

**Shad in the Classroom
Program Report
(2009-2014)**

4 June 2014

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Executive Summary

Many programs across the nation introduce fish and their associated habitats into the classroom to teach students about nature and the environment. These programs go by various names, including Trout in the Classroom, Salmon in the Classroom, and Shad in the Classroom. In North Carolina, Trout in the Classroom is led by the North Carolina Chapter of Trout Unlimited, and Shad in the Classroom is led by the North Carolina Museum of Natural Sciences (Museum). Similar to the Trout in the Classroom, which began in 2007 in North Carolina, the Shad in the Classroom program provides a hands-on, real-life science learning opportunity.

The American shad fishery was once one of the East Coast's most abundant and economically important. However, by the mid-1970s water pollution, over-harvesting and the blocking of spawning habitat by dams led to their decline. Today, American shad continue to have ecological, economic, and historical importance to North Carolina and much of the eastern seaboard of the U.S. Similar American shad programs have existed in the Potomac River basin since 1996, setting the groundwork for the Shad in the Classroom program in North Carolina. What began in 2009 as a pilot study in North Carolina involving four schools, the Shad in the Classroom program has grown to include 23 classrooms at 17 different schools in 2014. Students and teachers become involved in the program several weeks prior to receiving American shad eggs (fertilized embryos) spawned in North Carolina Wildlife Resource Commission (NCWRC) and United States Fish and Wildlife Service (USFWS) hatcheries.

Each February participating teachers attend an all-day workshop and learn how to construct their fish hatcheries, attend expert presentations, participate in hands-on activities, and receive curriculum materials to use in their classrooms. The program timeline begins with the teacher workshop in February and concludes with the release of fry reared by students into native rivers in April to early May. The timing for delivery of eggs to the classrooms is dependent on the natural spawning of the fish. Teachers typically begin setting up their tanks and teaching materials related to the program 2–4 weeks prior to receiving the eggs. Lessons and activities related to the American Shad are prime examples of cross curricular connections, integrating history, social studies, ecology, and management. Some teachers elect to have students keep journals throughout the course of the program, further incorporating writing components and practice. Students learn how to set up the tank and pump system, monitor water quality, and tend their shad eggs in special rearing systems. For one week during the spawning period, each classroom receives, monitors, and cares for a batch of shad eggs as part of this hands-on approach to learning about water quality, fisheries science, ecology, and history. Fry hatch within 4–5 days and are then released by the students in their river basin of origin. Teachers in the program also participate in an overnight canoe trip along the Roanoke River in late April or early May to explore the river-swamp ecosystem and its resources and to gain valuable insight to take back to their classrooms.

As they grow, the fry move downstream, and come together in schools. They will eventually leave the river and move into the sounds and then to the ocean. They will remain in the ocean for 4–6 years and then return to spawn in their native river basin in the spring to complete the life cycle. The NCWRC sample the young shad (collecting genetic material) as they move downstream and prior to moving into

the sounds. They use this information to determine the proportion of shad that have been reared in the state and federal hatcheries (including the schools') compared to shad that were spawned directly in the river. These data help the NCWRC determine the management strategies for the American shad fishery. Having the schools be part of this restoration program is a valuable educational tool.

The Shad in the Classroom Program is the result of many dedicated partners. The program is managed by the Museum and it receives significant logistical and financial support from the Albemarle-Pamlico National Estuary Program (APNEP), the NCWRC, and the USFWS. Very important to the program are the many volunteers who generously give their time to enhance the program and the dedicated teachers.

The Shad in the Classroom Program has reached 99 classrooms from 2009 to 2014 and many thousands of students. Between 2013—2014, approximately 5,800 students were reached (prior to 2013, the numbers of students were not tracked). Through their observations and experiences, students learn concepts related to the American shad's survival, the species cultural and biological importance, its ecological connections to other species and habitats, and the significance of genetic integrity. Teachers also integrate various other disciplines into the program, such as math, social studies, technology, art, literacy, and writing. The program heightens knowledge and awareness in future generations of an important migratory fish, the American shad.

ACKNOWLEDGEMENTS

We would like to acknowledge all of the teachers and volunteers who help implement the Shad in the Classroom Program each year. The teachers and volunteers are dedicated to making the program a success and are invaluable. Specific individuals who assisted with various aspects of the program for 2014 are listed below.

Workshop Speakers

Ben Ricks ben.ricks@ncwildlife.org – (NCWRC District Biologist)

Dr. Heather Evans heatherkevans@msn.com – (Museum Researcher – assisted with genetics lecture)

Dr. Jesse Fischer jessefischer@gmail.com – (NCSU Post-doc Researcher)

Dr. Joe Hightower jhightower@ncsu.edu – (NCSU Professor)

Additional Education

Fish Dissection Lecture

Dylan Owensby dpowensb@ncsu.edu – (NCSU Grad Student)

Gus Engman acengman@ncsu.edu – (NCSU Grad Student)

Dr. Jesse Fischer jessefischer@gmail.com – (NCSU Post-doc Researcher)

Kevin Hining kevin.hining@ncwildlife.org – (NCWRC District Biologist)

Laura Belica labelica@ncsu.edu – (NCSU Grad Student)

Tomas Ivasauskas tjivasau@ncsu.edu – (NCSU Grad Student and helped coordinate with the graduate students)

Electrofishing Demonstration

Ben Ricks ben.ricks@ncwildlife.org – (NCWRC District Biologist)

Kyle Rachels kyle.rachels@ncwildlife.org – (NCWRC Assistant District Biologist)

Water Quality and Invertebrate Sampling Program

Kris Smith – kris.smith@ncwildlife.org – (NCWRC Wildlife Information and Education Specialist)

Egg Delivery and Larvae Release Assistance

Bill Crowell bill.crowell@apnep.org – (APNEP Director)

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Tamara Poles Tamara.Poles@naturalsciences.org – (Museum Coordinator of Distance Learning)

