



# Freshwater Mussel Restoration Program



**FACT SHEET**  
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## **What are Freshwater Mussels?**

Freshwater mussels are bivalve mollusks that live in lakes, rivers, streams and tidal freshwater areas with many similarities to oysters, clams and scallops that live in estuarine and marine systems. By feeding at the base of the food chain on a rich mixture of suspended matter, both marine and freshwater bivalves can attain high population biomass and play critical roles in the function and structure of aquatic ecosystems. However, freshwater mussels in North America belong to different taxonomic groups (Unionidae, Margaritiferidae) and have different life history strategies compared to their marine counterparts. Most notable is the fact that they do not reproduce by broadcast spawning with prolific planktonic larvae; rather, they brood larvae which parasitize a fish host for short periods. This strategy enables freshwater mussels to disperse over great distances both upstream and downstream without moving far on their own. Unfortunately, this complex life cycle is easily short-circuited, such as when the required fish host is no longer available because of fish passage blockages.

Another important life history difference is that freshwater mussels live very long, up to 100 years, and it takes them about 8-10 years until they reach sexual maturity. In contrast, marine bivalves can often grow to adulthood and produce mass quantities of free-swimming larvae within 1-2 years. As filter-feeders that process high volumes of water, they are also susceptible to water quality impacts even if degraded water quality is only sustained for a short period. Freshwater mussels are not as swift to recover following disturbance events even after environmental conditions improve.

North America is home to the greatest biodiversity of native freshwater mussels in the world (more than 300 species); however, for the reasons noted above more than 75% of our native 300+ species are under some special conservation status. Freshwater mussels are the most imperiled taxonomic group out of all plants and animals in the United States. Just as alarming for ecosystem integrity, population biomass and integrity appears to be just as reduced relative to historical accounts. Of the 12 native species of freshwater mussels in the Delaware Estuary, only one is reported to be abundant, and its distribution is patchy.

## **What Ecosystem Services are Provided by Bivalve Shellfish?**

Wherever bivalves are abundant, they appear to filter suspended solids, phytoplankton and perhaps even pathogens resulting in water quality improvement. They thereby increase light penetration through the water column, improving growing conditions for bottom plants and algae. Their biodeposits enrich sediments, benefiting other fauna and flora. Beds and reefs of mussels, oysters, and clams provide structural complexity and stabilize bottom sediments, providing habitat for other organisms such as fish. They have long been regarded worldwide as some of the best bioindicators of environmental conditions, particularly long-term status and trends. Generally, the presence, diversity, and population health of bivalve shellfish throughout watersheds is directly indicative of the overall health of the system, and therefore bivalve shellfish represent excellent “common denominator” targets for setting environmental goals.

## How Does this Program Link to Other Shellfish Restoration Initiatives?

Recent evidence suggests that similar ecosystem services are furnished by all of the key bivalve species living throughout the Delaware Estuary watershed. Until recently, most restoration and enhancement efforts aimed at bivalve shellfish have focused on improving stocks of commercial species such as oysters. Restored oyster reefs are now valued for their ecological benefits as well as their commercial value. The Partnership is an avid supporter and participant in oyster revitalization in Delaware Estuary, and the Freshwater Mussel Recovery Program represents an expansion of our shellfish restoration activities by investigating use of noncommercial bivalve species to address a multitude of environmental challenges. For example, intertidal reef communities consisting of mussels are also being used as “living shorelines” to stabilize edges of tidal marshes that are eroding because of sea level rise and other factors.

The Partnership views bivalve shellfish as an excellent choice on which to base ecosystem restoration because they represent “common denominator” resources that require good water quality, habitat conditions, and fish passage (for freshwater mussels), but the converse is not necessarily true. Bivalve shellfish are regarded worldwide as possibly the best bioindicators of aquatic system integrity over long time scales. Where abundant, they are referred to as “ecosystem engineers” because they are habitat-forming animals that can dominant functional processes by large scale filter-feeding at the base of the food chain. They therefore not only tell us about environmental conditions but offer solutions for remediation and ecosystem enhancement, such as related to food web complexity and stability, water quality and TMDL’s, and habitat enhancement.

