on the Potomac River Basin, the Potomac River Fisheries Commission, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the National Biological Survey, the U.S. Environmental Protection Agency, the National Park Service, the National Marine Fisheries Service, Montgomery County, Maryland, the Chesapeake Bay Foundation, and The Potomac Conservancy.

2The Fish and Wildlife Service's document entitled *A Strategic Plan for the Restoration of American Shad to the Potomac River Upstream of Little Falls Dam* (Odom, 1995), endorsed and adopted by the Little Falls Task Force, recommended that up to 8 years of a stocking effort for American shad will be necessary to sufficiently augment and imprint the Potomac River's stocks.

help them return and use it. American shad stocks in particular have remained depressed in the Potomac River despite significant improvements in water quality made over the last several decades and a river harvest moratorium that has been in effect since 1982. The American shad stocking program is designed to both help restore shad by imprinting them to their historic spawning waters upstream of the dam and augment Potomac and Chesapeake Bay shad stocks.

The project has also sought and received voluntary help from a wide range of citizens and has incorporated local schools in the effort. In cooperation with the Chesapeake Bay Foundation, hundreds of students and their teachers help collect the adult shad for propagation and then raise shad fry in the classroom for later release in the Potomac. This educational "fry stocking fry" component is very important. Student activities included field trips aboard the CBF research vessel, *Susquehanna,* to the Potomac to learn about the ecology of the river and to see the American shad collections/egg stripping first hand.

2000 Activities

A. Stocking Effort: The major activity conducted was the continuation of the Task Force's planned eight year American shad stocking program. Adult American shad were captured with the assistance of Virginia waterman Marvin Lewis Harley and many volunteers and school groups for the purpose of supplying fertilized shad eggs to the USFWS's Harrison Lake National Fish Hatchery. In total, 757 American shad were captured (See Table 1). These fish yielded over 6.4 million fertilized eggs. From these, **approximately 3.2 million shad fry were stocked into the river in 2000. That brings the six year total for this project to over 10.7 million American shad fry being stocked into the Potomac River (See Appendix II).**

Table 1: Number of American Shad Captured and Eggs Produced in 2000

Date[1]	4/19	4/25	4/26	4/27	5/01	5/02	5/03	5/04	5/08	5/09	5/17	Total
Ripe Females	28	16	31	25	20	23	35	23	12	26	25	373
Green Females	21	4	9	3	6	9	10	4	8	14	7	93
Spent Females						2	3	2	1		1	9
Males	24	24	24	18	17	36	22	21	30	33	33	282
Liters of Eggs[2]	14.7	16.5	26.9	16	14.5	18.5	21.3	12.6	9.2	8.7[3]	9.7	159.9
Egg #s x 1000	551	563	896	609	585	602	904	496	522		654	6,383
Water Temp.	14	11	11	12		16			25	25	24	
Tidal Stage & Time	H8.5	L7.5	L8.5	L9	H5.5	H6.5	H8	H9	L6.5	L7.5	H8	

3,176,000 fry were stocked (50% survival, w/ good survival most of season)

[1] Seven collection events; 4/17, 4/18, 4/20, 4/24, 5/5, 5/10, and 5/11 were cancelled at the landing due to bad weather, equipment problems, etc.

[2]Liter volumes are as measured in the field (eggs continue to enlarge after field packaging). The "Total" liter measurement is from Harrison Lake National Fish Hatchery records.

[3] Harrison Lake National Fish Hatchery reported that this batch had a 95% mortality and was discarded.

Details of the brood stock collection methodologies can be found in Appendix III. Collection activities were as follows: The period of collections was between April 17 to May 17. Eleven collections were made. Ten of these collections also included scheduled rendevous with the Chesapeake Bay Foundation's (CBF) research vessel, *Susquehanna,* as part of student involvement in the project and this assistance component is described in Section B of this report. An additional seven collection events were cancelled at the launch site, Hallowing Point, Virginia, due to weather and/or river conditions.

