



# Recent Discoveries of Rare Freshwater Mussels (Unionidae) in the Urban Corridor of the Delaware Estuary

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## Abstract

Freshwater mussels are the most imperiled of all fauna and flora in the Delaware River watershed and across North America. These filter-feeders normally form dense beds in streams and rivers, and their decline contributes to degraded water quality, habitat complexity, and aquatic ecosystem resilience.

The Freshwater Mussel Recovery Program (FMRP) was launched in 2007 to begin to restore mussel populations as a means to advance ecosystem-based restoration (along with marine species such as oysters.) The FMRP depends on finding genetic broodstock from the same basin for hatchery propagation and/or relocation for range expansion. To date, the FMRP has been constrained to one species (*Elliptio complanata*) because the other 12 native species are very rarely found in streams in southeastern Pennsylvania (see poster by Thomas, et. al).

In 2009 and 2010, seven species of native freshwater mussels were discovered by snorkeling and dredging in the tidal freshwater portion of the Delaware Estuary between Trenton, NJ, and Chester, PA: the Pond Mussel, *Ligumia nasuta*; Tidewater Mucket, *Leptodea ochracea*; Alewife Floater, *Anodonta implicata*; Creeper, *Strophitus undulatus*; Eastern Floater, *Pyganodon cataracta*; Yellow Lampmussel, *Lampsilis cariosa*, and the Elliptio, *E. complanata*. At least four of these species are critically imperiled in NJ and PA and two were believed extirpated from PA.

The mussels formed robust, mixed-species beds in shallow subtidal areas mainly having fine grain bottom sediments with cobble. Their presence in the tidal freshwater portion of the watershed, but not in smaller tributaries, likely results from dams in those streams which interfere with passage of fish hosts essential for mussel reproduction

Since the remaining broodstock of these rare and ecologically important unionids exists in the urban corridor, their protection is paramount for future mussel restoration efforts in support of broad water quality, habitat and living resource goals.

## Introduction

North America is home to more species of freshwater mussels (~300) than anywhere else in the world. In healthy streams and rivers, assemblages of these mussels can be so dense that they dominate ecological functions by stabilizing benthic substrates, filtering vast amounts of water, and enriching sediments, etc.

Unfortunately, both the biodiversity and population abundance of mussels has been in steep decline, contributing to the impairment of water and habitat quality because of lost ecosystem services.

In the Delaware River Basin, there are twelve native species (Fig. 2), but only one (*Elliptio complanata*) can be easily found in non-tidal streams but its range and abundance is also severely constrained (see poster, Thomas et al.).

As part of an effort to improve water and habitat quality in streams, the Partnership for the Delaware Estuary is coordinating a pilot mussel restoration program in southeast PA (see posters by Padeletti et al. and Wood-Tucker et al.) To date, these efforts have been limited to one species of mussel (*E. complanata*) because we have not located other species for broodstock or transplanting.

In support of this effort, ad hoc qualitative mussel surveys were performed in the tidal freshwater area of the Delaware Estuary as part of the 2009 Delaware Estuary Benthic Inventory and 2010 Freshwater Mussel Recovery Program.



Figure 2. Area of interest in the tidal freshwater Delaware Estuary for 2009 and 2010 exploratory mussel surveys.

Figure 2. State conservation status of freshwater mussel species historically documented from the Delaware Estuary watershed. Gray-shaded cells indicate species that may never have been found in that state.

