

Shad in Schools

Christina Basin Program Report (2010-2012)

July 2012



written by
Martha Corrozi Narvaez
of
IPA's Water Resources Agency

with
Tim Lucas
of the
Brandywine Conservancy



Institute for Public Administration
School of Public Policy & Administration
College of Arts & Sciences
University of Delaware

www.ipa.udel.edu

serving the public good, shaping tomorrow's leaders

Shad in Schools

Christina Basin Program Report (2010-2012)

July 2012

written by
Martha Corrozi Narvaez
of
IPA's Water Resources Agency

with
Tim Lucas
of the
Brandywine Conservancy

Institute for Public Administration
School of Public Policy & Administration
College of Arts & Sciences
University of Delaware

www.ipa.udel.edu

serving the public good, shaping tomorrow's leaders

PREFACE

It is part of the mission of the Institute for Public Administration's Water Resources Agency (WRA) at the University of Delaware to provide water-resources education to students and civic groups to educate citizens about the crucial importance of water resources. In keeping with WRA's mission, IPA presents this report to provide a summary of the Christina Basin Shad in Schools Program (2010-2012).

The intent of this report is to summarize the program and commitment to implement the Shad in Schools program in the Christina Basin. This program is part of the broader education efforts to educate students and the public on the shad restoration efforts in the White Clay and Brandywine Creeks. The Shad in Schools program provides an experiential learning opportunity to students in the Christina Basin watersheds. It brings fish and their habitat into the classroom and serves to teach students about important environmental concepts related to water quality, ecosystems, biology, chemistry, and many others. In addition, this program incorporates history, art, public speaking, and other non-science disciplines.

I would like to acknowledge the project team members. Associate policy scientist Martha Corrozi Narvaez co-coordinated this program with the Brandywine Conservancy's Robert Londsorf (2010) and Tim Lucas (2011, 2012). Corrozi Narvaez authored this report with input and data provided by Tim Lucas and the teachers and volunteers involved in the project.

This report demonstrates a collaborative effort between IPA's Water Resources Agency and the Brandywine Conservancy, with abundant support and commitment from the Delaware Department of Natural Resources and Environmental Control, Pennsylvania Fish and Boat Commission, Delaware River Shad Fishermen's Association, Interstate Commission on the Potomac River Basin, and the many teachers and volunteers implementing the program in their schools.

It is our hope that this partnership will continue and will result in educated citizens, environmental stewards, and restored rivers once again flowing freely.

Jerome R. Lewis, Ph.D.
Director, Institute for Public Administration

ACKNOWLEDGEMENTS

We would like to acknowledge all of the teachers and volunteers who have helped to implement the Christina Basin Shad in Schools program. The teachers and volunteers have been extremely dedicated to making this program a success and have brought a greater awareness of our natural environment to their students and schools. The teachers have also been essential in compiling the data in this report by providing valuable information for each year they have implemented the program.

Kevin Brady (Avon Grove Charter)

George Claypool (Hillendale Elementary)

Sue Davis (Chadds Ford Elementary)

Julia Dooley (Maclary Elementary)

Karen Horikawa (Wilmington Friends)

Kathy Lamborn (Tower Hill)

Marie Maiura (Holy Angels)

Elizabeth McAndrew (Pocopson Elementary)

Sheila O'Callahan (St. Ann's)

Kerry Paranczak (St. Ann's)

Phil Robinson (Upland Country Day)

Gary Summers (Pocopson Elementary)

We would also like to acknowledge those who have helped to get this program started and have continued to provide the necessary support to make it both a success and an invaluable teaching tool in the Christina Basin.

Jim Cummins, Interstate Commission for the Potomac River Basin

Matt Fisher, Delaware Department of Natural Resources and Environmental Control

Robert Lonsdorf, formerly of the Brandywine Conservancy

John Berry, Delaware River Shad Fishermen's Association

David Bittner, Delaware River Shad Fishermen's Association

Jerre Mohler, U.S. Fish and Wildlife Service

TABLE OF CONTENTS

Executive Summary	Page 1
Section 1. Background	Page 3
Section 2. Program Overview	Page 6
Section 3. Program Timeline	Page 8
Section 4. Program Partners	Page 9
Section 5. Eggs and Release	Page 12
Section 6. Budget	Page 16
Section 7. Outcomes	Page 18
Appendix A. Student Quotes	Page 22
Appendix B. Samples of Shad in Schools Press	Page 23

EXECUTIVE SUMMARY

Many programs across the nation introduce fish and their associated habitats into the classroom to teach students about nature and the environment while utilizing math and science concepts. These programs present a unique learning opportunity for students and the public. The Christina Basin Shad in Schools program is one of several of these programs being implemented in the Mid-Atlantic region. These programs focus specifically on the American Shad—its history, biology, and habitat—and have been implemented in more than 70 schools in the Susquehanna River Basin, Chesapeake Bay watershed, Delaware River Basin, and Neuse and Cape Fear River Basins.

As part of the education efforts related to the river-restoration projects on the Brandywine and White Clay Creeks, the Christina Basin Shad in Schools program began in 2010. In 2010 four schools were participating, and there was one demonstration tank at IPA's Water Resources Agency (WRA) at the University of Delaware. By 2012, the third year of the program, nine schools and 10 classrooms were participating. Schools participating in the program are located throughout the Pennsylvania and Delaware portions of the Christina Basin in the Brandywine, White Clay, and Red Clay Creek watersheds.

This program has been made possible by many dedicated partners. The program was led by the Brandywine Conservancy and WRA. Critical partners to the program include the Delaware Department of Natural Resources and Environmental Control, Pennsylvania Fish and Boat Commission, Interstate Commission on the Potomac River Basin, and the Delaware River Shad Fishermen's Association. This program would not be possible without the many dedicated teachers and volunteers who have chosen to bring this program to their students and schools and have committed many hours to create a unique and successful learning tool.

