

Experimental Stocking of Inoculated American eels in the Susquehanna River Watershed

2015 Annual Report

PURPOSE: Payments to the eel stocking fund as mitigation for the Penn House Commons Redevelopment project.

PROJECT TITLE: Experimental Stocking of Inoculated American eels in the Susquehanna River Watershed

PROJECT OFFICER:

Steven P. Minkkinen, Project Leader, Maryland Fishery Resources Office, USFWS
U.S. Fish and Wildlife Service, 177 Admiral Cochrane Dr., Annapolis, MD 21401
phone: 410-573-4508, fax: 410-263-2608, e-mail: steve_minkkinen@fws.gov

Alternate contact:

Julie Devers, Fishery Biologist, Maryland Fishery Resources Office, USFWS
phone: 410-573-4508, e-mail: julie_devers@fws.gov

INTRODUCTION

American eel populations have been declining along the Atlantic coast. Although the Chesapeake Bay and tributaries support a large portion of the coastal eel population, the Susquehanna River comprises 43% of the Chesapeake Bay watershed and until recently was devoid of eels above Conowingo Dam. Construction of large mainstem dams in the early 1900's effectively closed the river to upstream migration of juvenile eels (elvers). Before dams were constructed, the annual harvest of silver eels in the Susquehanna River was nearly one million pounds. While eels were stocked in the Susquehanna and its tributaries sporadically from 1938 to 1980, there is currently no commercial harvest and very little recreational fishery for eels. Dams on the Susquehanna River not only eliminated a once abundant eel fishery; they likely had a profound effect on the way the ecosystem functions.

Research conducted by the U.S. Geological Survey (USGS), Northern Appalachian Research Laboratory (NARL) and the U.S. Fish and Wildlife Service (USFWS), Maryland Fishery Resources Office (MFRO) indicates that American eel is a successful host fish for the freshwater mussel, *Elliptio complanata* (eastern elliptio) in the Susquehanna River. The larvae (glochidia) of freshwater mussels must parasitize a host fish to complete metamorphosis to the independent juvenile life stage. Glochidia from eastern elliptio collected in the Susquehanna River have higher metamorphosis success rates on American eels ($\geq 90\%$ success) than on other fish species found in the Susquehanna River (Lellis et al. 2013). While eastern elliptio is the most abundant and widespread freshwater mussel species in the northeastern United States, there are fewer eastern elliptio in the Susquehanna River watershed than nearby watersheds, including the Potomac and Delaware (Lellis 2002, personal communication, James McCann, MDDNR). In some streams and rivers, they comprise the most abundant biomass of any fauna in a watershed and can provide great filtration capacity. For example, the estimated 280 million eastern elliptio in the Delaware River have the potential to filter between 2 billion and 6 billion gallons of water and remove 78 tons of sediment from the water column each day (Spooner and Lellis 2010). If eels are important to reproducing eastern elliptio populations in the Susquehanna River, restoring eels could also restore mussels, which could result in ecological benefits throughout the watershed.

PROBLEM STATEMENT

Many tributaries to the Susquehanna River have few or no eastern elliptio. In tributaries that have populations of eastern elliptio, stocking eels can benefit the mussels by providing a missing link in the reproductive cycle. However, restoring eastern elliptio to tributaries with

small or no populations of eastern elliptio could take many years. To jumpstart the reintroduction of eastern elliptio in streams where there are few or none, it may be more expedient to manually inoculate eels with eastern elliptio glochidia for release in selected streams.

HYPOTHESIS: Introduction of inoculated American eels to Susquehanna River tributaries will result in eastern elliptio population increases.

In order to test this hypothesis and as mitigation for the Penn House Redevelopment, the objectives of this project are to:

1. Release at least 2000 American eels inoculated with eastern elliptio glochidia over a 3 year period from 2014 to 2016 into Penns Creek, in Union County, PA.
2. Release at least 10% of the inoculated eels in cages in the stream.
3. Each year inoculated American eels are released; at least 15 eels will be retained for laboratory verification that attached glochidia transform to juvenile mussels.
4. Survey freshwater mussel populations downstream of caged eel locations to collect baseline mussel population data (2014/2015) and to assess recruitment to the mussel populations 4 years (2017) and 6 years (2019) after the first reintroduction of inoculated eels.