Wilson Laney wilson_laney@fws.gov – (USFWS Fishery Biologist)

River Days – Geodome

Art Howard – art@artworkhd.com – (Video Production)

Karen Polk – karen.polk@naturalsciences.org – (Museum River Days Specialist)

Marie English – marie.english@ncdenr.gov – (APNEP AmeriCorp Member)

Mickey Sorrell – mickey.sorrell@ncdenr.gov – (Natural Heritage Program AmeriCorp Member)

In addition, we are very appreciative of the fish donations for the 2014 dissection lectures from Rich Noble, Phil Doerr, and fellow anglers, the NCSU Student Subunit of the NC Chapter of the American Fisheries Society (chain pickerel removal event), and the NCWRC's Armstrong Hatchery. American shad eggs were generously provided by Jeff Evans and the staff at the Watha State Fish Hatchery and Stephen Jackson and the staff at the Edenton National Fish Hatchery.

Background and Partners

There are many programs throughout the U.S. that employ a similar method and bring fish and their habitats into the classroom. In North Carolina, Trout in the Classroom began in 2007 and Shad in the Classroom began in 2009. Trout in the Classroom is administered by the North Carolina Trout Unlimited Chapters and it started with two schools and now has 37 schools (2014) in North Carolina. Schools receive between 100 and 150 trout eggs (embryos) and they raise them about 7 months to the fingerling stage prior to release. The cost of the trout program is about \$900 per classroom (includes cost of cooling system).

In addition to North Carolina, several states participate in similar shad in the classroom programs: Delaware, Maryland, New Jersey, Pennsylvania, Virginia, and West Virginia, and the District of Columbia (Figure 1). A number of participating states are part of the Interstate Commission on the Potomac River Basin (ICPRB). The Delaware River Shad Fishermen's Association is another large organization that works with a shad in the classroom program. Some of the names used for these programs include Shad in the Classroom, Schools in Schools, and Shad in Schools. Some of the states also have a Trout in the Classroom program and some even have Perch or American eels in the Classroom Programs.

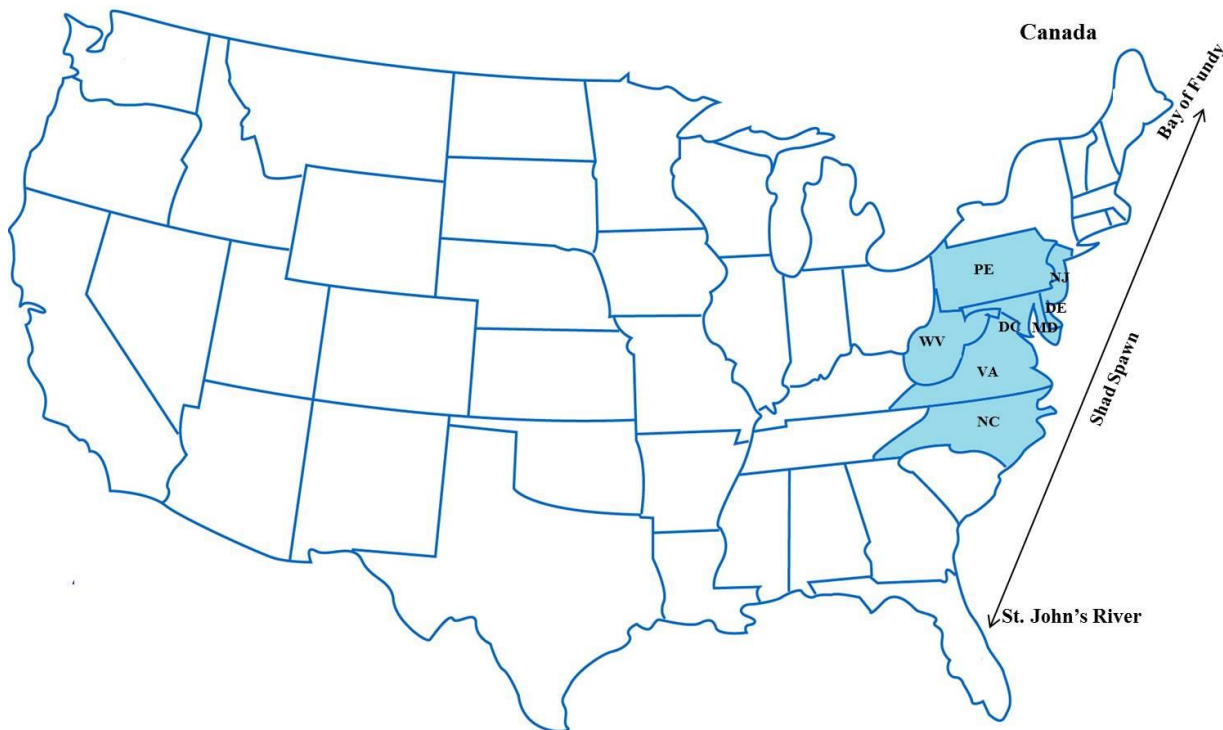


Figure 1. —Map of the states we found to participate in some version of a shad in the classroom program: Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia, and the District of Columbia. Arrow depicts American shad spawning distribution which ranges from the Bay of Fundy in Canada to the Saint John's River in Florida.

In North Carolina, the United States Fish and Wildlife Service (USFWS) started a pilot American shad program with four schools in 2009. Two of those school programs were administered by the North Carolina Wildlife Resources Commission (NCWRC), Education Section. The following year (2010) the USFWS partnered with the North Carolina Museum of Natural Sciences (Museum), and the program grew to 13 schools (USFWS funding), three of which were administered by the NCWRC, Education Section. Beginning in 2011, the Museum assumed control of the Shad in the Classroom program and worked with 19 classrooms [with funding provided by the Abermarle-Pamlico National Estuary Partnership (APNEP), Dominion Power, and National Fish and Wildlife Foundation], while the NCWRC, Education Section continued a separate program. Under the Museum’s guidance (and with funding provided solely through APNEP), the Shad in the Classroom program reached 20 classrooms each in 2012 and 2013, and 23 classrooms in the 2014 program year. Note that these numbers reflect the number of tanks that are in a school; some schools had multiple classrooms sharing in the shad rearing or at least observing the program. A comprehensive list of the participating schools (2009 – 2014) is included in Table 1.