The program has a set timeline that begins in late March and runs through late May/early June. The program typically runs about 4-6 weeks. Teachers develop lesson plans and teach with materials related to the program. A tank is set up and the water quality is tested and acclimated to suit the highly anticipated American shad eggs. The timing for when the classrooms receive the eggs is dependent upon the natural cycles of the fish and has typically occurred in early May for the Christina Basin program. The egg source for the Christina Basin program has been the Potomac River Basin in 2010, 2011, and 2012. Additional eggs were received from the Easton, Pa., hatchery in 2012.

Once the classrooms receive their eggs the students maintain the water quality and sort the viable and nonviable eggs. The average mortality rate for the eggs varied significantly—64 percent, 81 percent, and 93 percent in 2010, 2011, and 2012, respectively. The final stage of the program is to bring the students outside to the shad's natural habitat and release the newly hatched fry into the streams. The releases typically take place in early May and occur in close proximity to the schools on the White Clay, Brandywine, and Red Clay Creeks.

The cost of the program ranges from \$6,300-\$7,800, with the highest costs accrued in the first year and decreasing in subsequent years. Typically in the first year of the program, it is more costly due to the additional hours required for teacher training, system setup, and learning the system. Once the hatchery is purchased in the initial year, the capital costs decrease significantly from \$500-\$600 in the first year to \$50-\$100 for each following year. The most costly portion of the program is the hours spent by the staff, teachers, and volunteers to implement the program.

The Christina Basin Shad in Schools program has reached a total of 2,849 students either directly or indirectly from 2010-2012. Of this, 1,147 students were directly involved in the program from 2010-2012. The largest number of students directly involved in this program in a single year (2012) was 460.

This program is unique in that it teaches many concepts through exposure to the American shad. The Christina Basin Shad in Schools teachers have been creative in the ways that they incorporate various disciplines into this program, such as math, science, technology, social studies, and the arts. The program has grown significantly over the years and has received positive feedback at public events and professional meetings as well as publicity in local, regional, and state media.

SECTION 1. BACKGROUND

There are many environmental education programs throughout the nation that are based on the concept that experiential learning engages children on a personal level and can have positive effects on a child’s learning experience. There are many programs throughout the nation that employ this teaching method and bring fish and their habitats into the classroom. Table 1 provides a list of these programs that bring lessons and learning opportunities to the classroom through the introduction of salmon, trout, and shad.



Figure 1. American shad, Alosa sapidissima, the largest of the herrings and an anadromous fish

Table 1. Environmental Education Programs that Bring Fish to the Classroom

Program	Location	Program Notes
Salmon in the Classroom	495 schools in Washington state	Reaches 40,000 schoolchildren in the state.
Trout in the Classroom	26 states	Raise trout from egg to fingerling in 26 states for over 20 years.
Atlantic Salmon Egg Rearing Program (ASERP)	N.H., Conn., Vt.	Initiative began in Massachusetts in 1997 by Trout Unlimited. Today it is in NH, CT, and VT. Hatch and raise young Atlantic salmon in the classroom and later release the fish in the stream. There are more than 30 schools that have or are currently participating in the program.
Lake Ontario ASERP	Lake Ontario	Lake Ontario ASERP program is part of the Lake Ontario Atlantic Salmon Restoration Program (LOASP). As of 2008, 38 classrooms and 5 outdoor education centers participated in the program.
Shad in Schools	Susquehanna River Basin, Chesapeake Bay, Delaware River Basin, and Neuse and Cape Fear River Basins	In several major basins in the Northeast region of the United States. The initial program began in 1996, and over 70 schools have participated to date.

These programs vary slightly, but all demonstrate the connection and the unique balance between living resources and the environment. Although the programs incorporate different

fish species, activities, teaching methods, and grade-levels, there are several commonalities among the programs. These include the following:

- Interdisciplinary in nature, with application in science, social studies, mathematics, language arts, fine arts, and physical education
- Collaboration among teachers, volunteers, government agencies, and local organizations
- Hands-on environmental education in the classroom
- Teaching and learning both inside and outside the classroom
- Unique programs based on the teachers wants and needs for the class

In addition to the common elements of the programs listed above, these programs also teach the students about the following important concepts:

- Water quality
- Stream habitat
- Water resources and the environment
- Conservation efforts
- Ecosystems

Shad in Schools is just one of several similar programs—a hands-on environmental education program that brings fish into the classroom. The Shad in Schools program originated in the Washington, D.C., area in 1996 along the Potomac River, and it has been a huge success. The Shad in Schools program has since been undertaken in several watersheds in the region.

- Chesapeake Bay Watershed
 - Living Classrooms has implemented this program in the Potomac and Anacostia Rivers. Since 1996, more than 50 schools from Washington D.C., and Alexandria, Fairfax, Montgomery, and Prince George’s Counties have participated in the program.
 - Programs have been implemented in the Mattaponi and Pamunkey Rivers (Va.).
- Delaware River Basin
 - Delaware River – This program is being implemented by the Delaware River Shad Fishermen’s Association and has been implemented for the past five years with 16 local schools. The geographic focus is the Delaware and Lehigh Rivers.
 - Christina Basin – This program began in 2010 with four schools and one demonstration tank. By 2012 the program had grown to 10 schools with a focus in the Brandywine and White Clay Creek watersheds.

- Neuse and Cape Fear River Basins

This program currently includes three Raleigh, N.C., schools.

- Susquehanna River Basin

Perryville Middle School, North Harford, and Queen Anne’s County high schools are participating in this program with the support of the Maryland Department of Natural Resources.

The Shad in Schools program, as well as the programs involving other fish listed in Table 1, provide great benefits to the participating students. The programs impact the students directly involved yet these concepts and ideas reach beyond the students to other teachers, friends, and relatives. The programs also serve as extremely valuable public education tools for river restoration programs throughout the nation. Together these programs present a unique learning opportunity for students and the public. This report will detail specific information related to the Christina Basin Shad in Schools program for 2010-2012.

SECTION 2. PROGRAM OVERVIEW

The Christina Basin is a 565-square-mile watershed comprising the Brandywine, Red Clay, and White Clay Creeks, and the Christina River watersheds. There are ongoing efforts in the Christina Basin's Brandywine and White Clay Creek watersheds to restore shad and migratory fish passage and habitat, increase spawning areas, and benefit the resident fish in the watersheds. The Shad in Schools program, an education and outreach tool, is part of these larger restoration efforts in the Brandywine and White Clay Creek watersheds.