Penns Creek was chosen to test this hypothesis because there are relatively fewer mussels than Buffalo Creek, but we know that they do exist there.

METHODS

Eel translocation

Although Objective 1 (as stated above) was completed in 2014 with the release of 2100 American eels inoculated with eastern elliptio glochidia (detailed in the 2014 annual report), we attempted to inoculate additional eels for release in 2015. In order to do this, gravid female eastern elliptio were collected from Buffalo Creek near Lewisburg, PA on April 27, 2015, when water temperature was 11.4° C, and May 4, 2015, when the water temperature was 17.7°C, and collected from Penns Creek near Krazterville, PA on May 4, 2015, when water temperature was 15.5°C, and on May 7, 2015, when water temperature was 16.0°C. The mussels were held in a temperature controlled environment at 12.5 °C to delay glochidia release to coincide with eel

availability. An elver ramp was deployed below Conowingo Dam in 2015 from May 21, 2015 through September 9, 2015. Captured elvers were sedated, measured, and counted. Beginning on May 23, 2014, water temperature in the mussel tanks was raised approximately 1 degree each day until May 29, 2015 when the water temperature was 19.0°C. Tanks were siphoned each day after temperature reached 18°C. On June 8, mussel tanks were siphoned one last time. After examining water samples each day, we determined that no viable glochidia were released into the holding tanks from eastern elliptio collected in the spring of 2015. Therefore, no elvers were inoculated and released into cages in Penns Creek in 2015.

Mussel survey

Baseline mussel surveys were conducted in 2014 and 2015. Following qualitative surveys conducted in 2014 (detailed in the 2014 annual report), additional qualitative surveys were conducted in Penns Creek in Union County, PA in August, 2015 above the Rt. 104 Bridge in Penns Creek and above and below the Rt 1015 Br., adjacent to the Little Mexico Campground in Winfield (Figure 1, Table 1). Qualitative surveys were conducted at a 600 meter stream reach above Penns Creek Bridge and an 800 meter stream reach near Little Mexico Bridge. Using snorkeling equipment, the number of mussels and the search time were recorded after each 200 meter section to determine a CPUE (# mussels found per hour). In addition, quantitative surveys were conducted to estimate mussel abundance and assess presence of juvenile mussels in 2015. Quantitative surveys were conducted in August of 2015 at the following sites: above the Rt. 2003 bridge in New Berlin, above the Rt. 3003 bridge in Millmont, above the Rt. 235 bridge in Glen, above the Rt. 104 bridge in Penns Creek, adjacent to Stein Lane in Kratzerville, and above and below the Rt 1015 Br. adjacent to the Little Mexico Campground in Winfield (Figure

1, Table 1). All quadrats were excavated to 10 cm or to hardpan and sifted through a 5 mm² mesh screen in order to detect juvenile mussels. Counts of each species and length measurement were collected for all mussels (Figure 2). Quantitative and qualitative survey methods followed accepted protocol developed by Strayer and Smith (2003). Results of the quantitative mussel survey were analyzed using the Mussel Estimation Program (Version 1.1.4) developed by David R. Smith (USGS, Leetown Science Center, Leetown, WV) (Table 2).

RESULTS and DISCUSSION

While inoculation of 2100 American eels with eastern *Elliptio* glochidia and the subsequent stocking in cages in Penns Creek was successful in 2014, we were not able to replicate the stocking in 2015. From previous experience, we have found that eastern *Elliptio* become gravid around 12°C and release their glochidia at around 18°C. We collected several batches of mussels at varying temperatures. Although the mussels were held in similar conditions to previous years, none of the mussels that we collected released viable glochidia. We suspect that they either were not gravid at the time of collection or reabsorbed their glochidia at some time that they were held until American eels were collected. We plan to attempt to inoculate American eels again in 2016. The USGS Northern Appalachian Research Laboratory is currently holding eels through the winter so that we will have eels readily available when the mussels become gravid.