Table 1. Schools Participating in the North Carolina Shad in the Classroom Program (2009–2014)

Release Basin/School	Number of Classrooms by year					
	2009	2010	2011	2012	2013	2014
Cape Fear River Basin						
Harnett Central Middle School (NCWRC)	1	1				
Lake Rim Elementary (NCWRC)	1	1				
Overhills Elementary (NCWRC)		1				
Neuse River Basin						
Angier Elementary					1	1
Broughton High School						2
Bunn High School				1	2	2
Centennial Campus Magnet Middle School	1	1				
Central Park School for Children					1	1
Chatham Central High School						1
Chestnut Grove Middle School				1		
Daniels IBMYP Magnet Middle School		1	1	1	1	2
Don D. Steed Elementary				1		
Exploris Middle School		1	1	1	1	1
East Wake Middle School		1	2	2	2	2
East Wake School of Integrated Technology						1
Forest Pines Dr Elementary					1	
Fuquay Varina Middle School						1
Hall Woodward Elementary				1	1	
Lakewood Montessori Middle School					2	2
Lead Mine Elementary	1	1	1			
Lillington Shawtown Elementary			1	1		
McLauchlin Elementary				1		
Mineral Springs Middle School						1
Sandy Grove Middle School				1	1	

Table 1. Schools Participating in the North Carolina Shad in the Classroom Program (2009–2014)
Continued

Release Basin/School	Number of Classrooms by year					
	2009	2010	2011	2012	2013	2014
Neuse River Basin						
South Asheboro Middle School				1		
South Iredell High School					1	1
South View High School				1		
Southern Vance High School				1	1	1
Speas Elementary				1		
The Oakwood School				1		
Tiller School Elementary (Carteret County Charter School)					1	1
Upchurch Elementary				1	1	1
West Hoke Elementary				1		
Woods Charter Middle School				1	1	1
Roanoke River Basin						
Bartlet Yancey High School		1				
Chestnut Grove Middle School		1	1	1		
Don D. Steed Elementary			1			
Hall Woodward Elementary			1			
Hawk Eye Elementary			1			
Hertford County High School						1
McLauchlin Elementary			1			
Red Oak Middle School					2	
Rockfish Hoke Elementary			1			
Sandy Grove Middle School			1			
Scurlock Elementary			1			
Southern Vance High School		1	1			
Speas Elementary		1	1			
The Oakwood School			1			
Upchurch Elementary			1			
West Hoke Elementary			1			
Windsor Elementary		1				
Total Number of Schools	4	13	18	19	16	17
Total Number of Classrooms	4	13	19	20	20	23

Current new tank construction costs approximately \$300 per tank system. Other expenses include tank refurbishment, chemical resupply, teacher training workshop, teacher professional development trek, school field trips to release sites, travel for eggs and delivery, presentations and conferences, part-time staff, Geodome supplies and contractors, and museum overhead. Programs from other states have reported the costs for tank construction and running their program ranges from \$550 to \$2,000 per system (with some programs, some of those costs are due to a cooling system).

In 2013 and 2014 each school received about 1,000 eggs from the NCWRC. The Neuse River broodstock fish are brought to the Edenton National Fish Hatchery and the Roanoke River broodstock fish are brought to the Watha State Fish Hatchery. Originally, American shad fry were released in the river basin closest or most convenient to the school. However, this was not in-line with the NCWRC's American shad management goals of keeping shad in their specific watershed. Therefore, since 2011, fry are only released in the river basin of their parentage, and since 2013, Roanoke basin fish are specifically only released at the NCWRC boat ramp at Weldon on the Roanoke River.

In summary, the Shad in the Classroom program has been led and administered by the Museum since 2011. Over the years, state and federal agencies and NCSU have played significant roles in the implementation of the program, including:

- Abermarle-Pamlico National Estuary Partnership
- Dominion Power
- National Fish and Wildlife Foundation
- North Carolina State University
- North Carolina Wildlife Resources Commission
- United States Fish and Wildlife Service

American shad have ecological, economic, and historical importance to North Carolina and much of the eastern coast of the U.S. Through the Shad in the Classroom program, students get a hands-on and real-life connection with learning about their environment while addressing the importance of American shad restoration and water quality. Teachers report a great enthusiasm by themselves and their students for the program.

Shad in the Classroom Program 2014 Report

This report summarizes the activities that were accomplished for the 2014 Shad in the Classroom Program. Twenty-three classes at 17 different schools participated in the program: 4 elementary, 10 middle, and 9 high school classes. We increased the program by three classes from 2013. We originally accepted 27 classrooms, but four determined that they were unable to commit to the program this year partly due to changes in schedule complicated by make-up/snow days.

Yearly program planning began with forming a timeline, reviewing applications, and conducting a tank and parts inventory. All new teachers and several returning teachers attended an orientation and training session in February. Returning to their schools, they typically began preparing their classrooms for the arrival of the shad eggs 2–4 weeks prior to receiving the eggs in April. American shad broodstock were collected approximately one week later than expected due to the cold winter and water temperatures and the shad not yet being on the spawning grounds. Most classes released the shad larvae on the Thursday or Friday of the week that they received them; however, this year one classroom retained half of their shad fry for an additional week, feeding them on brine shrimp that they raised in their classroom. Many of the teachers took advantage of either (or both) a fish dissection lecture that we coordinated with NCSU graduate students and post doctorates or a shad printing (Gyotaku) activity and supplies that we made available.