Collections were made along edge of the Potomac River mainstem channel between Marshall Hall and Gunston Cove in the Ft. Belvoir area. Twenty volunteers helped collect the adult shad. Two drifting gill nets, approximately 91 meters (300 feet) long, 5.5 meters (18 feet) deep, with 14 centimeter (5 ½") stretch mesh were sequentially deployed, and fished together along the Virginia side of the channel. The nets were continuously tended. The nets were fished at evening slack-water, at either the high or low tidal shift, which resulted in a duration of approximately two hours. Fishing was performed roughly between 4:00 p.m. to midnight, depending on the tide.

The catch-per-unit-effort (CPUE) was calculated as 757 total fish/(11 collection events)(2 nets set) which equals 34.4 shad/net-set. The six-year average CPUE is 17.4 shad/net-set, and 2000 had the strongest CPUE of the six year program. From the 757 shad captured, 373 ripe females produced 6,383,000 eggs, which equals 17,100 eggs/ripe-female. The 757 shad captured produced 3,176,000 fry which equals approximately 4200 fry/shad-captured. If 1 in 373 (.26%) return[3], the 2000 stocking should yield an estimated 8,500 shad returning, or about 11 shad returning for each shad collected.

B. Assistance to the Schools: For the fifth year in a row the Interstate Commission on the Potomac River Basin (ICPRB) worked together with the Chesapeake Bay Foundation (CBF) "Schools-in-Schools" program and the USFWS Harrison Lake Fish Hatchery to incorporate schools in the raising of shad in the class room for release into the Potomac. Fifteen schools participated (See Appendix IV for a listing of these schools). Student activities included field trips aboard the CBF research vessel, *Susquehanna,* on the Potomac to learn about the ecology of the river and to see the shad collections/egg stripping first hand. Each school subsequently raised about 2000 shad fry in each of their classrooms for release in the Potomac River near Great Falls. Therefore an estimated 30,000 additional American shad fry were stocked into the Potomac River by the Schools-in-Schools project. Students take what they learn during the river trips and in their classrooms raising shad and use their experiences throughout the year, and longer. The project is seen as an excellent way to enhance their learning environment. For example, the students use math to calculate estimates of the number of eggs and fry in their tanks, they learn and apply water chemistry as necessary to keep the young shad alive, they write about the project and even construct web pages on the project. Almost all tell their fellow students what is going on, some make presentations to other classes. A notable public speaking engagement was provided for one student at the October 12, 1999, dedication ceremony for the fishway. Ben

[3]Based on monitoring data from the Conowingo Dam fish lifts (Hendricks 1998) which found that it takes 373 hatchery fry stocked in the Susquehanna River to get one returning adult shad.

Symons, a 5th Grader from Westbrook Elementary School, Montgomery County, Maryland, was at the head table giving supporting remarks along with Secretary of Interior Bruce Babbitt, Md. Senator Paul Sarbanes, Md. Gov. Parris Glendening, Congresswoman Connie Morella, USCOE Brigadier General Stephen Rhoades and Col. Bruce Berwick. Ben Symons and other Westbrook students at the ceremony were stellar representatives of the hundreds of students from the fourteen other schools involved in rearing shad that could not attend due to space constraints. In 2000, Westbrook Elementary School teacher Sandi Geddes received a Maryland Association of Science Teachers Award for Excellence in Science Education for her involvement in this project. The student's enthusiasm for the project is very strong and inspirational.

The student component was not without problems. An unusual heat wave of early May played some havoc on the water temperatures of the school's rearing tanks. This heat wave was especially difficult because it came on a weekend, when the schools air conditioning systems were not prepared and working, and the students and teachers were hard pressed to maintain the rearing tank temperatures. Most where able to battle the temperatures by adding extra frozen water bottles to the tanks and keep their shad fry alive. This episode also served as a good example, as they learned that in science, like all things, plans do not go perfectly, but we learn through the problem solving process.