Figure 2. At the release site, students sort and count eggs prior to the release.

WRA and the Brandywine Conservancy have been working in collaboration to implement the Shad in Schools program in the Brandywine and White Clay Creek watersheds in Delaware and Pennsylvania. In 2010 Robert Lonsdorf, then of the Brandywine Conservancy, arranged for four schools located in the Brandywine watershed to join the program as part of the dam removal efforts in the Brandywine. By 2012 there were 10 schools from the Brandywine, White Clay, and Red Clay creek watersheds participating in this program.

The Shad in Schools program is an applied experience that educates students, teachers, and the public about the history, problems/decline, and life cycle of American shad while teaching math and science concepts through the balance of water conditions and temperature. The objectives of this program include the following:

- Educate and inform students, teachers, parents, and the public about the American shad, its history, its importance to the environment, and its impact on local communities.
- Create awareness among students of the importance of good water quality as a prerequisite to a healthy aquatic environment through hands-on water-quality testing, controlling water temperature, and applying factors that are necessary for the survival of shad eggs and fry.
- Disseminate information about the American shad, how it affected our heritage, and its current impact on the local environment and economy.

The Shad in Schools program has a distinct timeline that must be followed each year in order to mimic the natural conditions in the stream and prepare for the arrival of the American shad eggs. In mid-April the schools receive their shad-rearing tank equipment, and the shad tank is

constructed. Once constructed, the tank runs for approximately 2-3 weeks prior to receiving the shad eggs. During this time, the students conduct water-quality tests on the system, including tests on ammonia, nitrite, nitrate, pH, and temperature.

Once the tank is constructed and the system is acclimated appropriately, the students are prepared to receive their shad eggs. Eggs are collected from mature shad and introduced to the students' tanks. There they will grow and hatch into fry in about 3-5 days, and on the fifth day they are released into the Brandywine, White Clay, and Red Clay Creeks.

The shad fry that the students release will remain in the Brandywine, White Clay, and Red Clay Creeks until the water temperatures begin to drop in the fall. The shad will then swim out to the Atlantic Ocean, where they will continue to grow. They will remain in the ocean for 4-6 years before returning to the river they were released in for their first spawn.



Figure 3. Sorting the viable and nonviable eggs is critical to the survival of the eggs.

SECTION 3. PROGRAM TIMELINE

The Shad in Schools program has a distinct timeline that must be followed each year in order to mimic the natural conditions in the stream and prepare for the arrival of the American shad eggs. In mid-April, the schools receive their shad-rearing tank equipment, the shad tank is constructed, and water circulates for approximately 2-3 weeks before receiving the eggs. Because the delivery of eggs into the tank is completely dependent upon the shad spawning, the exact dates on which the eggs are received varies each year. A more detailed timeline is provided below:

Late March/ April:

- If this is the first year the program is being conducted, the teachers (and some students) attend a project workshop and receive all necessary supplies and equipment for raising shad in classrooms.
- Teachers begin preparing students through classroom activities.

April:

- Classes set up shad equipment (shad system) and run for at least 2-3 weeks prior to shad egg arrival.
- Students conduct water-quality tests on the system.
- Teachers increase preparation activities with students (newspaper clippings, fishing reports, pictures, speakers, etc.).

May:

- Eggs are collected. Sources in the Christina Basin program vary and include:
 - Migrating shad are collected and stripped of eggs (Potomac River).
 - Eggs are collected from a live-spawn shad hatchery (Easton, Pa.).
- Schools receive shad roe (eggs), and they are acclimated to the classroom tanks (approximately five days).

Late May/ June:

- Students raise shad larvae for up to five days.
- Students release shad fry at designated release sites.



Figure 4. The shad-hatchery system

SECTION 4. PROGRAM PARTNERS

The Shad in Schools program is led and administered by WRA and the Brandywine Conservancy. Over the years, conservation, historic, state, and educational institutions have also played critical roles in the implementation of this program, including:

- Brandywine Zoo
- Delaware Chapter, Trout Unlimited (Bill Mentzer)
- Delaware Department of Natural Resources and Environmental Control
- Delaware Museum of Natural History
- Delaware River Shad Fishermen's Association
- Gary Summers (Classroom Volunteer)
- Hale-Byrnes House (Kim Burdick)
- Interstate Commission for the Potomac River Basin (Jim Cummins)
- Local Schools (see Table 2)
- Local Sportsmen's and Conservation Organizations
- Pennsylvania Fish and Boat Commission
- U.S. Fish and Wildlife Service (Jerre Mohler)

During the first year of the program, four schools from the Brandywine watershed participated in the program. By the third year of the program, there were nine schools participating in the program. The number of schools participating in the program (by year for each year of the program) is included below.

- 2010: 4 schools and 1 demonstration hatchery at WRA
- 2011: 10 schools/11 classrooms participating
- 2012: 9 schools/10 classrooms participating

Schools from the Brandywine, White Clay, and Red Clay Creek watersheds that have participated in the program (2010-2012) are included in Table 2 and Figure 5.

Table 2. Schools Participating in the Shad In Schools Program (2010-2012)

State/Watershed/School	2010	2011	2012
<i>Delaware</i>			
<i>White Clay</i>			
Maclary Elementary School		1	1
Holy Angels School		1	1
<i>Brandywine</i>			
St. Ann’s School		2	2
Tower Hill School	1	1	1
Wilmington Friends School	1	1	1
St. Edmond’s Academy (observation only)			
<i>Pennsylvania</i>			
<i>White Clay</i>			
Avon Grove Charter School		1	
<i>Brandywine</i>			
Hillendale Elementary School		1	1
Pocopson Elementary School	1	1	1
Chadds Ford Elementary School	1	1	1
<i>Red Clay</i>			
Upland Country Day School		1	1
Total Number of Classrooms	4	11	10
Total Number of Schools	4	10	9