Common Name	Scientific Name	State Conservation Status		
		DE	NJ	PA
Dwarf Wedgemussel	<i>Alasmodonta heterodon</i>	Endangered	Endangered	Critically Imperiled
Triangle Floater	<i>Alasmodonta undulata</i>	Extirpated	Threatened	Vulnerable
Brook Floater	<i>Alasmodonta varicosa</i>	Endangered	Endangered	Impaired
Alewife Floater	<i>Anodonta implicata</i>	Extremely Rare	No Data	Extirpated ?
Eastern Elliptio	<i>Elliptio complanata</i>	Common	Common	Secure
Yellow Lampmussel	<i>Lampsilis cariosa</i>	Endangered	Threatened	Vulnerable
Eastern Lampmussel	<i>Lampsilis radiata</i>	Endangered	Threatened	Imperiled
Green Floater	<i>Lastigona subviridis</i>	No Data	Endangered	Imperiled
Tidewater Mucket	<i>Leptodea ochracea</i>	Endangered	Threatened	Extirpated ?
Eastern Pondmussel	<i>Ligumia nasuta</i>	Endangered	Threatened	Critically Imperiled
Eastern Pearlshell	<i>Margaritifera margaritifera</i>	No Data	No Data	Imperiled
Eastern Floater	<i>Pyganodon cataracta</i>	No Data	No Data	Vulnerable
Squawfoot	<i>Strophitus undulatus</i>	Extremely Rare	Species of Concern	Apparently Secure



Figure 3. Shells of seven native species of freshwater mussels found in the tidal Delaware River in 2009-2010: Pond Mussel, *Ligumia nasuta* (Ln); Eastern Floater, *Pyganodon cataracta* (Pc); Yellow Lamp Mussel, *Lampsilis cariosa* (Lc); Eastern Elliptio, *Elliptio complanata* (Ec); Creeper, *Strophitus undulatus* (Su); Tidewater Mucket, *Leptodea ochracea* (Lo); and the Alewife Floater, *Anodonta implicata* (Ai).

## Methods

Qualitative survey mussel methods included: 1) towing an oyster dredge in shallow subtidal habitats (Fig. 4) as part of the Delaware Estuary Benthic Survey (2009), 2) shoreline walks to search for cast shells (2009, 2010), 3) wading in shallows with glass bottom viewing scopes (2010), and 4) snorkeling in shallows (2010). Surveys were exploratory and focused on detecting the presence or absence of any native species. Cast shells and live animals were measured for shell height (Fig. 5) and find location. A few live individuals of selected species were retained from PA for later dissection to permit positive identification and analysis of physiological metrics such as condition index and proximate tissue biochemistry. Confirmation of taxonomy was performed by USGS.

## Results

- Seven native species of freshwater mussels were found (Fig. 3).
  - Most species were found at several locations in the area of interest (Fig. 1).
  - Both PA and NJ sides of the river had mussels in mixed species assemblages.
  - Size ranges were diverse, including a few juveniles, populations are reproducing.
  - Abundance appeared high in several areas (>20 mussels m<sup>-2</sup>).
  - Mussels were most abundant between mean low water and 6 feet depth.
  - Snorkeling was the most effective search technique.
  - Some live pond mussels were in the low intertidal zone; all others were subtidal.
  - Best habitats were coarse silts and fine sands amongst cobble and debris.
  - Submerged aquatic vegetation was present in many areas with mussels (Fig. 4).
- These surveys were exploratory. Most reaches in the area of interest were not visited. Therefore, the distribution and size of the population remains largely unknown. However, following initial media coverage of these finds, we have learned of numerous additional accounts of mussels in the river (mainly anecdotal).

Figure 4. Kelly Somers (PDE) and Renee Searfoss (EPA R3) sort submerged aquatic vegetation (SAV) revealed during exploratory mussel surveys with an oyster dredge in 2009.



Figure 5. Roger Thomas and Sylvan Klein record the sizes of mussels collected by wading and snorkeling in 2010.



## Conclusions and Next Steps

Freshwater mussels are long-lived (30-100 years), and the populations that were found consisted of both young and old animals. Therefore, it appears that these mussels have existed in the urban corridor largely unnoticed for quite some time.

These finds offer hope that mussel restoration efforts can be broadened to include multi-species assemblages that can be tailored for different stream conditions. Most non-tidal streams in southeast PA have no mussels left.

While more study is needed, it is plausible that the combined assemblage of mussels and SAV is sufficient to affect mass balance of nutrients and suspended solids in the area between Trenton and Wilmington.

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