C. Monitoring:

1. Young of the Year (YOY) American shad: The ICPRB also assists the US Fish and Wildlife Service (USFWS) in monitoring for YOY American shad in the Potomac River to help assess fish passage effectiveness and potential stock recovery. A 4' wide x 3' deep bow mounted pushnet (1/4" mesh) is used to sample nine stations in the tidal river between Chain Bridge and Fort Belvoir. Sampling is performed at night, from 9:30 p.m. to 1or 2:00 a.m. Collections in 2000 occurred over the course of three independent, two-night, monitoring events; July 20-21, 26-27 and August 2-3. One hundred and eleven YOY shad were collected, compared to twelve in 1999 (a severe drought year), and one hundred and forty eight in 1998. Eight of the YOY collected in 2000 had hatchery marks; four captured near Fletchers Boat House, two from near Three Sisters Island, one from Key Bridge and one from near Roosevelt Island. In addition to assessing the stocking program, this information may eventually permit the development of a fishery independent method to determine YOY year-class strength using the push net surveys. The relationship to YOY year-class strength and returning adult year class strength is poorly understood at this time.

2. Adults: Springtime monitoring of the Little Falls fishway was conducted through boat-electrofishing at Mather Gorge. The USFWS, the Maryland Department of Natural Resources (MD DNR) Fisheries Program, and the US Geological Survey (USGS) all contributed significantly to this effort, both in personnel and the use of equipment. Monitoring was conducted approximately twice weekly, weather and flow permitting, from April 10 to May 8. Monitoring was scheduled to go into late May, but was discontinued after May 8 for several reasons: 1) the boat ramp at Mather Gorge became un-usable due to low flow conditions and 2) water temperatures rose 20 degrees over a two day period because of an unusual hot spell which effectively shut down spawning activity for the migratory fishes. Three American shad were collected, no other migratory fishes were captured.

The American shad spawning run was one of the best in decades and it is somewhat perplexing that more shad as well as other migratory fishes were not captured at Mather Gorge. Indeed, it is a goal of the restoration effort to bring a return to the conditions described in turn-of-the-19th century. The US Fish Commission reported that striped bass, white perch and American shad ascended up to Great Falls, where shad "numbers are taken by means of long-handled dip-nets (Smith and Bean, 1898)." A report by the prestigious Washington Biological Society of Washington (McAtee and Weed, 1915) stated that "this portion of the river (Little Falls to Great Falls) is strongly characterized by the distribution of anadromous fishes." While three is not great "numbers" it is not zero either, and should be considered encouraging. It probably will take a while for fish to return to a long restricted area, and population pressure is not yet a strong influence to force emigration back into the area. Although, statistically rigorous stock comparisons are not available at this time, at least for the Potomac River if not the entire coast, almost all migratory stocks, while showing progress towards recovery, are still well below historic (turn of the 19th century) levels. American shad, in particular, are probably only about 10%, or even less, of their historic average abundance.

In addition, there are many inherent difficulties in monitoring between Little Falls and Great Falls, the most significant being access and safety. Mather Gorge is the current focus of our monitoring effort because it is the only location in that section of the river with a boat ramp that can effectively handle an electrofishing boat. Unfortunately, Mather Gorge is not a good fish holding area because it has high energy with few resting areas. Therefore, the three American shad captured this year may not adequately represent the numbers and types of migratory fishes using the area upstream of Little Falls. Conversely, the base of Great Falls may be holding more fish, but it is not accessible to the electrofishing boat. The recommendation is to consider additional methods including gill netting or a return to long-handled dip nets such as those used in years past. At this time, no other alternative methods are seen as practical, cost effective and compatible with the National Park settings.

Boat access to the Little Falls dam pool would also be very helpful but not feasible at this time. The best location for a boat ramp and for possible observations of the new fishpassage would be on the Virginia side. Unfortunately, the 1954 deed regarding the access road to the US property on the Virginia side of the dam may not be a strong enough legal instrument to exercise such a purpose according to interpretations by the US Army Corps of Engineers' Real Estate Division.