This year, we initiated the ‘River Days’ program to reach students and communities along the Roanoke River. We used the Museum’s inflatable immersion theater, the Geodome, to show a video production entitled ‘We are the River’ documenting the cultural and natural history, conservation, and connection of local communities to the Roanoke River. Contract staff and Americorps members presented supplemental activities to build on the video content.

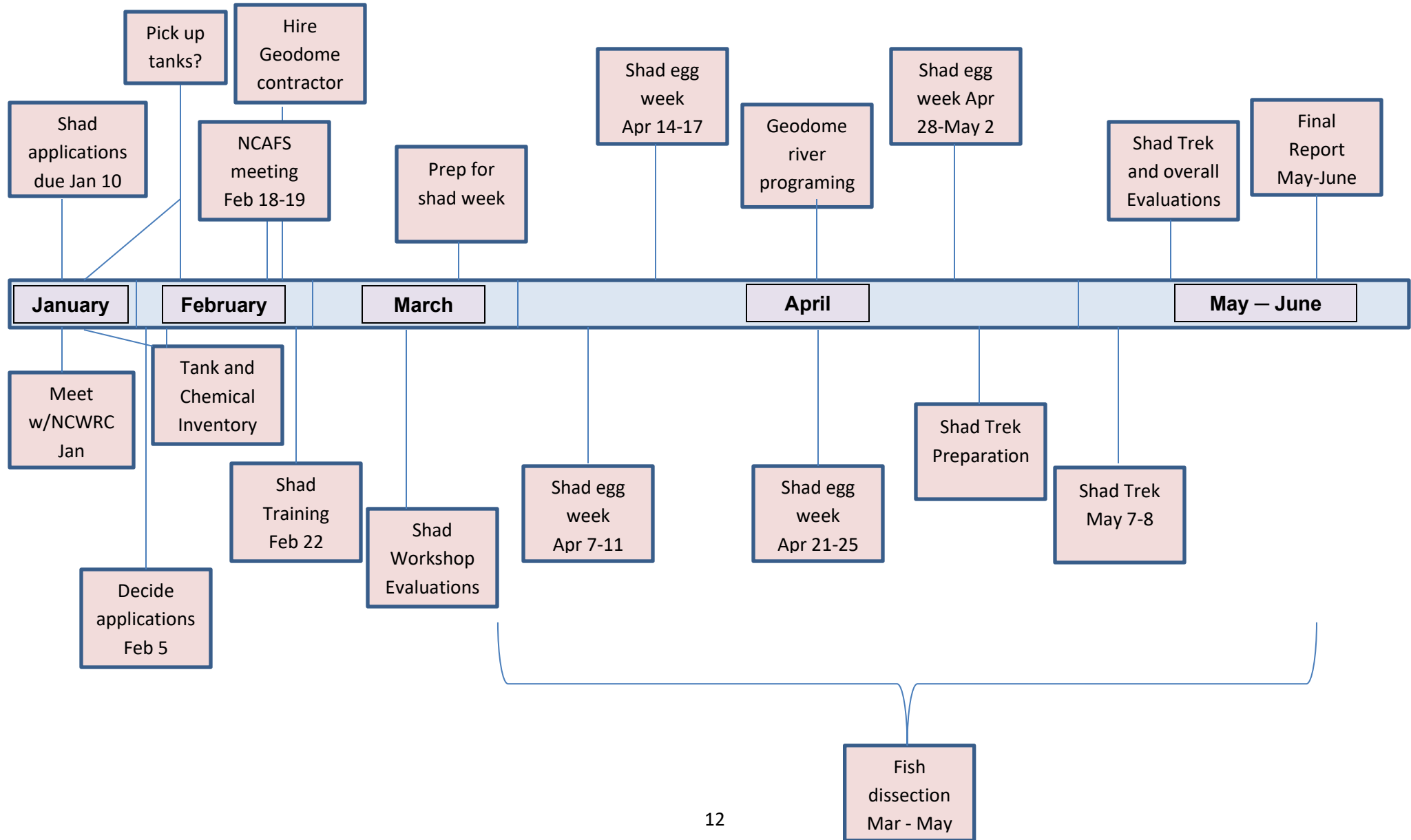


Photo 1. Brine shrimp hatchery



Photo 2. American shad larvae with brine shrimp in its stomach.

Shad in the Classroom 2014 Timeline



Tank Inventory

At the start of the program, tank parts and chemicals were inventoried and items purchased as needed. Tanks were retrieved from schools no longer participating in the program. New tanks were constructed and old tanks refurbished, as needed, with the assistance of Museum exhibits staff. An updated inventory list is on file.

Teacher Orientation and Training

A teacher orientation and training session was conducted on 22 February 2014. Danielle Pender, Melissa Dowland, and Megan Chesser co-led the session. Ben Ricks (NCWRC), Jesse Fisher (NCSU), and Joe Hightower (NCSU) were guest lecturers, and Heather Evans (Museum) assisted with the genetics lesson. Teachers were provided information about American shad life history, restoration, and management. They received equipment and instructions for raising shad and learned ways to incorporate shad and aquatic ecology into their curriculum. Teachers were provided with hands-on fish anatomy, morphology, and dissection lessons and participated in a shad printing (Gyotaku) exercise. Meeting in a central location with researchers, collaborating partners, and museum program staff facilitated networking among all teachers and schools involved in the project. Seventeen teachers attended the 2014 workshop. Of those, 15 responded to the survey regarding the workshop. All teachers reported that they were very to extremely satisfied with the workshop and they learned the concepts very to extremely well (Table 2). The survey contained 10 questions; however, one of the questions was purely qualitative (asked the teachers how they intend to use the workshop experience in their teaching) and is therefore not included in the table.