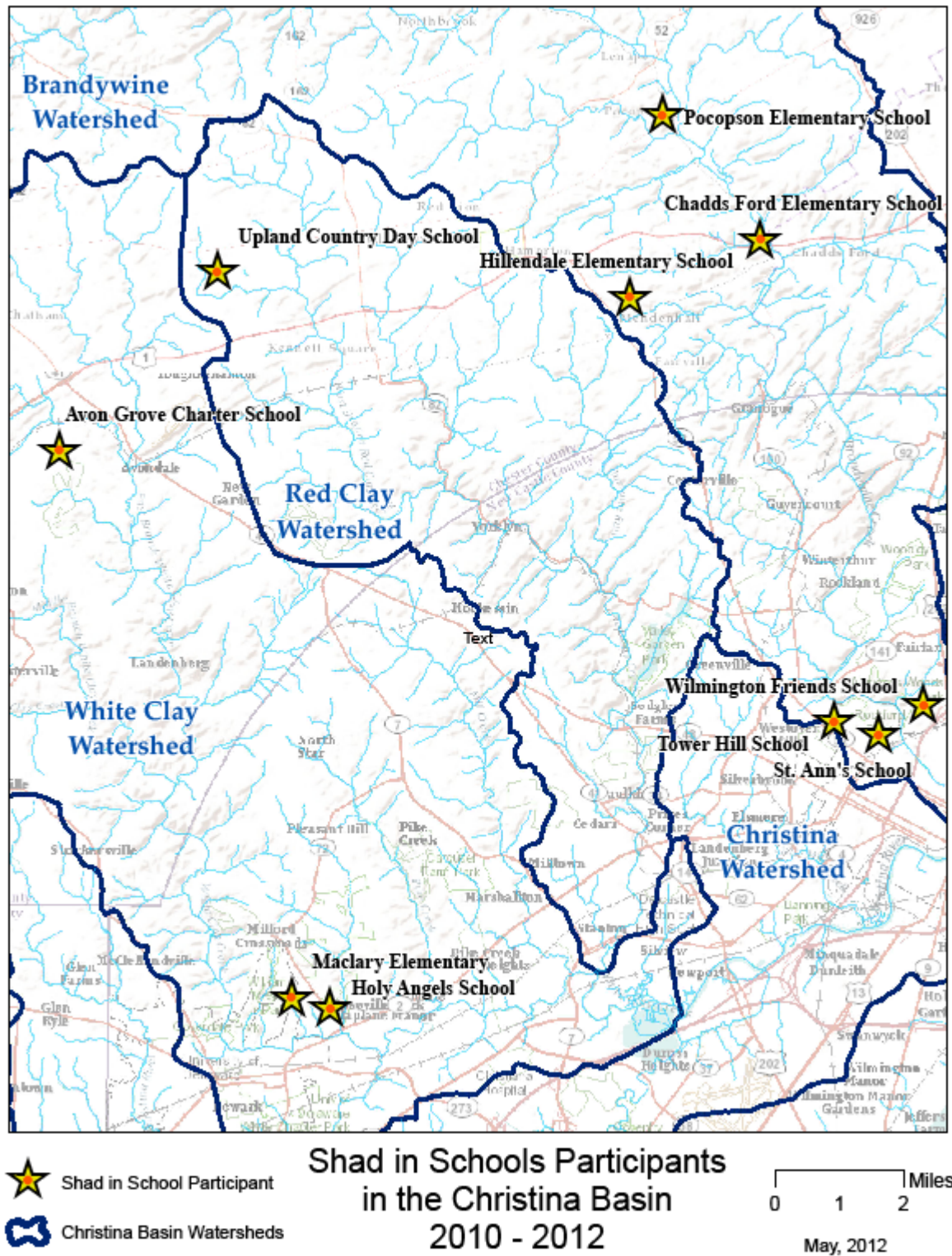


Figure 5. Location of the Shad in Schools Participants (2010-2012)

SECTION 5. EGGS AND RELEASE

Obtaining the Eggs

An integral part of this program is to obtain eggs for the shad hatcheries. Jim Cummins of the Interstate Commission for the Potomac River Basin (ICPRB) has been an essential partner to this program and has provided expertise as well as eggs for the Christina Basin Shad in Schools program from 2010-2012. From 2010-2012 the source of eggs for the program has been the Potomac River Basin. It is the intent of the program coordinators that a Delaware River Basin source of eggs is secured for the future in order to eliminate transferring eggs across watershed boundaries. The U.S. Fish and Wildlife Service's experimental hatchery located in Easton, Pa., is the intended source of eggs for the immediate future.



Figure 6. A pitcher of shad eggs is ready to be distilled for the Pennsylvania schools.

In 2012 the Christina Basin schools secured eggs from both the Potomac River Basin and the Delaware River Basin. In early May 2012, 10 Christina Basin classrooms received eggs from the Potomac River Basin. Of these 10 classrooms, only two classrooms had viable eggs that hatched. For this reason and per our request, the experimental hatchery in Easton, Pa., worked with the Christina Basin Shad in Schools program to provide additional eggs to four of the eight schools.

Permitting

Each year WRA and the Brandywine Conservancy work with the Pennsylvania Fish and Boat Commission (PAFBC) and Delaware Department of Natural Resources and Environmental Control (DNREC) to obtain permission to release the shad fry into the Brandywine, White Clay, and Red Clay Creeks in Pennsylvania and Delaware. Each year PAFBC and DNREC have been responsive to the requests and have been helpful partners in providing the schools with permits to release the fry into the states' waters.

In 2012 the PAFBC required that all eggs that are from a source outside of the Delaware River Basin be disinfected prior to releasing the fry into Pennsylvania waters. In April 2012 the Delaware River Shad Fishermen's Association (DRSFA) attended a training to learn how to disinfect the Potomac eggs. The PFBC trained four DRSFA members at their Van Dyke anadromous fish hatchery and supplied them with most of the materials necessary for disinfecting the shad eggs. (This is standard protocol in most states when introducing living items from one river system to another.) Mike Hendricks, a Pa. biologist for the PFBC, conducted the training. To the benefit of the Christina Basin program, the Delaware shad-fisherman group disinfected the Potomac eggs for the four Pennsylvania schools in the Christina Basin Shad in Schools program.