During 2014 and 2015 qualitative and quantitative surveys of Penns Creek, we found several sites that have pockets of freshwater mussels. While there is a broader diversity of mussel species in Penns Creek (6 species in comparison with 3 species in Buffalo Creek, north of Penns Creek, and 1 species in Middle Creek, south of Penns Creek), there are fewer mussels than

found in Buffalo Creek. In Buffalo Creek, there were 5.6 mussels/ m² (SE ± 0.41) at the highest density site. However, the mussel density at the highest density site at Stein Lane in Penns Creek, 2.8 mussels/m² (SE ± 0.49) was similar to that found at the highest density site in Middle Creek, 2.4 mussels/m² (SE ± 0.23). However when comparing only eastern elliptio density, Stein Lane had only 1.8 mussels/m² (SE ± 0.37) in comparison with 5.45 mussels/m² (SE ± 0.43) and 2.8 mussels/m² (SE ± 0.49) in Buffalo and Middle Creeks, respectively.

The length of the eastern elliptio found in Penns Creek (Figures 2 and 3) was similar to that found in baseline mussel surveys in Buffalo Creek in 2010 and Middle Creek in 2008. The average length of all eastern elliptio in found during quantitative surveys in Penns Creek was 68.0 mm (SE ± 9.4). This is similar to the average length of eastern elliptio found in Middle Creek, 75.1 mm (SE ± 13.2) but barely overlaps the length range of eastern elliptio found in Buffalo Creek, 83 mm (SE ± 14.9). There was 1 eastern elliptio found in Penns Creek under 30 mm (presumably juvenile) in comparison with 0 found in Middle Creek and 2 found in Buffalo Creeks during baseline surveys before eels were introduced.

FUTURE PLANS

In 2016, we will again attempt to inoculate American eels with eastern elliptio glochidia. At four years (2017) and six years (2019) after the first stocking of inoculated eels in Penns Creek, we will conduct mussel surveys near stocking sites. We will conduct qualitative mussel surveys and quantitative surveys at cage deployment sites to detect sub-adult mussels.

EXPECTED OUTCOME

At the completion of this project we hope to find an increase in juvenile eastern elliptio near the release sites. Mussel surveys throughout the project will indicate success when compared to baseline data.