Photo 3. Jesse Fisher, Dissection Lecture



Photo 4. Teachers, Gyotaku fish printing

Table 2. Workshop Survey Results

Question	Response variable														
How well did the workshop explain the importance of the shad restoration and management program?	80% (12) extremely well; 20% (3) very well														
How well did the workshop explain the life history of shad?	73% (11) extremely well; 27% (4) very well														
How well did the workshop explain the proper components to raising shad eggs to the larval stage?	53% (8) extremely well; 48% (7) very well														
How confident do you feel in building the shad tank system on your own?	80% (12) extremely confident; 20% (3) very confident														
How resourceful was the leadership team in helping you with your questions about the program?	73% (11) extremely resourceful; 27% very resourceful (4)														
How comfortable do you feel in contacting the other teachers that you met at the workshop with questions?	53% (8) extremely comfortable; 40% (6) very comfortable; 7% (1) moderately comfortable														
How sufficient was the information you learned to incorporate shad into your curriculum?	40% (6) extremely sufficient; 60% (9) very sufficient														
What aspects of the workshop were useful? Please choose all that apply.	<table border="1"> <thead> <tr> <th>Life History</th> <th>Shad Restoration</th> <th>Dissection</th> <th>Videos</th> <th>Tank Building</th> <th>Genetics</th> <th>Sharing Experience</th> </tr> </thead> <tbody> <tr> <td>100% (15)</td> <td>93% (14)</td> <td>93% (14)</td> <td>93% (14)</td> <td>80% (12)</td> <td>80% (12)</td> <td>100% (15)</td> </tr> </tbody> </table>	Life History	Shad Restoration	Dissection	Videos	Tank Building	Genetics	Sharing Experience	100% (15)	93% (14)	93% (14)	93% (14)	80% (12)	80% (12)	100% (15)
Life History	Shad Restoration	Dissection	Videos	Tank Building	Genetics	Sharing Experience									
100% (15)	93% (14)	93% (14)	93% (14)	80% (12)	80% (12)	100% (15)									
Overall, how satisfied are you with the workshop?	93% (14) extremely satisfied; 7% (1) very satisfied														

Egg Delivery and Larval Fish Release

We coordinated the arrival of the eggs and the release of the larval fish with the schools, hatchery, drivers, and fisheries biologists. This involved foremost the timing of the spawning of the American shad, but also took into account school schedules. American shad broodstock were collected approximately one week later than expected in 2014 due to the cold winter and water temperatures and the shad not yet being on the spawning grounds. Many people assisted with the delivery of the eggs and with the release of the larval fish and are mentioned in the acknowledgments.

Eight classes received eggs on Monday, 14 April 2014. Of those, 6 classes released larval fish on Thursday, 17 April 2014 in the Neuse Basin, one released larval fish on Friday, 18 April 2014 in the Roanoke River Basin at Weldon, and 1 class lost all of their fish (Table 3, Figure 2). Nine classes received eggs on Monday, 21 April 2014. Of those, 3 classes released larval fish on Thursday, 24 April 2014, and 6 released on Friday, 25 April 2014 in the Neuse River Basin. The remaining six classes received their eggs on Monday, 28 April 2014 and all released larval fish on Friday, 2 May 2014 in the Neuse River Basin. One class raised a second tank of shad and fed them



Photo 5. Central Park School for Children students release at Fall of Neuse State Park



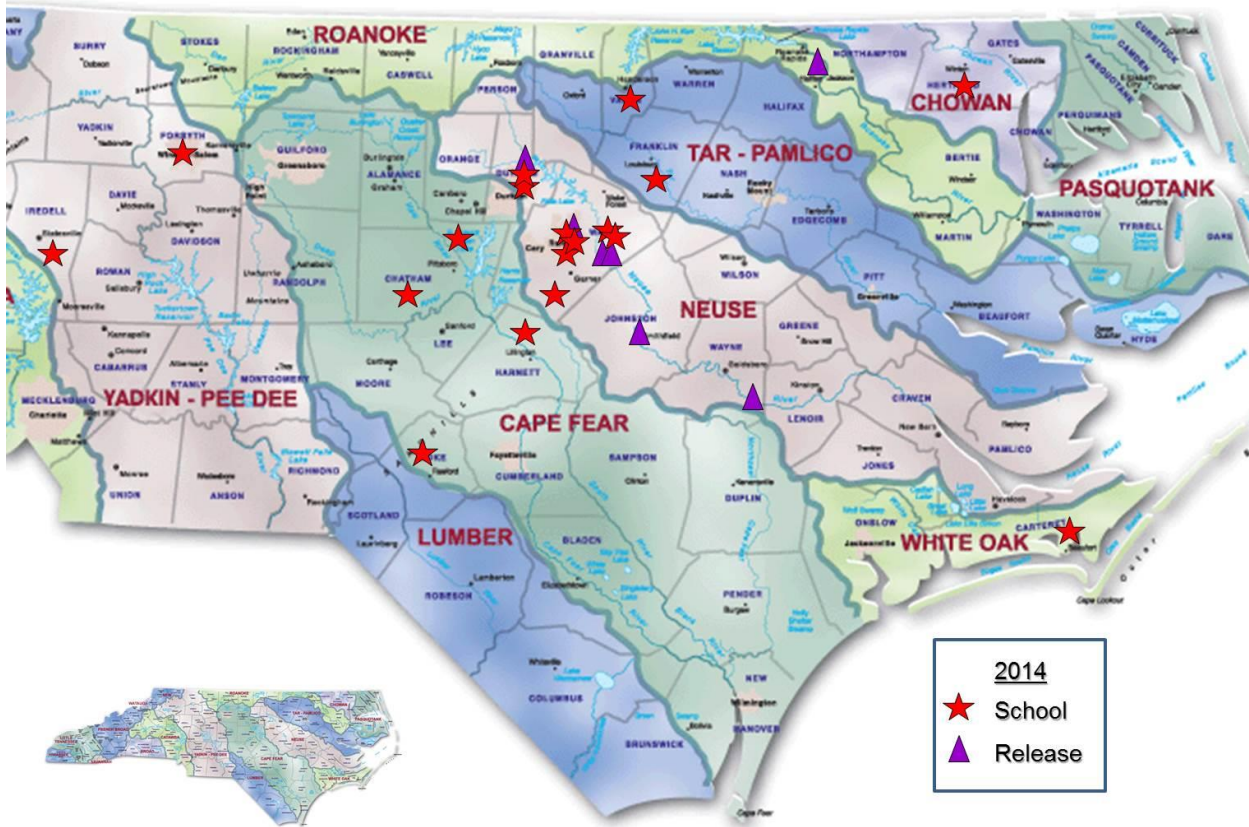
Photo 6. Ben Ricks and Kyle Rachels electrofishing demonstration for East Wake Middle School and Bunn High School at Milburnie Dam