Number, Volume, and Mortality Rates

Due to the variability of natural conditions, the number of shad eggs distributed to each school/hatchery per year varies. According to ICPRB’s Jim Cummins, the egg size can vary from 30,000 to 40,000 eggs/liter for Potomac eggs. When estimating the number of eggs per volume of eggs received, for 80-90 ml, there are anywhere between 2,400 and 3,600 eggs. Table 3 provides an estimate of the average volume and number of eggs delivered to each classroom by year and the estimated total number of eggs used for the program each year. Table 4 provides an estimate of the shad fry released per release.

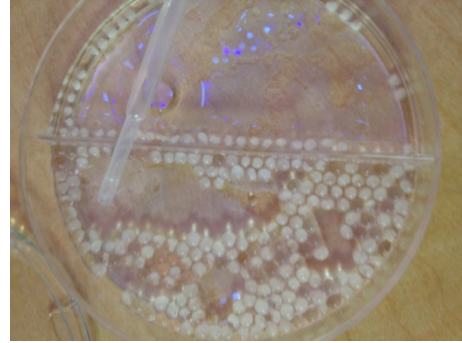


Figure 7. A Petri dish of viable and non-viable shad eggs.

Table 3. Number and Volume of Eggs (2010-2012)

Year	Total Volume (ml) (estimate)	Volume Received/School (ml/school) (measured)	Total Number of Eggs (estimate)	Number of Eggs/School (estimate)
2010	400-450 (4 classrooms)	104	12,000-18,000	3,000-4,500
2011	800-900 (11 classrooms)	77	26,400-39,600	2,310-3,080
2012 (Potomac)	800-900 (10 classrooms)	80-90	24,000-36,000	2,400-3,600
2012 (Easton)	1,200 (4 classrooms)	300	>20,000	>5,000

Table 4. Shad Fry Released

School	Shad Fry Released (Approx.)			
	2010	2011	2012 (Potomac)	2012 (Easton)
Avon Grove Charter School		-		
Chadds Ford Elementary School	1,200-1,600	900-1,200	0	900-1,200
Hillendale Elementary School		600-800	0	350-400
Holy Angels School		600-800	100	
Maclary Elementary School		10	200	
Pocopson Elementary School	2,500	300*	0	0
St. Ann’s School		-	0	
Tower Hill School	-	-	0	
Upland Country Day School		-	-	
Wilmington Friends School	200-400	0	0	400-700

*Hillendale provided Pocopson with fry to release due to an algae problem in the tank.

Mortality Rate

Once the schools receive the eggs the anticipated mortality rate for the eggs is approximately 50 percent. Each year the mortality rate varies based on numerous variables such as collection conditions, fertilization rate, egg delivery conditions, length of time for delivery to hatchery, hatchery conditions, water quality, etc. Table 5 provides a summary of the estimated mortality rates by school for each year of the program.

Table 5. Mortality Rate by School and Year

School	Mortality Rate (Approx.)			
	2010	2011	2012 (Potomac source)	2012 (Easton source)
Avon Grove Charter School		-		
Chadds Ford Elementary School	63%	65%	100%	90%
Hillendale Elementary School		-	100%	90%
Holy Angels School		-	99%	
Maclary Elementary School		99.8%	80%	
Pocopson Elementary School	31%	100%*	100%	100%
St. Ann’s School		-	100%	
St. Ann’s School	-	-	100%	
Tower Hill School	-	-	100%	
Upland Country Day School		60%	50%	
Wilmington Friends School	99%	99%	100%	
Average	64%	81%	93%	93%

*Due to a fungus, all eggs died.

Release

The date of release for each school is dependent upon the arrival of the eggs. The eggs typically hatch in 3-5 days; therefore, schools typically choose a release date 5 days after the delivery of the eggs. A list of the release dates for the first three years of the program are provided below.

- 2010 Release: May 7, 2010
- 2011 Release: May 6, 2011
- 2012 Release: May 4, 2012**

**During the 2012 Shad in Schools program, there was more than one release due to the high mortality rates of the initial batch of Potomac eggs. During 2012, additional releases took place on June 1st and 4th as a result of getting a second batch of eggs on May 30, 2012.

Each school identifies a site into which to release the shad larvae. Site location is dependent upon the convenience of getting the students to the site as well as working with the stream conditions in terms of accessibility to the stream and tidal vs. nontidal portions of the stream. A list of the release sites is listed in Table 6.

Table 6. *Shad in Schools Release Sites*

SHAD IN SCHOOLS RELEASE SITES		
SCHOOLS	RELEASE SITE	YEAR OF RELEASE
<i>Delaware</i>		
<i>Brandywine</i>		
Wilmington Friends School	Behind the Brandywine Zoo (near N. Van Buren St and N. Park Drive)	2010, 2011
Tower Hill School	On a trail off of Mt Vernon Rd.	2010, 2011
St. Ann's School	Hagley Museum and Library property	2011
<i>White Clay</i>		
Holy Angels School	Hale-Byrnes House	2011, 2012
Maclary	Hale-Byrnes House	2011, 2012
<i>Pennsylvania</i>		
<i>Brandywine</i>		
Chadds Ford Elementary School	Ring Run, a tributary of the Brandywine, on the school grounds	2010, 2011, 2012
Hillendale Elementary School	Under the Route 1 bridge by the Brandywine River Museum	2011
Pocopson Elementary School	Off of West Street Road (Pa. Rt. 926)	2010, 2011
<i>White Clay</i>		
Avon Grove Charter School	Unknown tributary of the White Clay	2011
<i>Red Clay</i>		
Upland Country Day School	Red Clay Tributary – Sinclair Farm (Pa. Rt. 926, Unionville)	2011

SECTION 6. BUDGET

There have been several local, regional, and national funding sources that have generously provided financial support for this program at various points from 2010-2012:

- American Rivers
- Brandywine Conservancy
- FishAmerica Foundation
- National Fish and Wildlife Foundation (NFWF)
- Private Philanthropic Donors
- University of Delaware, Water Resources Agency

The capital costs for the schools to implement this program are highest in year one (approximately \$500-\$600) and minimal in the subsequent years (\$50-\$100/year). The average capital cost per school to participate in this program is detailed below:

- Year one (hatchery, training/travel): \$500-\$600 for the first year for tank and supplies (one full system) and travel to/from the training workshop.
- Each additional year: \$50-\$100 each year for additional supplies per system.