3. Analysis of Adult shad otoliths and scales: Analysis of the adult shad for evidence of hatchery (tetracycline) marks was completed by Mike Hendricks of the Pennsylvania Fish and Boat Commission and much of this section comes from his data and personal communications with him. In all, one hundred and forty otoliths were processed. Four (2.7%) exhibited a single mark, day 5 or 6, and all were five year old fish, indicating hatchery fish stocked in the Potomac River in 1995. These four came from a group of thirty five fish collected about a mile downstream of the fishway at Little Falls, near Fletcher's Boat House in the District of Columbia. Therefore, 11.4% of the adult American shad collected from this area were found to be of hatchery origin. One of the two adult shad collected from above the dam at Great Falls (a third fish remains unaccounted for) exhibited a triple mark, days 3,13,17 or 3,9,12, although the increments were so close together that they had difficulty discriminating them accurately. This shad was age 4 based on otolith and scale age. Based on the mark and the age, it was likely one

of 561,000 larvae stocked in the West Branch Susquehanna in 1996. There is also a slight possibility that this fish was one of 1,989,000 larvae stocked in the Potomac in 1996, for in that year the Potomac's marking sequence was day 3,9 and some tagging anomalies do occur. None of the shad collected near Fort Belvoir were found to have hatchery marks. There was a high percentage (42.9%) of repeat spawners in this group. Mike Hendriks reported that the scale samples were in excellent condition.

D. Outreach: Media coverage of the project included a 8/9/00 NBC (Washington Channel 4) report by Doug McKelway and the Potomac Basin *Reporter* May-June 2000 newsletter article entitled "Project Continues to Add Shad in Potomac." A copy of this article is attached in Appendix V.

Appendix I:
US Army Corps of Engineers' News Release for 2/4/00

Appendix II:

Summary of the Number of American Shad Captured, Eggs Collected, Fry Released, and Catch-Per-Unit-Effort (CPUE) for Project Period 1995-2000, Including Estimates of Shad Returns

Prepared by: Jim Cummins
Interstate Commission on the Potomac River Basin

Year	1995	1996	1997	1998	1999	2000	Totals
# Ripe females	135	166	245	105	119	373	1143
# Green (unripe) Females	78	51	92	50	44	93	408
# Spent (post-spawn) Females	3	1	0	8	10	9	31
# Males	78	157	207	153	116	282	993
# Total Shad	294	375	544	316	289	757	**2575**
# Eggs Collected x 1000	2,405	4,353	5,744	2,626	2,594	6,383	24,105
# Collections/# nets set	11/22	11/22	12/24	14/28	15/30	11/22	74/148
CPUE (# Shad[4]/net-set)	**13.4**	**17.0**	**22.7**	**11.3**	**9.6**	**34.4**	**17.4**
# Eggs/Ripe-female	17,800	26,200	23,400	25,000	24,400	17,100	21,100
# Fry Stocked x 1000	**1,175**	**1,989**	**1,535**	**1,589**	**1,304**	**3,176**	**10,768**
# Fry Stocked / Each Shad Captured	4000	5300	2800	5000	4500	4200	**4200**
Estimated # of Shad Returning[5]	3,200	5300	4,100	4,300	3,500	8,500	**28,900**
Est. # Shad Returning / Each Shad Captured	11	14	8	14	12	11	**12[6]**

[4]CPUE is based upon numbers of shad actually kept for collection of eggs. It does not include green or spent females and surplus males which were released.

[5]Based on monitoring data from the Conowingo Dam fish lifts (Hendricks 1998) which found that it takes 373 hatchery fry stocked in the Susquehanna River to get one returning adult shad.

[6]Approximately 240 shad are needed to stock 1 million shad fry (with 2700 estimated to return).

Appendix III:
Description of the Techniques Employed to Capture Adult American Shad Brood Stock and the Process of Preparing Fertilized Eggs For Delivery to the U.S. Fish and Wildlife Service's Harrison Lake National Fish Hatchery
1995-2000

Acknowledgments

The fishing techniques herein described have been very successful for this project, providing an efficient, cost effective way of collecting the necessary brood stock. While the basic steps described are fairly straight forward, fishing them is a skill and art that takes many years to master. A great deal of gratitude is deserved by Mr. Marvin "Lewis" Harley, the Virginia waterman assisting the project. His contributions have gone well beyond his contracted time and materials. His knowledge of the river and the methods used to capture fish have been invaluable. His skills, desire to help bring these fish back to recovery, and polite and gentlemanly demeanor have never failed to elicited admiration from myself, the volunteers, the students and teachers, and all involved in the project.