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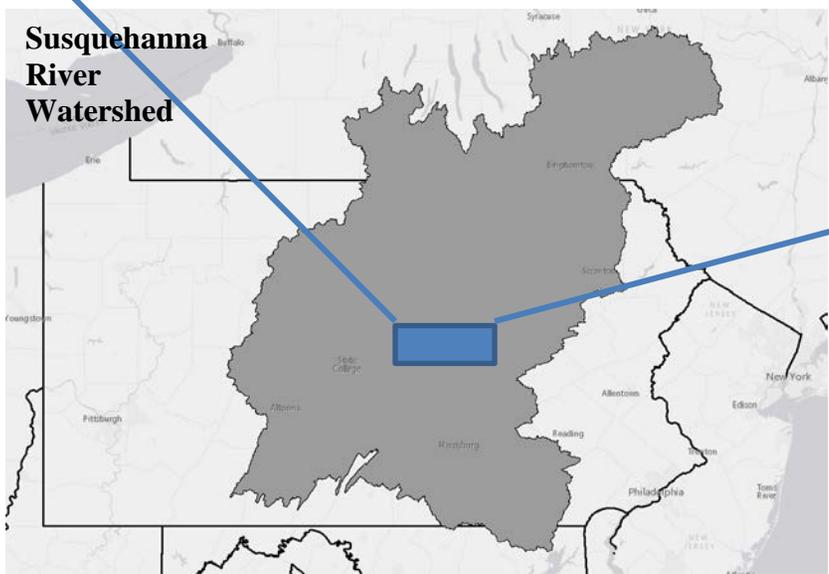
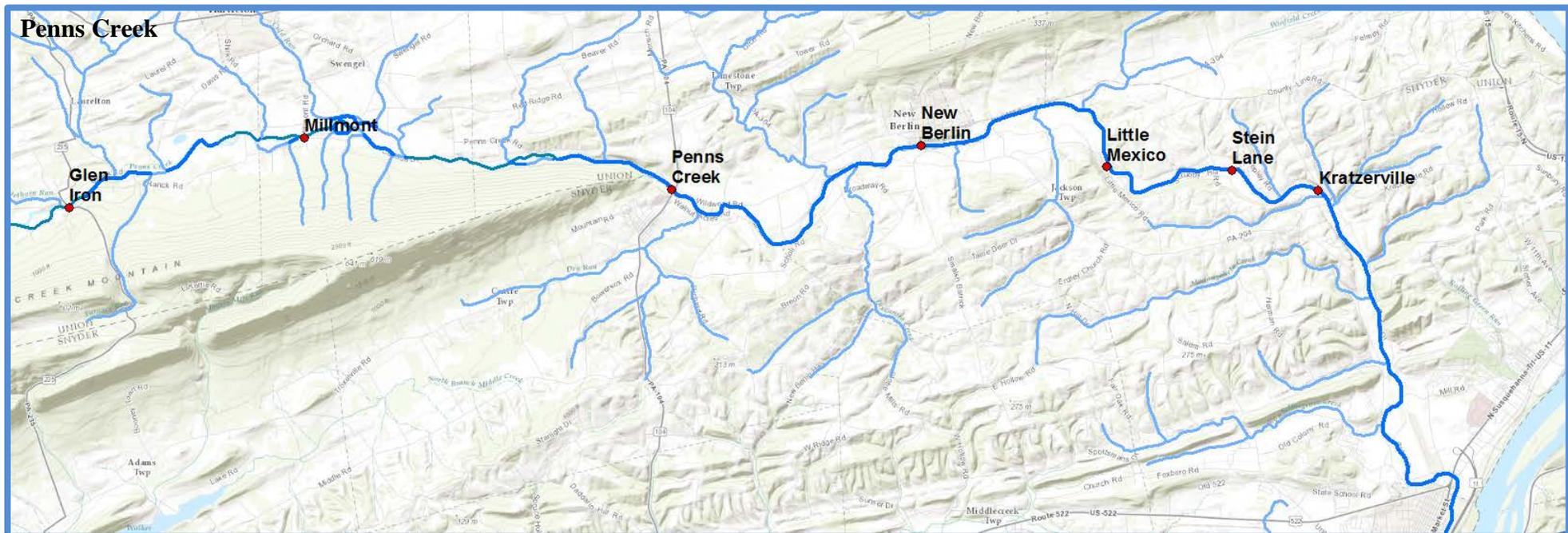


Figure 1. Penns Creek in the Susquehanna River Watershed, Union County, PA. Red dots indicate sites surveyed for freshwater mussels.