The largest cost for implementing this program is the time commitment associated with this program, for example, the staff time to coordinate the program as well as the teachers' and volunteers' time. The tanks are set up and running for approximately 4-6 weeks in total. Over this time period there are many hours spent in order to ensure that this is a powerful teaching tool and that the project is a success. Below is a brief summary estimating the number of hours for the program coordinators, teachers, and volunteers.

Coordinators' Hours

The Christina Basin Shad in Schools program is coordinated by WRA's Martha Corrozi Narvaez and the Brandywine Conservancy's Tim Lucas. The program typically runs for 4-6 weeks. Prior to the start of the program, there are one or two meetings to communicate with the teachers, make sure that all of the teachers have the necessary supplies, and resolve any questions for the upcoming year. Additionally, communication from and through the coordinators is essential throughout the program. The coordinators are also responsible for securing the PAFBC and DNREC permits for release and retrieving and distributing the eggs. Each coordinator commits approximately 50 hours per year to the program, a total of 100 hours per year.



Figure 8. Testing the water quality (top) and standing along the banks (bottom) at the release site on the White Clay Creek at the historic Hale-Byrnes house.

Teachers’ Hours

Teachers’ hours range from 40-60 hours per teacher/year. This time commitment includes set-up, planning, teaching, monitoring the tanks, and tank disassembly. During the first year, additional time is needed for planning, attending the teacher training, and becoming familiar with the equipment; this can add to the total amount of time.

Parent/Volunteer Hours

This can range anywhere from 0-20 hours per year depending on the teacher’s need for assistance and/or parent/volunteer interest in the program.

When considering the total costs for the program, the coordinator’s, teacher’s, and volunteer’s time is the most costly component of the program. Capital costs are most expensive in the first year and only \$50-\$100 in the following years. In the Christina Basin, in total, the program costs about \$7,800 to implement in the first year and \$6,300 to implement in the second and remaining years. A summary of the total budget for the Christina Basin Shad in Schools program is provided in Table 7.

Table 7. Total Budget for the Shad in Schools Program

Item	Detail	Year 1		Year 2	
		Unit Cost	Total Cost	Unit Cost	Total Cost
Equipment	Hatchery	\$500	\$500	\$0	\$0
	Supplies	\$100	\$100	\$100	\$100
Coordinator Hours	100 hours for two coordinators	\$40/hour	\$4,000	\$40/hour	\$4,000
Teacher Hours	70 hours/teacher	\$40/hour	\$2,800		
	50 hours/teacher			\$40/hour	\$2,000
Volunteer Hours	20 hours/volunteer	\$20/hour	\$400		
	10 hours/volunteer			\$20/hour	\$200
Total Cost			\$7,800		\$6,300

SECTION 7. PROGRAM OUTCOMES

Student Impact

This program exposes the students to several important science and math concepts among others:

1. History, importance, and life cycle of the American shad
2. Scientific procedures for measuring, testing, collecting, and organizing data
3. Mathematics to estimate, calculate, and predict results
4. Charts, maps, and graphs to aid in using information
5. Information exchange among other classes in the school and to parents and adults
6. Delicate balance of nature and work toward preserving or improving natural resources
7. American shad restoration in rivers
8. Reporting and presentation techniques, both oral and written

In addition to important science and math concepts, the program reaches many children in the short time period that the tank system is up and running. This program provides a valuable experiential learning opportunity for students in the classroom where the hatchery is located (direct involvement) and those indirectly involved. With one hatchery there is the ability to teach many children key math and science concepts through direct interaction with the tank and the process of running the equipment and caring for the eggs. This program also tends to develop a “buzz” around the school and has a ripple effect through the school. Some teachers choose to involve other students through observation, presentations at assemblies, hallway murals, or other school-wide projects.

In the Christina Basin Shad in Schools program, a total of 2,849 students have been part of this program either directly or indirectly from 2010-2012. Of this, 1,147 students were directly involved in the program from 2010-2012. The largest number of students directly involved in a single year (2012) was 460. Table 8 provides detailed information on the number of students directly and indirectly involved in this program by school and year. Students who have been both directly and indirectly involved in the program have very positive things to say about their experience. Sample quotes from the students directly involved in the project are provided in Appendix A.

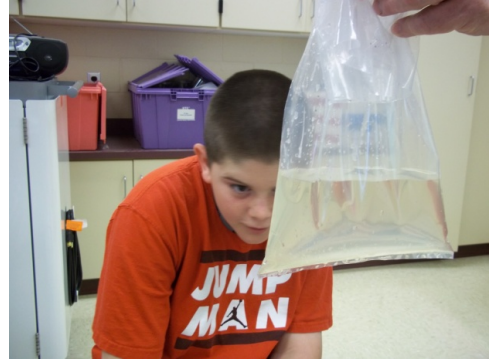


Figure 9. Classroom activities: peering at the bag of eggs (top) and sorting viable and nonviable eggs (bottom)

On average, based on information provided by several teachers, the students with direct involvement spent about 2.5–4 hours per class working on the program prior to the release during the 4–6 week program. An additional hour or more was spent at the release during the program. According to one teacher, in the 2011 school year each student spent a total of 21 hours (direct involvement), and in 2012 each student spent approximately 14 hours (direct involvement) during the 4–6 weeks.