The drift net technique employed followed the traditional commercial fishing methods used in the Potomac River for many generations. While new monofilament nets were purchased and used, the project was very fortunate to also have been provided with donated cotton nets that were the traditional gear used on the river. Many of the nets were Mr. Harley's. The nets hadn't been fished since the fishery was closed in 1982. They were carefully boxed and stored by watermen who, like Mr. Harley, take much pride in their work. These nets are hand-rigged, and for all purposes identical. However, each waterman had their own unique and subtle ways of rigging and storing them. One set of nets was donated by the widow of waterman Herman Shepard. When I was deploying his nets from the burlap bags I was undoing what he had carefully done twenty years previous. As the net uncoiled, I detected a faint smell of the river gathered up so long ago, and as the net passed through my hands and fell into the water to form the line of old cork floats, bobbing once again, I was blessed with a fleeting presence of this man and image of his labor.

Methods

At mid-afternoon to early evening crew, usually the author and Mr. Harley, and any volunteers would gather at Mr. Harley's home on Hallowing Point, Virginia. Nets and gear would be loaded on board his boat (a 21 foot Carolina skiff) at the Hallowing Point Estate's landing near his home and we would motor upstream, checking the condition of the tide by observing the effects of the current on the several navigational buoys we passed on the way. Collections were made along the Potomac River mainstem between Marshall Hall and Gunston Cove in the Ft. Belvoir area.

Two drifting gill nets, sequentially deployed, were fished together along the Virginia side of the channel. The nets were approximately 91 meters (300 feet) long, 7 meters (23 feet) deep, 14 centimeter (5 ½") stretch mesh, made of either #69 twine cotton or monofilament, with top line suspended below the surface approximately 1.5 meters (5 feet) from floating 16 centimeter (6 inch) diameter corks rigged about every 4.5 meters (15 feet). The bottom line was very lightly weighted, rigged with 16 centimeter (6 inch) diameter 9 gauge galvanized metal rings set about 4.8 meters (16 feet) apart. A ring is rigged below each cork, the difference in spacing between

the corks and rings is done because the bottom line is a little longer than the top line to help provide the necessary slack in the nets. The nets were fished at evening slack-water, at either the high or low tidal shift, for a duration of approximately two hours and continuously tended as described in the following paragraph. Fishing was performed roughly between 4:00 p.m. to midnight, depending on the tide, with the best "fishing tides" being near dusk and with a full moon. It is imperative that collections are made during slack tides because otherwise the currents in the Potomac River would be too strong for the nets to fish properly, they should hang loosely, and they would drift considerable distances (miles), subjecting them to snags, potential damage and loss.

The nets were tended, i.e., the nets were allowed to drift but when the bobbing of corks indicated that fish had become entangled in the net, that section of the net was lifted, fish were removed from the net, and the section of net was dropped and allowed to keep fishing. At the end of the drift, the net was taken up, starting at one end, and all fish were removed and the net put in a large bucket or tub. It was typical during most collections to have some by-catch, principally gizzard shad and channel and blue catfishes, but also longnose gar and rockfish. Care was taken to release by-catch alive. Captured shad were examined as brought on board for sex and maturity. Male or "buck shad" and females which appeared ripe, "roe shad," were kept alive on board the boat in a 100 gallon oval stock tank. The tank had a submerged bilge pump, modified with a large intake filter, that re-circulated and aerated the water while providing current which helped the shad orient correctly in the tank. Typically any female shad that did not have roe running from them, termed "green shad," were released back into the river. Some of the green shad that were kept were also the result of false positive decisions, i.e., they appeared as running ripe females when captured and were therefore kept but at stripping they only produced a few eggs. Unfortunately, American shad do not handle well and all fish placed in the holding tank succumb to stress. Therefore, in some cases due to their condition, these green fish were also not released.

When enough shad were collected, at least 6 females and a similar number of males, the fish were quickly taken to the north (upstream) side of Ft. Belvoir and transferred to shore for stripping. Shad were transferred to 50 gallon containers of river water at the shoreline, bucks and roes going to separate containers to increase efficiency during stripping. This Fort Belvoir site is very handy because it is in close proximity to the channel edge where we drift the nets. Indeed, it is the closest that the main river channel comes to the Virginia shoreline downstream from Alexandria. Therefore it takes only a little time to transfer the fish, and personnel would remain behind to strip the eggs while the waterman and crew would return to finish fishing the drifting nets.

