

Distribution of Freshwater Mussels (Unionidae) in Relation to Depth in the Tidal Delaware River

THE ACADEMY
OF NATURAL SCIENCES
of DREXEL UNIVERSITY

Melanie Mills¹, Roger Thomas¹, Danielle Kreeger^{1,2}, Priscilla Cole², Lance Butler³

¹The Academy of Natural Sciences of Drexel University, Patrick Center for Environmental Research, 19th and Ben Franklin Parkway, Philadelphia, PA 19103

²Partnership for the Delaware Estuary, One Riverwalk Plaza, Suite 202, Wilmington, DE 19801

³Philadelphia Water Department, 1101 Market Street, Philadelphia, PA 19107



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.

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 thirteen native species (Fig. 1), but only one (*Elliptio complanata*) can be easily found in non-tidal streams although its range and abundance is severely constrained.

Since 2009, researchers from the Academy of Natural Sciences of Drexel University and the Partnership for the Delaware Estuary have been conducting freshwater mussel surveys and transplant studies throughout southeast PA. Qualitative sampling in early 2012 between Trenton NJ and Philadelphia, PA revealed healthy populations of both *E. complanata* and *Pyganodon cataracta*.

During the summer of 2012 intense quantitative surveys were conducted at four locations between Trenton NJ and Philadelphia, PA. The results of these studies may indicate that sufficient numbers of freshwater mussels exist to allow limited transplantation, and subsequent restoration, in local streams throughout southeastern PA.

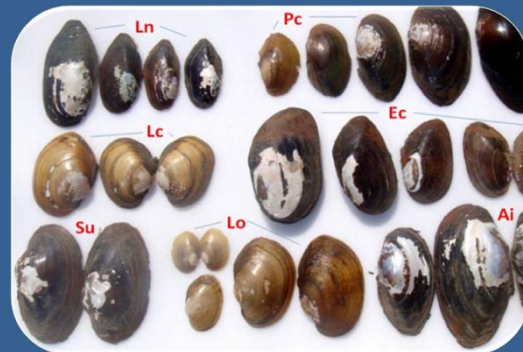
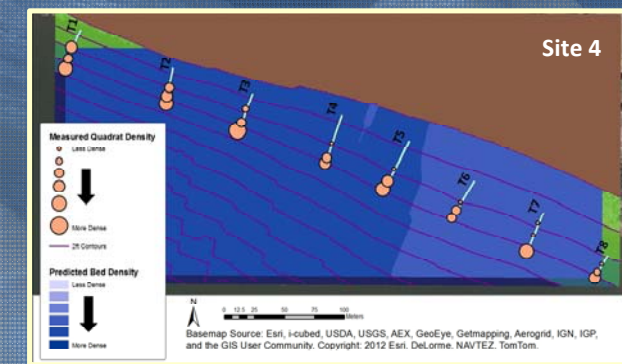
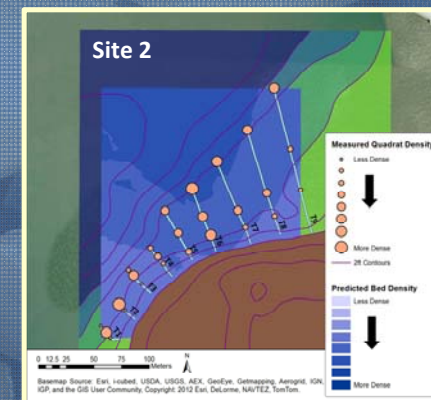
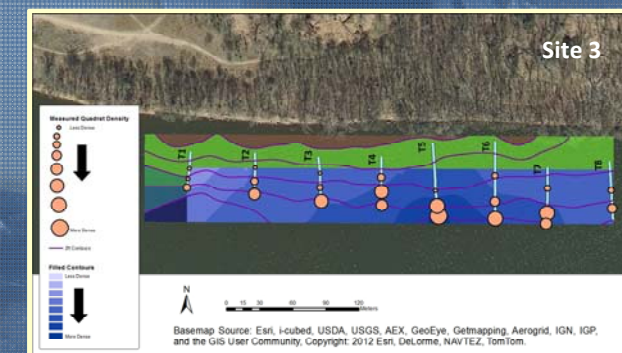
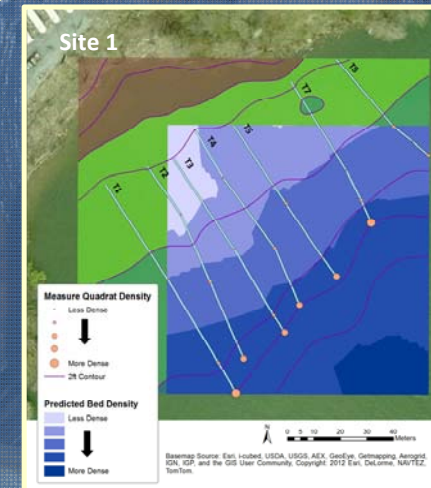


Figure 1: Shells of seven native species of freshwater mussels found in the tidal Delaware River in 2009-2012: Pond Mussel, *Ligumia nasuta* (Ln); Eastern Floater, *Pyganodon cataracta* (Pc); Yellow Lamp Mussel, *Lampsilis cariosa* (Lc); Eastern Elliptio, *Elliptio complanata* (Ec); Creeper, *Strophitus undulatus* (Su); Tidewater Mucket, *Leptodea ochracea* (Lo); and the Alewife Floater, *Anodonta implicata* (Ai).



