Freshwater Mussel Species Occurrence Surveys in the Delaware Estuary

Bucks County, Pennsylvania

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ABSTRACT

The mission of the Pennsylvania Fish and Boat Commission (PFBC) is to protect, conserve and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities. As a partner of the Pennsylvania Natural Heritage Program, the PFBC is tasked with protecting threatened, endangered, and special concern species and investigating each species known range. Freshwater mussels are frequently characterized as the most imperiled taxonomic group in North America; but, while awareness of the vital role they play in aquatic ecosystems is growing, they are still largely overlooked and understudied. While the PFBC has targeted fish species in the Commonwealth for decades and has a plethora of internal data, the tracking of freshwater mussel species occurrence and range is, comparatively, in its infancy. In 2020, the PFBC conducted surveys within the Delaware Estuary to better determine the presence and range of freshwater mussel species. Surveys were conducted in 22 locations, using surface-supplied-air at depths up to 4.5-m, between Bristol and Bensalem, in Bucks County, PA. Six species (# of individuals) were identified: *Elliptio complanata* (1,965), *Utterbackiana implicata* (1,764), *Leptodea ochracea* (27), *Lampsilis cariosa* (8), *Ligumia nasuta* (1), and *Lampsilis radiata* (1). Qualitative survey methods are inherently biased towards larger individuals; therefore, while many size classes (including small individuals) were recorded through measurement, recruitment cannot be verified. Subsequent surveys will be carried out in the upper tidal portion of the Delaware Estuary to further characterize species composition and range. The data presented should guide partners' quantitative surveys to determine density and recruitment of freshwater mussels in the Delaware Estuary.

Figure 1. (Top) Cargo Ship within the Dredged Federal Navigation Channel. (Bottom Left) Surface-supplied-air unit. (Bottom Right) Undeveloped Shoreline.

MATERIALS & METHODS

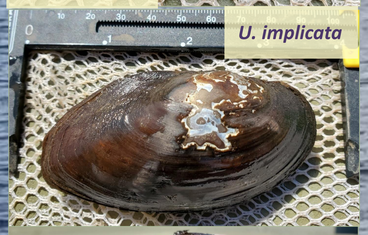
Prior to surveys, a desktop search was conducted to determine survey sites and boat access to the Delaware Estuary. Neshaminy State Park Marina, in Bucks County, PA was used for boat ingress and egress using a 16-ft Lowe Roughneck (Mercury 40HP Jet Outboard motor). Survey weeks were determined based on tidal cycles. The PFBC safety guidelines limit dive depths to 4.5-m, therefore days with a mid-day low tide were targeted to maximize available survey area and time. Sites were located at 0.5-mile intervals. Qualitative survey methods followed PFBC Mussel Sampling Procedures for Unassessed Waters. Surface-supplied-air was provided by a Brownies – Third Lung F285X gas-powered generator (Figure 1). 22 surveys were conducted, with two divers, and each survey was concluded after 30-minutes, yielding 60 minutes of effort. All individuals encountered were collected, identified to species, measured for length, and photographed. When a high number of individuals were encountered, lengths were recorded for the smallest and largest of each species. One specimen (*L. radiata*) was sacrificed to provide a voucher to the Carnegie Museum of Natural History in Pittsburgh, PA. All other individuals were returned to the water at the conclusion of each survey. Water quality parameters were collected at each survey site.

RESULTS

Six freshwater mussel species were encountered (Table 1). Water quality was recorded (Table 2). CPUE (number of individuals encountered per minute) ranged from 0 to 9.75. The number of individuals encountered per survey averaged 228 with a range of 0 to 585.

Table 1. Species totals and size range.

Species	Number of Individuals	Size Range (mm)
E. complanata	1,965	33 – 102
U. implicata	1,764	32 – 127
L. ochracea	27	46 – 80
L. cariosa	8	46 – 91
L. nasuta	1	81
L. radiata	1	74



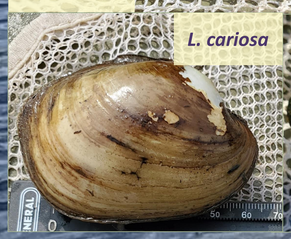


Table 2. Water Quality Parameters.