On the shore of Fort Belvoir the eggs were stripped into a large stainless steel bowl. When the stripping of a batch of roe shad was complete, generally 4-6 fish, milt was stripped from a similar number of bucks onto the top of the eggs. Care must be taken to minimize contamination from scales, blood and especially feces, the latter being removed when necessary from the eggs with turkey basters. Eggs and milt were then slightly mixed together with a quick but gently stirring by a wet hand and fingers. A large feather, often a turkey feather, has traditionally been used to stir the mixture. However, the wet hand and fingers method has not appeared to increase egg mortality and has worked just as well. River water was then added to the bowl to activate the sperm and the bowl was set aside, out of direct light, for approximately 5 minutes, during which fertilization is completed. During this time the eggs settle to the bottom of the bowl due to gravity. The mixture then undergoes a process of repeated rinsing and decanting to help clean

the eggs to remove scales, mucous, clumps of unripe eggs, blood, etc which tend to gather on the top layer of the bowl. After 4-6 of these decanting/rinsing , the fertilized eggs were transferred to a floating egg box. During this transfer another important egg cleaning step is performed by pouring the eggs into a large kitchen colander held over the egg box, through which the diameter of the colander's holes allow the eggs to pass but restricting the remaining mucous, blood clots and fish scales from entering the floating egg box and contaminating the eggs. The eggs must then water harden for at least one hour before they are ready to move. Thus after the final batch of eggs were stripped, fertilized and cleaned, there was an hour of time that must be left for the eggs to harden. During this hour the fish that were used that evening were weighed and measured for fork and maximum total length. Additionally, over the course of the collecting period, subsets of what eventually totaled one-hundred heads were also collected and prepared during this hour for later otolith aging and OTC tag research. Fish tissue samples were also collected as part of the Fish and Wildlife Service's standard procedure to investigate wild fish health.

When all the fertilized eggs had sufficient time to harden and gear was assembled we returned to the landing at Hallowing Point. At this time the eggs were prepared for shipping to the USFWS hatchery. This required putting the eggs in plastic bags, 4 liters of eggs to the bag, adding an equal volume water and then and equal volume of pure oxygen, double bagging and sealing them to be water and airtight, labeling the bag for date and river, and boxing them in sealed styrofoam boxes. Eggs are driven to Fredericksburg, Va where they are delivered to USFWS personnel for further transport to the hatchery. Typical transfer times where midnight to 3:00 a.m.. The next morning the equipment was cleaned, nets are straightened, and necessary repairs to either were made for the next collection. Weather permitting, the process began again that afternoon.

Appendix IV:
List of Schools-in-Schools Participants, 2000

Virginia Schools:	**City**
Walt Whitman Middle School	Alexandria
Hayfield Secondary School	Alexandria
Frost Middle School	Fairfax
Lake Braddock Secondary School	Burke
Langston Hughes Middle School	Reston
Lacey Instructional Center	Reston

Maryland Schools:	**City**
Col. Brooke Lee Middle School	Silver Spring
Forest Oaks Middle School	Gaithersburg
Julius West Middle School	Rockville
Westbrook Elementary School	Bethesda
Hoover Middle School	Rockville
Jefferson School	Jefferson
Lake Seneca Elementary School	Germantown
Poolesville High School	Poolesville

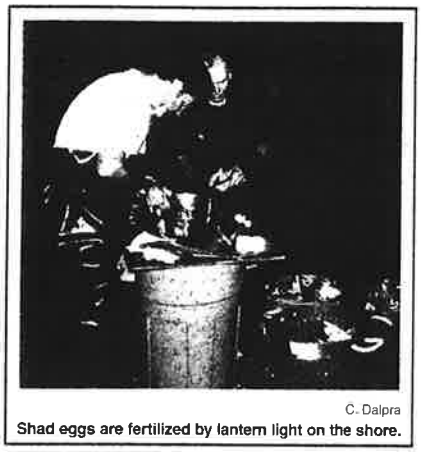
District of Columbia School:

Sidwell Friends School

Appendix V.