on brine shrimp. Those fry were released on Thursday, 8 May 2014. Classes releasing in to the Neuse River Basin received approximately 23,000 eggs from the Edenton National Fish Hatchery (1,000 to each class, with the exception of one classroom which has two tanks and received 2,000 eggs). One school received eggs from Watha State Fish Hatchery (approximately 1,000 eggs total).

Table 3. Egg and Larval Release Timing and Release Site Information

Educator	School	Received Eggs	Released Eggs/Larva	Release Site
Anne Howell	Hertford County HS	4-14-2014	4-18-2014	Roanoke River at Weldon
Christina Edmiston	Upchurch ES	4-14-2014	4-17-2014	Neuse (Anderson Point)
Dorothy Holley	East Wake School of Integrated Tech.	4-14-2014	4-17-2014	Neuse (Milburnie)
Edwin Davis	Broughton HS	4-14-2014	4-17-2014	Neuse (Lassiter Mill Dam)
Jennifer Howard	Southern Vance HS	4-14-2014	4-17-2014	Neuse River (Cliffs of the Neuse State Park)
Judy Compton	Central Park School for Children	4-14-2014	4-17-2014	Neuse River (Cliffs of the Neuse State Park)
Laura Lane	Mineral Springs MS	4-14-2014	4-17-2014	Neuse (Eno River)
Matthew Lanner	Fuquay Varina MS	4-14-2014	4-17-2014	Neuse (Smithfield)
Courtney Millis	Lakewood Montessori MS	4-21-2014	4-25-2014	Neuse (Eno River)
Emily Coppes	Angier ES	4-21-2014	4-25-2014	Neuse (Anderson Point)
Jane Forde	Broughton HS	4-21-2014	4-24-2014	Neuse (Lassiter Mill Dam)
Laine Staton	Lakewood Montessori MS	4-21-2014	4-25-2014	Neuse (Eno River)
Leslie K. Jones	Chatham Central HS	4-21-2014	4-24-2014	Neuse (Cliffs of the Neuse State Park)
Richard Kowaleski	Daniels IBMYP Magnet MS	4-21-2014	4-25-2014	Neuse (Lassiter Mill Dam)
Sarah Lancaster	Daniels IBMYP Magnet MS	4-21-2014	4-25-2014	Neuse (Lassiter Mill Dam)
Shannon Hardy	Exploris MS	4-21-2014	4-25-2014	Neuse (Milburnie Dam)
Sonja Younger	Woods Charter MS	4-21-2014	4-24-2014	Neuse (Eno River)
Karen Curry	East Wake MS	4-28-2014	5-2-2014, 5-8-2014	Neuse, (Milburnie Dam)
Kelly Riley	Tiller ES	4-28-2014	5-2-2014	Neuse River (Cliffs of the Neuse State Park)
Mary Beasley	Bunn HS	4-28-2014	5-2-2014	Neuse (Anderson Point)
Melissa Oakley	Bunn HS	4-28-2014	5-2-2014	Neuse (Anderson Point)
Michelle Amato	East Wake MS	4-28-2014	5-2-2014	Neuse (Anderson Point)
Sarah "Kristen" Bright	South Iredell HS	4-28-2014	5-2-2014	Neuse (Eno River)

Figure 2. — School and release site locations (approximate)



Overall, the shad rearing and release was successful for most schools. Each class was to receive approximately 1,000 eggs; however, counts may differ as to what the school actually reported receiving. A few of the schools had problems with low pH combined with higher water temperature, and one of those lost all of their larval fish and eggs. The combination of low pH (< 6.8) and higher temperature ($\geq 70^\circ \text{F}$) is particularly stressful to the shad fry and was noted to occur and contribute to lower success at a few schools last year as well. Percent survival for each tank ranged from as low as 0% up to 99.5% and averaged 53% (Table 4). Ten classes averaged $\leq 50\%$, 13 averaged $\geq 51\%$, and 9 averaged $\geq 75\%$ survival to release.

Table 4. Egg and Larval Survival and Release Numbers

Educator	School	No. Eggs Received	No. Eggs/Larva Survived to Release	Percent Survival
Anne Howell	Hertford County HS	1,100	600	54.55
Christina Edmiston	Upchurch ES	900	800	88.89
	Lakewood			
Courtney Millis	Montessori MS	1,000	30	3
	East Wake School of			
Dorothy Holley	Integrated Tech.	1,000	600	60
Edwin Davis	Broughton HS	1,000	773	77.3
Emily Coppes	Angier ES	200	100	50
Jane Forde	Broughton HS	1,000	921	92.1
Jennifer Howard	Southern Vance HS	1,150	884	76.87
	Central Park School			
Judy Compton	for Children	500	100	20
Karen Curry	East Wake MS	2,000	1900	95
Kelly Riley	Tiller School	1,000	450	45
	Lakewood			
Laine Staton	Montessori MS	1,000	850	85
Laura Lane	Mineral Springs MS	1,000	0	0
Leslie K. Jones	Chatham Central HS	400	375	93.75
Mary Beasley	Bunn HS	1,200	54	4.5
Matthew Lanner	Fuquay Varina MS	643	482	74.96
Melissa Oakley	Bunn HS	1,200	50	4.17
Michelle Amato	East Wake MS	1,000	950	95
	Daniels IBMYP			
Richard Kowaleski	Magnet MS	700	50	7.14
Sarah "Kristen" Bright	South Iredell HS	1,400	450	32.14
	Daniels IBMYP			
Sarah Lancaster	Magnet MS	500	75	15
Shannon Hardy	Exploris MS	1,100	600	54.55
Sonja Younger	Woods Charter MS	1,000	995	99.5

