



## Species Action Plan:

### Eastern pearlshell (*Margaritifera margaritifera*)

#### Purpose and Goals

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**Purpose:** This plan provides an initial five years blueprint for the actions needed to attain near-term and, ultimately, long-term goals for the conservation and recovery of the eastern pearlshell. The action plan is a living document and will be updated as needed to reflect progress toward those goals and to incorporate new information as it becomes available.

**Goals:** The immediate goal is to maintain the extant populations of eastern pearlshell in the Commonwealth and to protect its remaining habitat. The secondary goal is to enhance extant populations by improving and increasing local habitat. Ultimately it is hoped the species will recover to the point where it can be removed from the Pennsylvania list of endangered species (58 Pa. Code §75.1).

#### Natural History

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**Taxonomy:** Class Bivalvia, Order Unionoida, Family Margaritiferidae (margaritiferids), Eastern Pearlshell (*Margaritifera margaritifera*, Linnaeus 1758). (Figure 1.)



**Figure 1.** Eastern Pearlshell Mussel (*Margaritifera margaritifera*). Photo-PFBC.

**Description:** Linnaeus first described the eastern pearlshell in 1758. Strayer and Jirka (1997) describe the shell characteristics as “elongate, subelliptical to arched, thick (but often cracking when dried).” Shell size reaches up to 152 mm (Ortmann 1919). Ortmann (1919) described the Pennsylvanian specimens (from the vicinity of Rene Mont) as the largest specimens ever recorded for that time. Bogan (2005, correspondence) further notes that shell specimens are “somewhat inflated, somewhat cylindrical in cross-section, often becoming arcuate in older specimens.” Beak sculpture consists of longitudinal ridges, sometimes broken (Bogan 2005, correspondence). Periostracum dark brown to blackish, without rays. Pseudocardinal teeth are strong; however, lateral teeth



nearly or entirely absent. The eastern pearlshell's nacre color varies from pearly white, to sometimes with pink or with purple tones. Pits are present where the mantle muscle attaches to the shell. These pits, when examined closely, have a trailing edge not unlike a shooting star.

Habitat: The eastern pearlshell is found in clean, low nutrient, calcium-poor, fast-flowing areas of small creeks to medium-sized rivers where often it is the only mussel species (Smith 1976).

Life History: The eastern pearlshell has been described as the longest living invertebrate known and Bauer (1987) reports specimens > 100 years old. The eastern pearlshell is a short-term brooder (tachytictic), spawning yearly during mid-June through August (Hastie and Young 2003, Young and Williams 1984). Conner (1909) noted that the Pennsylvania breeding season occurred during June and August. Hastie and Young (2003) report glochidia being released into the water column beginning mid-July and tapering off around the beginning of September. The eastern pearlshell uses salmonid species as its host, including rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*) and brook trout

(*Salvelinus fontinalis*). These salmonid species are found within the historic range of the eastern pearlshell and are stocked by the Pennsylvania Fish and Boat Commission (PFBC). Specific salmonid host fish use by Pennsylvania's eastern pearlshell has not been determined. The eastern pearlshell diet is unknown, but presumed to be bacteria, detritus, phytoplankton, and zooplankton.

## **Distribution and Status**

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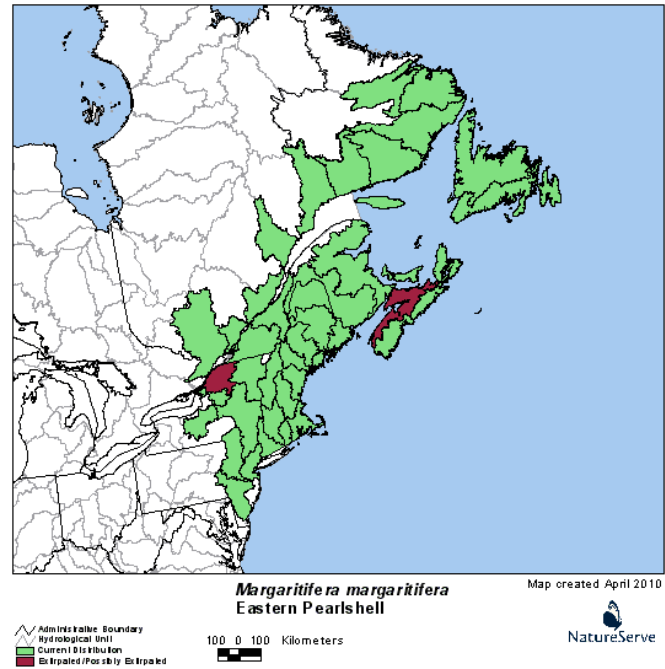
Global and National Distribution: The eastern pearlshell is a Holarctic species found on the North American, Asian and European continents. Large populations remain in northern Russia (Varzuga River) and declining populations (little to no recruitment) remain in Western Europe.