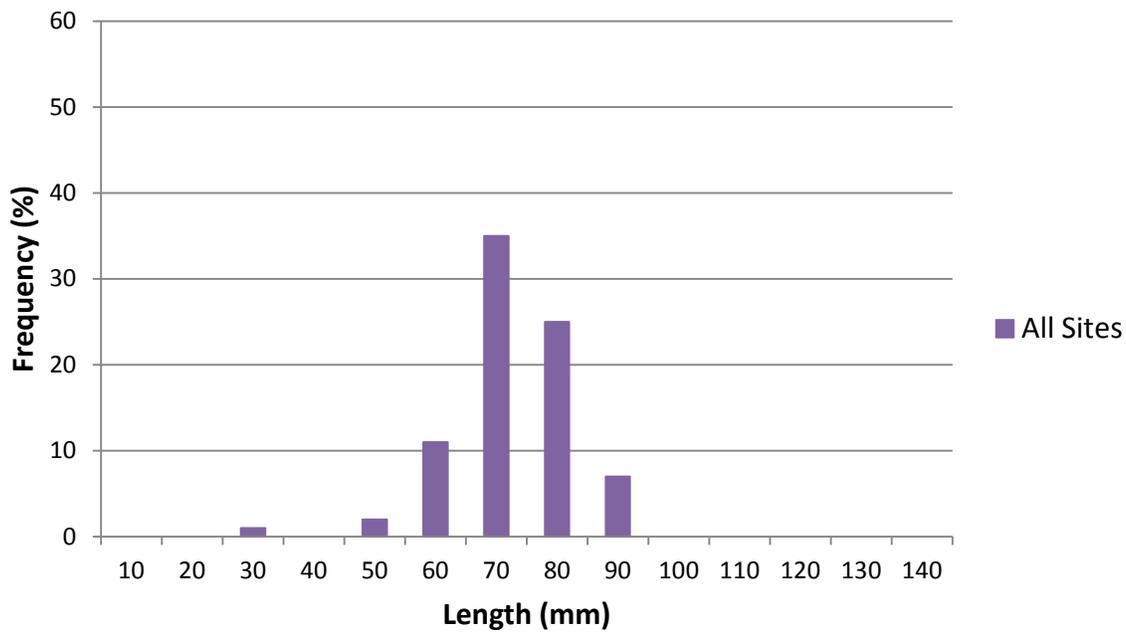


Figure 2. Length frequency of eastern elliptio found at all quantitative survey sites in Penns Creek, Union County, PA in 2015.

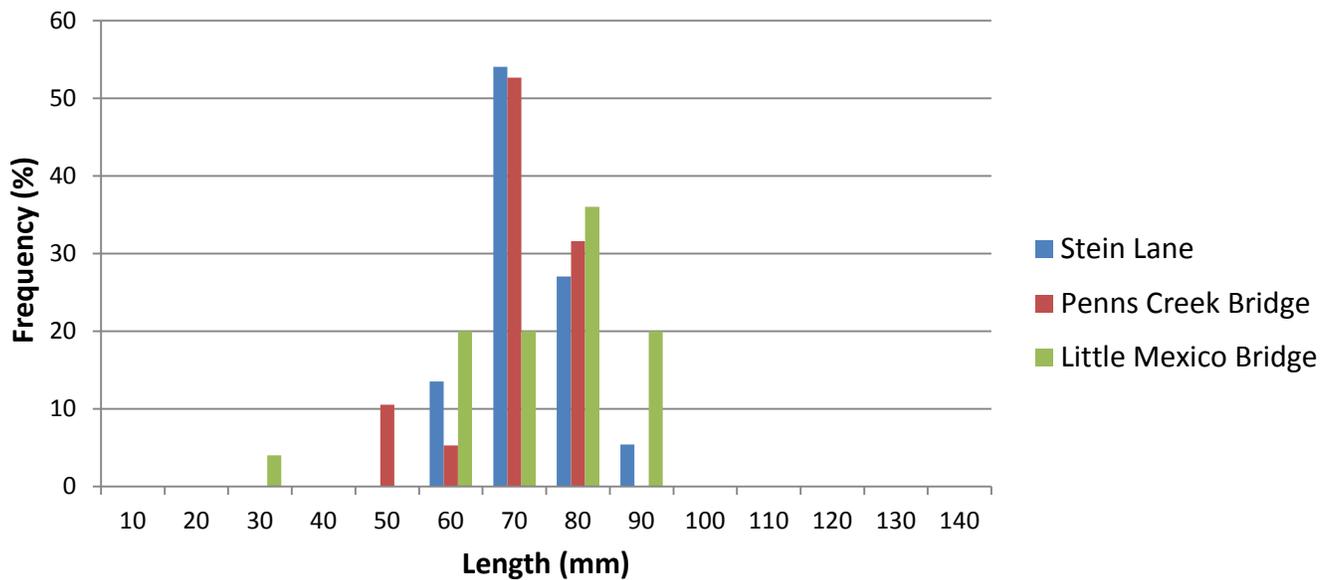


Figure 3. Length frequency of eastern elliptio found in Penns Creek, Union County, PA during quantitative surveys at Stein Lane, Penns Creek Bridge, and Little Mexico Bridge in 2015.