Additional Education

In addition to learning concepts related to the shad survival, cultural and biological importance of the species, its ecological connections to community assemblages and habitat, and the significance of genetic integrity, we have made available additional educational activities to enhance the program. All teachers responded to the program evaluation survey (Table 5). This year we also coordinated a water quality and invertebrate sampling program at one release (1 classroom) administered by Kris Smith (NCWRC, Wildlife Information and Education Specialist) and helped coordinate (along with East Wake Middle School) an electrofishing demonstration at another release (4 classrooms, 2 at East Wake Middle School and two at Bunn High School) administered by Ben Ricks (NCWRC, District Biologist) and Kyle Rachels (NCWRC, Assistant District Biologist).

American Shad Molds – Fish Printing

This year we had 8 American shad molds made for fish printing (Gyotaku) and made two travel kits (4 shad molds each) available for the teachers to borrow and use in their classrooms. Eight teachers took advantage of these available resources and the new activity, and reported that the exercise enhanced the learning experience for their students.

Fish Dissection

We coordinated with the NCSU NC Chapter of the American Fisheries Society Student subunit to conduct fish anatomy/morphology and dissection lessons. Five student and post-doc members volunteered (listed in acknowledgments) and also Kevin Hining (NCWRC District Biologist) to conduct these lessons. Sixteen teachers requested to have the dissection lecture at their school; however, we were only able to accommodate 8 classes. All teachers that were able to participate in this class reported that the activity greatly enhanced the learning experience for their students.

Curriculum Activities and Videos

Last year a genetic based educational exercise titled “Who’s your Shaddy” was developed with the help of Drs. Morgan Raley and Heather Evans of the Museum. We updated the exercise this year to be more comprehensive, include more details, and increased usability. Four teachers (3 high schools and 1 middle school) reported using this exercise and reported that it was “just right” as far as understandability and complexity for their students. One middle school teacher reported not using the genetic exercise due to its complexity. Additional on-line curriculum activities are available for the teachers to use including Food Web Activities (13 reported as useful), GIS Watershed Activity (8 reported as useful), Wishes of Fishes Activity (8 reported as useful), Non-Fiction Reading Activity (16 reported as useful), and Hands-on Activities for Students (14 reported as useful). Seven videos were created for the program previously and all teachers reported using at least some videos and many reported that they were very useful.

Table 5. Additional Education Survey Results

Question	Response variable
Fish Printing – enhance learning?	9% (2) greatly enhanced; 17 (4) enhanced; 9% (2) somewhat; 65% (15) did not use
Fish Dissection – enhance learning?	31% (7) greatly enhanced; 65% (15) did not use; 4% (1) not yet happened at time of survey
Genetic Exercise – complexity or understanding?	22% (5) just right; 78% (18) did not use
Food Web Activities – usefulness?	43% (10) very useful; 10% (2) useful; 4% (1) somewhat useful 43% (10) did not use
GIS Watershed Activity – usefulness?	13% (3) very useful; 17% (4) useful; 4% (1) somewhat useful 66% (15) did not use

Table 5. Additional Education Survey Results – Continued

Question	Response variable
Wishes of Fishes Activity – usefulness?	26% (6) very useful; 4% (1) useful; 4% (1) somewhat useful 66% (15) did not use
Non-Fiction Reading Activity – usefulness?	39% (9) very useful; 13% (3) useful; 18% (4) somewhat useful 30% (7) did not use
Hands-on Activities – usefulness?	53% (12) very useful; 4% (1) useful; 4% (1) somewhat useful 39% (9) did not use
Video -Add the eggs – usefulness?	48% (11) very useful; 13% (3) useful; 9% (2) somewhat useful 30% (7) did not use
Video –Build the Tank – usefulness?	26% (6) very useful; 22% (5) useful; 52% (12) did not use
Video – Fish Passage – usefulness?	70% (16) very useful; 17% (4) useful; 13% (3) did not use
Video – History – usefulness?	83% (19) very useful; 17% (4) useful
Video – It is Time usefulness?	52% (12) very useful; 26% (6) useful; 9% (2) somewhat useful 13% (3) did not use
Video - Lifecycle – usefulness?	87% (20) very useful; 13% (3) useful
Video – Overview – usefulness?	52% (12) very useful; 35% (8) useful; 13% (3) did not use

Shad Trek – Secrets of the Swamp

Nine participating teachers were originally scheduled to attend the shad trek; however, extenuating circumstances (family illness or injury) prevented several teachers from coming at the last minute. On Wednesday, 7 May 2014, 5 teachers, 1 AmeriCorp member (who worked as a facilitator for the River Days component of the program), and 3 museum staff canoed approximately 3 and 3/4 miles on Gardner Creek and Upper Deadwater Creek, tributaries of the Roanoke River. Camping took place at Beaver Lodge and Beaver Tail platform campsites. On Thursday, 8 May 2014 we completed the approximately 2 and 1/2 mile downstream canoe trip to the Astoria Landing Access Area (NCWRC). During the two day trip, the group learned about local and Neotropical migrant birds, aquatic invertebrates, reptiles, amphibians, fish, and plants in the Roanoke River ecosystem. Teachers responded very positively to the Trek with 100% of teachers indicating that the workshop increased their knowledge of science, their understanding and appreciation of the natural environment, and their comfort in the natural world. They also stated that they would use the workshop in their teaching and would recommend the workshop to other educators.