Working with numerous collaborating entities (see below), the Partnership is now working to expand the restoration dialogue to include the full diversity of native bivalves, including freshwater mussels that were once much more abundant, to provide new opportunities and tactics to promote ecosystem health across our large watershed. Basinwide shellfish restoration is also expected to fit within the Partnership’s new Regional Restoration Initiative to optimize net environmental outcomes from the diverse mix of conservation, enhancement and restoration activities underway in the watershed now and in the future.

## What is the Freshwater Mussel Restoration Program?

The Freshwater Mussel Restoration Program (FMRP) is a collaborative endeavor to rebuild the overall, population vigor of native species belonging to this group of animals throughout the Delaware Estuary and its Watershed. The FMRP takes a holistic approach that includes biodiversity conservation, range expansion, and most importantly, enhanced overall population abundance of a mix of species that fill different ecological niches. Initially at least, the focus will be to enhance the population robustness and resilience by reintroducing relatively common species into streams and niches that they have been forced to vacate at some point in the past. Based on existing data, we believe that most remaining populations of freshwater mussels, even common species,



*Mussel cages shown out of the water and affixed to the bottom*

are relegated to small pockets with little genetic exchange or reintroduction potential across their former range because of fish passage blockages and other habitat variables. Past extirpation could have occurred for many reasons, and in some cases stream conditions may not yet support reintroductions; whereas, in others we expect that conditions have recovered sufficiently to again support species that were lost over the past few hundred years.

To maximize the success of FMRP, Phase I of each project will consist of screening candidate restoration streams using caging protocols using live animals to gauge their readiness for restoration. Streams that historically held freshwater mussels and that are ranked as most suitable for restoration will be targeted for Phase II, which will consist of restocking by transplants as well as deployment of high quantities of seed propagated in hatcheries with new technologies. Depending on early success and the will of key agencies and partners, the FMRP may eventually be expanded to include species of special concern.



## Has the Freshwater Mussel Restoration Program Been Launched?

Phase I of the FMRP began in fall, 2007, to prioritize which streams to target for mussel reintroduction and population expansion in southeast Pennsylvania. Historical records suggest that up to a dozen species of freshwater mussels once lived in the region, but only one species has been found in recent years in the target streams. Current indications are that the water quality and other factors should be sufficient to sustain freshwater mussels in some of these streams where they have been lost over time. Between 2007-2009, Phase I caging protocols will be used to test restoration suitability of various streams in southeast PA. Preliminary propagation tests with candidate species will also be undertaken in 2008. Phase II will commence during 2008-2009 with the eventual goal of stocking at least 30,000 seed of a species that had become extirpated from areas of this system. By re-introducing freshwater mussel species and boosting population biomass in areas where they have been lost or impaired, the FMRP will improve ecosystem resilience by refilling niches once occupied by these “ecosystem engineers.” This project has been supported with generous start-up funding provided by ConocoPhillips and a grant from the national Fish and Wildlife Foundation.

## Who is Involved in FMRP?

The Partnership for the Delaware Estuary is leading FMRP, along with the US Fish and Wildlife Service, Drexel University, Cheyney University and the Academy of Natural Sciences. Additional in-kind support has been furnished by the Brandywine Conservancy and US Geological Survey. Representatives from the Pennsylvania Department of Environmental Protection, New Jersey Department of Environmental Protection, Philadelphia Water Department, Pennsylvania Fish and Boat Commission, Delaware State University, and the Heritage Programs of Pennsylvania have also expressed interest in this initiative.



If you are interested in becoming involved with this project, please contact Dr. Danielle Kreeger [DKreeger@DelawareEstuary.org](mailto:DKreeger@DelawareEstuary.org) or Angela Padeletti [APadeletti@DelawareEstuary.org](mailto:APadeletti@DelawareEstuary.org).

The Partnership for the Delaware Estuary, a National Estuary Program based in Wilmington, leads collaborative and creative efforts to protect and enhance the Delaware Estuary, and its tributaries for current and future generations. We envision everyone working together to make the Delaware Estuary the most inviting, prosperous and healthy natural recourse of its kind in the nation