This program is not only about the number of hours spent ensuring the water quality in the hatchery is conducive, sorting eggs, or releasing the eggs in a timely fashion but it provides an opportunity for the students to incorporate other activities and skills related to shad. Related activities the Christina Basin Shad in Schools' teachers have incorporated into the program include the following:

- Presentations
- Art murals
- Poster displays
- Public-speaking activities
- Report writing

Public Outreach

The Brandywine Conservancy and WRA have worked diligently to raise awareness about the Brandywine and White Clay Creeks' restoration efforts and the Shad in Schools program. Information on the Shad in Schools program has been developed and displayed in brochures and publications related to the Brandywine and White Clay Creeks' overall restoration efforts since the start of the Brandywine restoration efforts in 2004. More recently, since the program has gained momentum, outreach information has been displayed at the following public events:

- Creek Fest (2011 and 2012)
- Naturefest (Hagley, 2012)

Information on the program has also been presented at national, regional, and local conferences and meetings including, but not limited to:



Figure 10. Fish murals created by Maclary Elementary students (top) and Chadds Ford Elementary students show off their shad activities (bottom).

- American Water Resources Association national conference (2010)
- Partnership for the Delaware Estuary Science Summit (2011)
- Mason Dixon Task Force (2012)
- Delaware Shad Fisherman Association meeting (2012)

There has also been extensive Shad in Schools coverage in both statewide and local press that has helped to promote the program as well as the overall restoration efforts occurring in the Brandywine and White Clay Creeks. Table 9 is a summary of the press on the Shad in Schools program from 2010-2012. A selection of these articles is provided in Appendix B.

Table 8. Students Involved in Shad in Schools, 2010-2012

School	Type	Students (Approx.)					
		2010		2011		2012	
		Direct	Indirect	Direct	Indirect	Direct	Indirect
Avon Grove Charter School	-			-	-		
Chadds Ford Elementary School	3rd Grade	22	40	22	40	22	40
	4th Grade	-	50	-	50	-	50
Hillendale Elementary School	3rd Grade			65	-	65	-
	5th Grade			40	-	41	-
Holy Angels School	Students in school			-	192	-	206
	3rd, 4th, 5th Grade Enrichment Classes			45	490	45	490
Pocopson Elementary School	5 Classes	100	-	100	-	100	-
St. Ann's School	4th and 6th Grades			60	-	60	-
Tower Hill School	5th Grade	55	-	55	-	55	-
	7th Grade	-	18	-	18	-	18
Upland Country Day School	Environment/Conservation Club			12	-	12	-
Wilmington Friends School	7th Grade	63	-	48	-	60	-
Total by Year		240	108	447	790	460	804
Total (Direct)		1,147					
Total (Indirect)		1,702					
TOTAL		2,849					

Table 9. State-wide and Local Press on the Shad in Schools Program (2010-2012)

Source	Title of Article	Date
<i>The News Journal</i>	“Delaware Schools: Spawning a Revitalization Effort”	May 8, 2010
<i>The Daily Local</i> (Chester County, Pa.)	“Students Release Shad into Creek: It’s part of an effort to restore American Shad to Brandywine 300 years after disappearance”	May 8, 2010
<i>UCF School News</i> (Unionville Chadds Ford School District)	“Shad in Schools Program Comes to Pocopson and Chadds Ford Elementary Schools”	May 24, 2010
UDaily (University of Delaware)	“Shad in Schools: Restoring American Shad to White Clay Creek”	July 8, 2010
Communitypub.com (Greenville, Hockessin, Pike Creek, and Brandywine Hundred in Delaware)	“Circle of Life the lesson in student shad release”	May 9, 2011
Southern Chester County Weeklies (serving Kennett Square, Chadds Ford, Avon Grove, and Oxford)	“Area students help raise shad for the Brandywine Conservancy”	May 11, 2011
<i>The News Journal</i>	“Students Test Shad Project: Program puts species back in local habitats”	May 5, 2012

APPENDIX A. STUDENT QUOTES

Holy Angels School (2011)

“Mrs. Maiura, you have to do this again with next year’s class.”

Holy Angels School (2012)

“I wish we could do this again.”

“This was so much fun.”

“I think it was really neat that we were able to raise the shad in the classroom.”

“This was a great educational experience.”

Upland Country Day School (2012)

“Kids loved the project. Lower schoolers can’t wait to join the environment club. Loved the fry release.”

APPENDIX B. SAMPLES OF SHAD IN SCHOOLS PRESS

<http://www.delawareonline.com/apps/pbcs.dll/article?AID=2010305080008>

<http://www.delawareonline.com/fdcp/?1273503453026>



Delaware schools: Spawning a revitalization effort

The News Journal - May 8, 2010

In partnership with the Brandywine Conservancy, students from local schools Friday released American shad fry, or baby fish, into the Brandywine.

The fry will grow and travel downstream to the Atlantic Ocean, where they will live for four to six years before making their way back to the river to spawn, conservancy officials said.

Once plentiful in the Brandywine, the population declined after dozens of dams were built to power mills along the river.

The conservancy is leading a multiyear effort to restore the shad and other migratory fish, the group said, noting that restoration of the species will increase the vitality of the watershed and promote recreational fishing.



Purchase this Photo
Ben Para, a seventh-grader at Friends School, holds a cup of shad fry that he released into the Brandywine near the zoo Friday. (The News Journal/JENNIFER CORBETT)

On the Web
Brandywine Conservancy

Advertisement

Mom Dilemma #36:
Your daughter insists on wearing her princess costume to the grocery store. Allow it or not?

YES, at least she's dressed!

NO, I have some rules!

momslike.com
where real moms meet

Print Powered By FormatDynamics™

The Daily Local (dailylocal.com), Serving Chester County, PA

News

Students release shad into creek

It's part of an effort to restore American Shad to Brandywine 300 years after disappearance

Saturday, May 8, 2010

By ANNE PICKERING, Staff Writer

POCOPSON — Friday was a clear, sunny day and the thousand or so tiny baby Shad fish were ready to be released from the large holding tank at Pocopson Elementary School and start their life in the Brandywine Creek.

All five classes of fourth-graders at Pocopson, about 120 children, left the school in the morning in the company of their teachers and the Unionville-Chadds Ford School District officials and headed for the creek.

Some of the students carried large plastic jugs of water filled with the half-inch-long Shad "fry." At the banks of the creek, the students each took a cupful of the baby fish and placed them gently in the water.

They were taking part in a program to restore American Shad to the Brandywine 300 years after they disappeared.