Table 1. Sites surveyed in Penns Creek in Union County, PA. The * symbol indicates that a cage with approximately 700 young American eels (elvers), inoculated with eastern elliptio glochidia, was deployed at this site in 2014.

Site	Lat/Long	Qualitative		Quantitative	
		Distance Surveyed	Dates Surveyed	Area Surveyed	Date Surveyed
Kratzerville	40.868069, -76.890949	800 meters	8/1/14 and 9/24/14	n/a	n/a
Stein Lane	40.871277, -76.910818	n/a	n/a	1452 m ²	8/11/15
Little Mexico	40.873618, -79.942265	800 meters	8/13/15	1452 m ²	8/13/15
New Berlin*	40.875581, -76.986486	1200 meters	7/21/14 and 9/24/15	1452 m ²	8/11/15
Penns Creek Br.	40.867209, -77.049529	800 meters	8/13/15	1452 m ²	8/12/15
Millmont*	40.877577, -77.141454	800 meters	8/1/14 and 9/24/14	1452 m ²	8/11/15
Glen Iron*	40.864466, -77.200162	600 meters	7/28/14	1452 m ²	8/12/15

Table 2. Relative abundance (%), density ($\#/m^2 \pm SE$ and 90% Confidence), and abundance ($\#/1452 m^2 \pm SE$ and 90% Confidence), estimated using the Mussel Estimation Program (Smith 2007), and catch per unit effort (CPUE, # mussels/hour) of mussels found during quantitative and qualitative surveys in Penns Creek at Kratzerville, Stein Lane, Little Mexico Rd, New Berlin, Penns Creek Bridge, Millmont, and Glen Iron conducted during 2014 and 2015.

Species	Relative Abund. (%)	Density Est. ($\#/m^2$)	SE	90% CL	Abund. Est. ($\#/Xm^2$)	SE	90% CL	CPUE ($\#/hr$)
<i>Kratzerville</i>								
ALL	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18.5
Brook floater	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.28
Eastern elliptio	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13.67
Creeper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.25
Rainbow	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.03
Elktoe	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.25
<i>Stein Lane</i>								
ALL		2.878	0.4963	2.167-3.822	4196	723.64	3160-5572	n/a
Brook floater	5.08	0.146	0.0484	0.085-0.252	213	70.62	124-368	n/a
Eastern elliptio	62.71	1.805	0.3741	1.283-2.538	2632	545.5	1871-3701	n/a
Rainbow	32.2	0.927	0.2893	0.555-1.549	1351	421.75	809-2258	n/a
<i>Little Mexico</i>								
ALL		2.15	0.5402	1.422-3.25	3135	787.56	2074-4739	39.4
Brook floater	4.65	0.1	0.0573	0.039-0.257	146	83.6	57-374	2.58
Eastern elliptio	58.14	1.25	0.338	0.801-1.95	1822	492.8	1168-2843	34.24
Creeper	0	0	0	0	0	0	0	0.28
Yellow lampmussel	2.33	0.05	0.0497	0.01-0.256	73	72.4	14-373	1.29
Rainbow	34.88	0.75	0.2853	0.401-1.402	1094	415.9	585-2044	0.77
Elktoe	0	0	0	0	0	0	0	0.26
<i>New Berlin</i>								
ALL	0	0	0	0	0	0	0	7.06
Eastern elliptio	0	0	0	0	0	0	0	5.04
Creeper	0	0	0	0	0	0	0	0.13
Yellow lampmussel	0	0	0	0	0	0	0	0.13
Rainbow	0	0	0	0	0	0	0	1.39
Elktoe	0	0	0	0	0	0	0	0.38
<i>Penns Creek Bridge</i>								
ALL		1.438	0.2121	1.128-1.832	1785	263.43	1401-2276	33.4
Eastern elliptio	82.61	1.188	0.1863	0.917-1.537	1475	231.37	1139-1909	30.48
Rainbow	17.39	0.25	0.1014	0.128-0.487	310	125.94	159-605	2.88