The North American distribution of eastern pearlshell includes Atlantic Slope basins that range from Labrador south to Pennsylvania (Figure 2). In the United States, this species is distributed from Maine to Pennsylvania. New York tributaries to Lake Ontario are considered the western extent of the species range and Pennsylvania's Delaware River basin the southern extent.



Pennsylvania Distribution: Historically, the eastern pearlshell’s Pennsylvania range probably included the entire Schuylkill River basin. Presently, only two populations are known to exist in that basin (Figure 3).

The eastern pearlshell is also likely to have historically occupied portions of the Delaware River mainstem and tributaries. Live specimens were collected from the upper Delaware River mainstem in 2000 (Lellis 2000, unpublished data). Additional populations may occur in other under-surveyed river basins (e.g. Susquehanna River) or stream reaches (e.g. West Branch Delaware River) or tributaries.



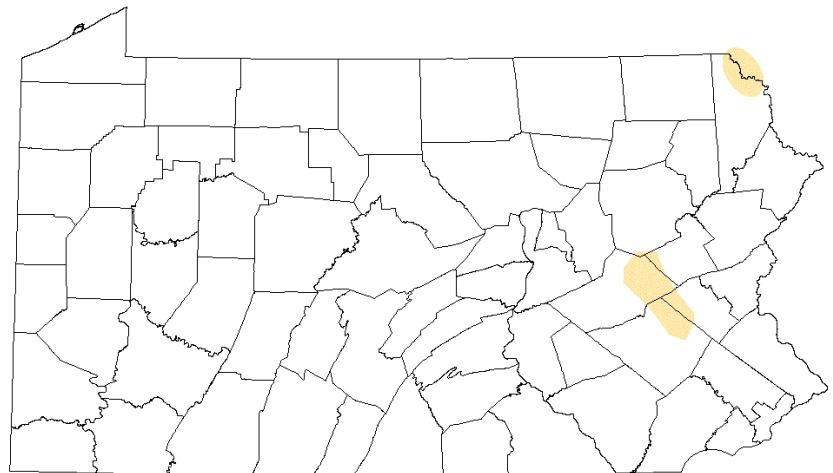
**Figure 2.** North American distribution of the Eastern Pearlshell (*M. margaritifera*) (NatureServe 2010).

Pennsylvania Legal Status: Endangered

State Rank: S1 – Critically Imperiled

Global Status: G4 – Apparently Secure

The eastern pearlshell will be considered for delisting when 80% of the historically-occupied streams contain three distinct naturally-reproduced year classes (PABS Bivalve Committee listing criteria).



**Figure 3.** Distribution of the Eastern Pearlshell in Pennsylvania. (Source: PFBC)



## Management Status

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The majority of all of the historic streams have been visited at least once by PFBC staff. Comprehensive assessments of historic streams have been restricted due to limited permissions from landowners and staff availability.

### Population trends:

One population in the Schuylkill River basin appears stable while the status of the Delaware River population is unknown.

## Threats

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The following is a description of past and present threats that have led to the decline of eastern pearlshell populations in Pennsylvania. Where appropriate, specific actions to reduce or eliminate threats are included in the list of conservation and recovery activities following this discussion.

**Historic Threats:** Historically the eastern pearlshell was highly sought for the high quality freshwater pearls produced by the species (Kunz and Stevenson 1908). Ortmann (1919) indicated that the “recklessness of the pearl-hunters has nearly exterminated it” from the Schuylkill River basin.

In addition to the pearl industry, portions of the Schuylkill River region were heavily mined for anthracite coal. The time of Ortmann’s 1919 publication was near the

peak production of coal. A number of streams which may have historically contained eastern pearlshell were probably destroyed by mine-related pollution.

### Current Threats:

**Habitat degradation:** Threats to eastern pearlshell include riparian habitat loss, sedimentation, incidental harvest, non-point source pollution from poor agricultural practices, and pollution from coal mining activities. Additionally, in the absence of best management practices implementation, eastern pearlshell populations could be negatively affected by actions such as road construction, stream channel modifications, logging activities, agricultural activities, land use changes, pesticide use, and other projects or activities in the watershed (see Cosgrove and Hastie 2001). Furthermore, populations inhabiting relatively short stream reaches having multiple bridges or ford crossings are likely to have more exposure to single catastrophic events such as toxic spills which could potentially annihilate the population during a single event. Several authors (e.g., Hastie *et al.* 2003, Galbraith *et al.* 2010) indicate that climate change may have deleterious effects on mussel populations. Eastern pearlshells and their hosts would be particularly vulnerable to elevated water temperatures and large flood events associated with an increase in precipitation.