Naomi Dickenson, 10, of West Chester, who said she wanted to be a scientist when she grew up, described how the students had watched over the eggs in the incubator.

Every day they checked the water temperature, the ph, the nitrate level and took out any eggs that had died.

The equipment had been obtained through a \$1,500 grant that one of their teachers, Elizabeth McAndrew, had applied for through the school.

Four schools in all Friday, including two in Chadds Ford and two in Wilmington, Del., participated in the Brandywine Conservancy program to restore American Shad to the Brandywine River.

About 8,000 shad were released Friday and the fish will stay in the Brandywine until the fall when they will swim down to the Atlantic. Once they mature in four to six years, they will try to come back to the place they were released to spawn.

The second part of the restoration is dealing with a major obstacle in their way — dams that were created for the hundreds of mills that used to line the banks of the Brandywine.

Efforts are under way to remove the dams or create fish ladders.

John Londsorf, senior planner for Watersheds and Biodiversity at the Brandywine Conservancy, is hopeful that when the Shad are ready to return, enough of the dams will have been breached or ladders built that they will be able to make it.

In Pennsylvania there are eight or more low-head dams along the East Branch and West Branch of the Brandywine and about nine in the Delaware state portion of the Brandywine. Since the program was started in 2005, two dams have already been breached or broken through, but chiefly through nature.

SHAD IN SCHOOLS CHRISTINA BASIN PROGRAM REPORT (2010-2012) – July 2012

Students release shad into creek - The Daily Local (dailylocal.com)

<http://www.dailylocal.com/articles/2010/05/08/news/srv0000008217354.prt>

The City of Wilmington owns the West Street Dam and applied for a grant to remove it. Lonsdorf said they are waiting to get word on the grant. The grant is for \$1.5 million and the city is contributing another \$500,000.

In the 17th century there were hundreds of thousands of Shad in the Brandywine.

The Delaware River has a large Shad population but it is declining. The reason may be lack of habitat, said Lonsdorf.

According to reports from local fisherman, the Shad get up the Brandywine as far as the first dam, the West Street Dam.

Other dam owners including DuPont and the state of Delaware are working on providing various types of fish ladders.

Follow us on Facebook and Twitter: www.twitter.com/wcdailylocal www.facebook.com/pages/West-Chester-PA/The-Daily-Local-News/315040070050

URL: <http://www.dailylocal.com/articles/2010/05/08/news/srv0000008217354.prt>

© 2010 dailylocal.com, a Journal Register Property



Shad in Schools Program Comes to Pocopson and Chadds Ford Elementary Schools

Shad in Schools is a program that was started in schools in the Washington, DC area along the Potomac River. Students raise fry (baby fish) and release them in local waters to imprint and, hopefully, return again in a few years to spawn. The program has been successful along the Potomac River. Robert Lonsdorf of the Brandywine Conservancy arranged for four Brandywine River area schools to join the program.



Elizabeth McAndrew, 4th grade teacher at Pocopson, Sue Davis and Curt Barr at Chadds Ford, and two Delaware teachers will be the first to work with students to raise fry for the Brandywine. Robert Lonsdorf is providing assistance in securing fish eggs.

Years ago, the Brandywine was “home” to many shad, but this is no longer the case. Three main reasons caused this elimination from our local stream: overfishing commercially, sediments and pollutants entering the water, and dams built for mills and power blocking the migratory routes. Unlike the salmon of the west coast, shad are not jumpers, so they are unable to reach their spawning grounds.

Our schools had their hatcheries set up, and students in 3rd or 4th grade have learned to monitor and test the water. Students released the tiny fry so they can begin their lives where their ancestors started theirs, in the waters of the Brandywine. This program allows students to participate directly in science research and the restoration of a historically important fish to the Brandywine. Students released the Shad on Friday, May 7, 2010.

Source: Town Square Delaware

Big Steps for Small Fish

June 5, 2012 by Parthena Moisaïdis

Sporting water shoes and baseball caps, nearly a dozen Wilmington Friends students gathered on the rocky shore of the Brandywine River this past Saturday morning and released shad fry into the water.

Many years ago, the small fish sustained George Washington’s troops, serving as a plentiful food source, but over generations, the shad population has decreased tremendously. As a result of the industrial revolution and the implementation of dams, few fish now have the ability to migrate.



As part of the program *Shad in Schools*, seventh-grade science teacher Karen Horikawa raises shad in her classroom, both for educational and restorative purposes. Prior to receiving the shad eggs, students learn about the cultural, historic and biological significance of the fish. Once the shad eggs arrive, Ms. Horikawa’s seventh grade students have the opportunity to observe and care for the soon-to-be fry, cleaning the aquarium and testing the water quality.

Student Katy Shannon said that she enjoyed the active role she had in raising the shad fry. “It was much more fun than studying from a book,” she said.

Due to their small size, shad fry are difficult to identify with the naked eye, so students used microscopes to better observe the fish.

“That was really interesting for me to see them moving around because I want to be a marine biologist,” said Kate Horan, another of Ms. Horikawa’s students.

On the morning of the highly anticipated release, Ms. Horikawa and the students distributed the fry among plastic cups and eased them into the river.

The shad will head to the ocean to spawn and return to the Brandywine River again this time next year.

“It’s amazing how they know the river and return every year,” Ms. Horikawa.

Just like the shad, I plan to return every year for the release. A classmate and I originally proposed the idea of implementing a program like this, and Ms. Horikawa has successfully carried out this project three years in a row. Not only has she educated students, but the annual release is an important measure in restoring native fish to the Brandywine.





***Institute for Public Administration
School of Public Policy & Administration
College of Arts & Sciences
University of Delaware***

180 Graham Hall University of Delaware Newark, DE 19716-7380

phone: 302-831-8971 e-mail: ipa@udel.edu fax: 302-831-3488

www.ipa.udel.edu

The University of Delaware's Institute for Public Administration (IPA) addresses the policy, planning, and management needs of its partners through the integration of applied research, professional development, and the education of tomorrow's leaders.



The University of Delaware is a non-discriminatory, equal opportunity, and affirmative action institution.
See www.udel.edu/aboutus/legalnotices.html for detailed policy information.