Parameter	August Range	September Range
Water Temp. (°C)	25 – 26	19 – 21
Visibility (m)	0.2 – 1.5	0.5 – 2.0
Conductivity (µS/cm)	216 – 232	263 – 277
pH	7.9 – 9.0	6.8 – 7.5
Survey Depth (m)	1 – 4.5	
DO (mg/L)	5.5 – 6.3	3.9 – 5.6
Alkalinity (mg/L)	46 – 52	58 – 62
Hardness (mg/L)	54 – 74	60 – 82
Chlorides (mg/L)	37 – 77	34 – 94

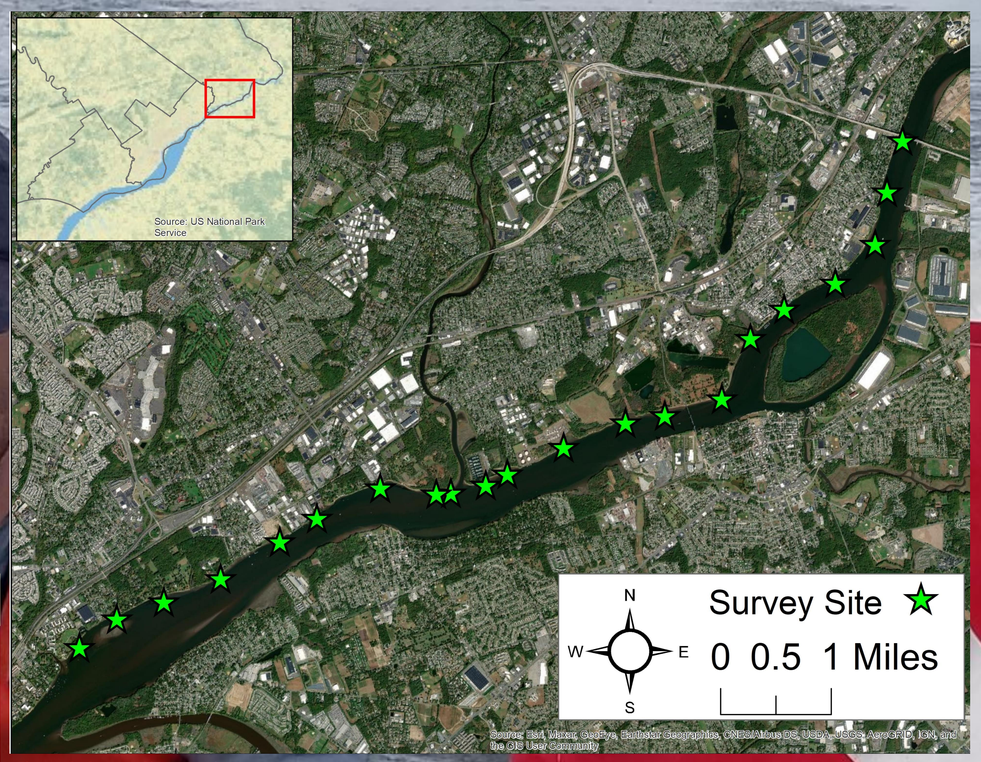


Figure 2. Survey Site Locations.

CONCLUSIONS & DISCUSSION

The PFBC is tasked with conserving Pennsylvania's aquatic resources. Establishing species known distribution is a key component to inferring species abundance and risk to be listed as threatened or endangered. The data presented here will help direct future status assessments for these imperiled species.

A review of historical data for the Delaware River drainage lists the potential for 13 species, while our surveys encountered six species. Separate PFBC surveys and qualified surveyor reports have documented *Alasmidonta heterodon*, *Alasmidonta varicosa*, *Margaritifera margaritifera*, *Pyganodon cataracta*, *Alasmidonta undulata*, and *Strophitus undulatus*. Reported historically, but not known to be recently encountered in the Pennsylvania portion of the drainage, are *Lasmigona subviridis*.

E. complanata and *U. implicata* comprised 99 percent of individuals encountered and both species rely on migratory fishes as hosts for recruitment. Therefore, removal of fish passage barriers within the drainage should continue to be a primary goal to expand these species' range. CPUE was highly variable (0 to 9.75) as well as search area (400-m^2 to 5,000-m^2). Low abundance surveys involved larger search areas with solitary individuals sparsely arranged and were associated with muck and sand substrates. High abundance surveys involved smaller search areas and revealed layers of individuals clumped together and were associated with substrates consisting of a mix of sand, pebble, and cobble.

Future studies could verify recruitment; determine density values; and investigate reasons for density variability.

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