Potomac Basin
REPORTER
1940 60 YEARS 2000
Vol. 56, No. 3 Interstate Commission on the Potomac River Basin May/June 2000

Project Continues to Add Shad in Potomac



C. Dalpra
Shad eggs are fertilized by lantern light on the shore.

The future of American shad in the Potomac River is looking brighter this year after a very good spawning season, the placement of fry upstream of Washington, and the modification of a major blockage to migration.

With the help of its partners, the public, and school groups, ICPRB's project to restore the American shad fishery completed a very successful year, placing an estimated 3.2-million fry in the Potomac River upstream of Washington, D.C. The figure is a record for the project.

Now six years old, the effort is important not only in trying to restore one of the most historical and valuable fisheries in the river, but also for its cooperative nature. The interstate effort relies not only on government funding, but on a growing roster of citizens, students, and nonprofit groups that recognize the importance of the program to the shad population and the ecology of the river as a whole. Major governmental supporters this season included the Virginia Chesapeake Bay Restoration Fund, the National Fish and Wildlife Foundation, and the U.S. Army corps of Engineers (ACE).

J. Cummins
Students release shad fry at Mather Gorge.

While American shad have always been found in the Potomac, their numbers have declined drastically since the 1950s. Their restoration is a major focus not only in the river, but throughout the Chesapeake Bay. George Washington netted shad off Mount Vernon, much as is done under the shad project today. Pollution, over-fishing, and loss of habitat from stream blockages such as dams have over time decimated the shad's numbers. Maryland banned shad fishing in 1982, followed by a Virginia moratorium in 1993.

Each spring, ICPRB Associate Director of Living Resources Jim Cummins and Virginia waterman Lewis Harley spend many evenings on the tidal Potomac near Mount Vernon, setting drift nets for shad. With the help of volunteers and school groups, the netted females that are about to spawn are stripped of their eggs. Milt taken from the males is mixed with the eggs, which are quickly fertilized and begin to grow and change color. Each night, the fertilized eggs are taken to a federal fish hatchery in Charles City, Va., where they are hatched, grown for several days, and chemically marked for later identification.

Some of the eggs are taken by school groups under the Chesapeake Bay Foundation's Schools in Schools Program. Students from 13 participating schools in Maryland, Virginia, and the District of Columbia were involved in raising the fry for release. The program provides aquaria, food for the fry, instruction, and a curriculum that integrates the program with other studies. Students also use a foundation boat to help with the shad netting, said the foundation's Jamie Baxter. "The project makes the shad program a part of the student's lives," Baxter said.

While a small fraction of the fry are released where the adult fish were captured, the majority are released in Mather Gorge, part of a 10-mile stretch of prime spawning and nursery area. That area became open to the spring migration when modifications to the dam at Little Falls, just upstream of the District, were completed. The alteration in the dam structure should allow shad and other species, such as striped bass, to the area between Little Falls Dam and Great Falls, which has been closed to them for some 50 years. Shad fry grown under the project and released should imprint on the release area and return to spawn there after migrating to the Atlantic for several years. This method is meant to "jump start" the species' use of the area, which can help to more-quickly raise the numbers in the depleted fishery.

Modifications to the dam were completed by ACE last February, and monitoring of the upstream area was performed by the Maryland Department of Natural Resources, U.S. Fish and Wildlife Service, and U.S. Geological Survey during spawning season. Only three American shad (and no other migratory fish) were found. While the small number of fish found during one of the best spawning runs in recent history is perplexing, Cummins cautioned, "We must keep in mind that it can take a while for fish to return to a long-restricted area, and that population pressure is a strong driving force in emigration into such an area." While all migratory fish stocks are well below the highest historical levels, American shad in particular are probably still only about 10 percent, or even less, of their historic average abundance," Cummins said.

The final batches of fry raised at the schools are released during an informal ceremony for the students along the river. This year, school groups arrived throughout the day to release their fry, chat about their experiences, and plant shad bushes, which flower about the time of the shad run, near the shore. Several groups released the nearly invisible fry to a chorus of "goodbye," "good luck," and "Don't get eaten by other fish." Many students were anxious for the day when their fry will return to spawn, and said that they would keep in touch with the program.