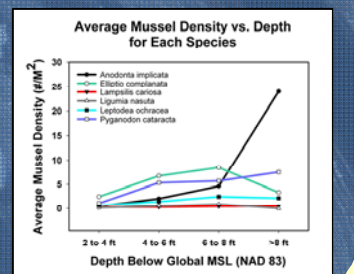
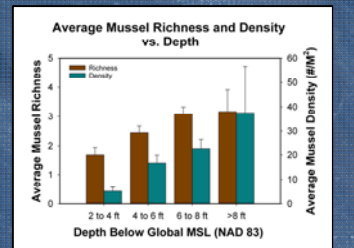
Results

- Species richness and density increased at all sites with depth
- Site 4 had greatest increase in species richness
- Site 3 had greatest increase in mussel density
- Site 2 had highest richness and density in the 4'-6' and 6'-8' zones
- Anodonta implicata* was the dominant species in deepest zone



Predicted mussel density (blue shading) based on the actual mussel density as observed in the quadrats (orange circles).

| Site | Depth Range (ft) | Average of Richness | Average of Density (#/M ²) |
|------|------------------|---------------------|--|
| 1 | 2 to 4 | 0.7 | 1.3 |
| | 4 to 6 | 0.8 | 1.6 |
| | 6 to 8 | 2.3 | 9.7 |
| | >8 | 3.0 | 18.5 |
| 2 | 2 to 4 | 2.9 | 10.6 |
| | 4 to 6 | 3.7 | 38.3 |
| | 6 to 8 | 4.0 | 51.0 |
| 3 | 2 to 4 | 1.2 | 2.8 |
| | 4 to 6 | 2.3 | 11.4 |
| | 6 to 8 | 2.8 | 19.5 |
| | >8 | 3.3 | 47.0 |
| 4 | 2 to 4 | 0.8 | 1.0 |
| | 4 to 6 | 2.3 | 5.2 |
| | 6 to 8 | 3.5 | 24.8 |



Methods

Quantitative mussel survey methods:

- Selected four sites along the Delaware River based on anticipated mussel populations (Fig. 2)
- Set transects from shore to ~ 6 feet deep during outgoing tide
- Placed 1m² quadrats along transects at sampling sites 2'-4', 4'-6', 6'-8' and >8' below global MSL (NAD 83)
- Snorkelers removed all mussels from each quadrat with metal scoop (to ~10cm depth)
- Identified and measured each mussel on shore
- Using RTK, collected elevation data (NAD 83) at each quadrat and at random points throughout site

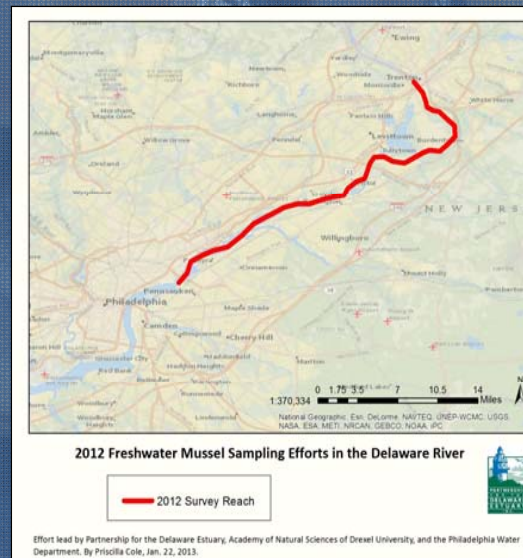


Figure 2. Map of the 2012 study area

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.

There was a strong correlation between mussel density and depth, and mussel richness and depth at each of the four sites sampled in the Delaware River between Philadelphia, PA and Trenton, NJ. Future efforts will include sampling in deeper waters with a dive team in order to fully assess the size and extent of the mussel population within the study area. Bathymetric and macrophyte data of shallow areas of the Delaware River are also needed to adequately map mussel beds.

Since freshwater mussel populations, species richness, and range are in serious decline across the Delaware River Basin, the vestigial mussel beds surveyed in the tidal freshwater reach of the Delaware River are of significant conservation importance and may also be beneficial for improving water quality and benthic habitat diversity in the future; they therefore merit careful protection.

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