**Flow alteration.** A primary threat to the continued existence of eastern pearlshell is



flow and habitat alteration due to placement or operation of existing impoundments. The effects of impoundments on mussel populations are well documented (Watters 2000) Gene dispersal via glochidia transport through the water column or passage of fish around the dams on occupied streams has been rendered unlikely except during extreme flood events. The construction of dams on historically occupied streams has eliminated large stretches of lotic habitat. The conversion of habitat from a lotic to lentic environment has altered the thermal and flow regimes within the impoundments by decreasing flow, increasing sedimentation, and creating thermal stratification.

The operation of dams on the Pepacton Reservoir (East Branch Delaware River) and Cannonsville Reservoir (West Branch Delaware River) has the potential to alter habitat and persistence of eastern pearlshell in the mainstem Delaware River. Both reservoirs serve as major water supplies to New York City and the dams are operated to maintain water supply as well as to meet a minimum mainstem flow target at Montague (river mile 246.8). Current proposals to revise release of water from two other impoundments on the Mongaup and Lackawaxen Rivers (located upstream of Montague) may affect the quantity of water available at the known eastern pearlshell locations.

**Genetics.** Geographic isolation restricts the natural exchange of genetic material among

Pennsylvania's eastern pearlshell populations. Further exacerbating potential genetic problems, small population sizes reduce the intra-population reservoirs of genetic variability. The apparent small population size of one extant population suggests that this population may suffer from reduced genetic variability. Loss of genetic diversity could adversely affect the species' ability to evolve and respond to natural changes. Soule (1980) recommended a minimum of 500 individuals to maintain genetic variability and evolutionary potential within a population.

**Invasive species.** The effects of predation on native fish species and/or competition for food and breeding habitat from nonindigenous fish species can result in drastic declines in, or even the elimination of, the native fish fauna. These declines could include the salmonid species necessary for the eastern pearlshell to complete their life cycles.

The spread of the diatom alga didymo (*Didymosphenia geminata*) into eastern pearlshell waterways is the most immediate invasive species threat to the eastern pearlshell. Didymo is currently known from the upper Delaware River mainstem where eastern pearlshell has been collected. Proliferation of didymo could result in the loss of mussel related ecosystem services (water filtration) as a result of the burial of mussels beneath didymo mats or loss of mussel reproductive capacity due to changes in host fish populations or behaviors.



**Predation.** Predation may also threaten the continued existence of the eastern pearlshell in the Commonwealth. Shells of the species have been found in raccoon middens along occupied streams and the species is presumably consumed by other mammals such as muskrats and minks. While predation is not thought to be a significant threat to healthy mussel populations, it could limit the recovery of endangered mussel species or contribute to the local extirpation of mussel populations already depleted by other factors (Neves and Odum 1989).

## **Conservation and Recovery**

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### Conservation Actions

#### **A. Schuylkill River Basin**

- 1) Work towards the protection, conservation and enhancement of extant populations.
  - a. Gather baseline quantitative information.
    - i. Characterize eastern pearlshell populations at extant locations.
    - ii. Characterize the physical habitat and the host fish community at extant locations.
  - b. Identify degraded habitat in occupied portions of the Schuylkill drainage.
    - i. Conduct desktop and ground truth analyses.

- ii. Begin landowner outreach.
    - iii. Complete restoration plans.
  - c. Implement planned restoration projects at five identified project sites.
  - d. Maintain current PFBC trout stocking within Schuylkill River basin.
- 2) Identify new streams in Schuylkill River basin with potential to harbor eastern pearlshell.
- 3) Determine restoration potential of historically-occupied Schuylkill River basin streams.
- 4) Restore degraded habitat in historically-occupied Schuylkill River basin streams.

#### **B. Delaware River Basin**

- 1) Work towards the protection, conservation and enhancement of extant populations.
  - a. Continue to work with Federal and state government agencies to develop flow recommendations that are protective of eastern pearlshell.
  - b. Encourage the development of regulations and policies that would reduce the introduction and spread of aquatic invasive species.
- 2) Gather additional baseline information on Delaware River population.
  - a. Characterize eastern pearlshell populations at extant locations.



- b. Characterize the physical habitat, host fish community, and the macroinvertebrate community at extant locations.
- 3) Survey the West Branch of the Delaware River for the presence of eastern pearlshell mussel populations.

### **C. Monitoring**

- 1) Initiate monitoring of existing populations
  - a. Identify and establish monitoring at four sampling sites within occupied streams.
  - b. Conduct monitoring every three years.

### **D. Reintroduction and Augmentation**

- 1) Plan for the reintroduction of eastern pearlshells in suitable waters within their historically-occupied range.
- 2) Implement planned reintroductions as deemed appropriate.

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