Photo 7. Teachers viewing a Prothonotary warbler nest

River Days – Geodome

The “River Days” component of the Shad in the Classroom program began this year (2014), and was primarily based around the Museum’s travelling, inflatable immersion theater, the Geodome. Over the course of the “River Days” week, the geodome visited 6 schools (all public, Title 1 schools) as well as Scotland Neck Senior Center. For the participating schools, 18 hours of programming (total) was provided, serving grades 4 through 8 (totaling 645 people). Each class rotated through the following three activities.

1. *We Are the River* video in the Geodome with accompanying river mural
2. *Who Lives Here?*-- a study of plant and animal biodiversity using hula hoop sample plots
3. *Hooks and Ladders*--fish migration enactment/game, or *The Incredible Journey* – a water cycle activity



Photo 8. Students participating in Incredible Journey water cycle activity

Participants found the program to be engaging and informative. The video piece and “River Days” program as a whole were very well received, and many people expressed interest in future events.

Budget

APNEP provided \$3000 in funding this year. The following table summarizes program spending during 2014.

Cost Category	Estimated	Actual 2014
Salaries & Wages <i>(by position)</i>	\$13,570	\$12,431
<i>Shad in the Classroom Specialist</i>	\$7,820	\$8,431
<i>Geodome Contractor 1*</i>	\$2,700	\$0
<i>Geodome Contractor 2*</i>	\$900	\$0
<i>Friends of the Museum Accountant</i>	\$2,150	\$4,000
Benefits <i>(by position)</i>		
Subtotal Salaries & Wages:	\$13,570	\$12,431
Supplies *	\$3,850	\$7,710
Travel*	\$9,740	\$1,819

Subcontracts*		\$6,592
Other Direct Costs *	\$2,840	
TOTALS:	\$30,000	\$28,551

Total amount of funds requested from APNEP (<i>\$30,000 maximum</i>)	\$30,000	\$28,551
Total amount of non-federal matching funds		\$
Total amount of leveraged funds (<i>this includes funding from all other sources</i>)		\$
Total amount of in-kind contributions (<i>this includes the value of all volunteer hours, donated equipment and donated materials leveraged</i>) – Museum staff time - \$7000; Use of state vehicles (not including gas) - \$1000	\$8,000	\$8,000
TOTAL CAMPAIGN COST:		\$36,551

*NOTE: Due to discrepancies in categorizing spending between Education staff planning and accountant invoicing, amounts spent in each category varied from what was originally indicated. For instance, travel by school grounds to release sites was originally categorized as travel; it was invoiced as contract services. Additionally, Geodome Contractor 1 was originally indicated as salaries & wages but was invoiced as contract services. Furthermore, Geodome Contractor 2 was unnecessary because Americorps volunteers from APNEP and Natural Heritage took that role. Overall, funds were spent as intended to meet needs and accomplish program goals.

Program Outcomes

Student Impact

The Shad in the Classroom Program exposes students to important science and math concepts including those listed below.

1. History, cultural and biological importance, and life cycle of the American shad
2. The shad’s ecological connections to other species
3. The significance of genetic integrity to population studies
4. Scientific procedures for measuring, testing, collecting, and organizing data
5. Mathematics to estimate, calculate, and predict results
6. Charts, maps, and graphs to aid in using information
7. Information exchange among other classes in the school and to parents and adults

8. The delicate balance of nature and work toward conserving or improving natural resources
9. American shad restoration in rivers
10. Reporting and presentation techniques, both oral and written

This program provides a valuable experiential learning opportunity for students in the classroom that houses the tank (direct involvement) and those indirectly involved (e.g. collecting and recording water quality during their science period). There were 3,067 students directly involved with the Shad in the Classroom Program this year.

Public Outreach

Information on the Shad in the Classroom Program is available on the Museum's website. The program also receives a lot of publicity by word-of-mouth from those who have participated in the program previously (including teachers, students, and volunteers). The River Days – Geodome component reached 645 people in the week bridging April–May. Information on the Shad in the Classroom Program has been presented at regional conferences and meetings including those below.

- APNEP Ecosystem Symposium – 20 November 2013
- NCSU NC Chapter of the American Fisheries Society Student Subunit Meeting – 3 December 2013
- North Carolina Chapter American Fisheries Society Annual Meeting – 18 February 2014

Information on the Shad in the Classroom Program was published this year on the APNEP website under “Soundings” on 9 May 2014 and will be published in the North Carolina Chapter American Fisheries Society Summer Newsletter in 2014.

Future Planning

The shad models for fish printing (Gyotaku) and the fish dissection lectures were very well received and we plan to continue them for next year. We will continue to work with teachers to increase the clarity and scope of understanding of the genetics exercise, “Who’s Your Shaddy?” and we plan to upload it to the Museum’s website. We will look into the possibility of additional schools raising brine shrimp and feeding the shad fry. Some of the teachers mentioned that they were unaware or uncomfortable leading additional activities for students to perform at the release; therefore, we plan to make an educational packet to assist with release activities. We have consulted with state and federal biologists regarding the low pH and high temperature combination problem that some schools reported having and are working on a protocol to better address this problem.

This was a productive and fulfilling Shad in the Classroom year. Teachers and students provided positive feedback on all aspects of the program including the workshop, Trek, River Days – Geodome, and the overall program. All teachers participating in the Shad in the Classroom Program, except for one (leaving the school, but would like to be in program if she finds a new school), reported that they would like to continue with the program next year. At present, we have 6 new teachers on the waiting list for the program in 2015. A few new activities were implemented this year, and others were improved, which added to the students' overall learning experiences. We received invaluable assistance from partners and volunteers helping with the deliveries of eggs, attendance at releases, and educational lectures. Working with this program is a positive experience for all involved.