Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

WILD HERITAGE NEWS

Spring 2020

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Photo Banner:
Muckets

Mary Walsh

Is Anything Down There?

A deep dive into the Ohio River's freshwater mussels

by

Mary Walsh

For the average person, the deep, muddy Ohio River is something they wouldn't touch with a 10-ft pole. From the banks, one cannot see any life below surface. In places there are piles of trash accumulated on the banks; cement walls and warehouses line the river in sections. With the long history of pollution, the river seems dirty and untouchable.

Indeed the river has been receiving wastewater since the industrial revolution. The pollution from intensive natural resource extraction (e.g., oil, coal, and timber) and manufacturing in the watershed degraded the conditions for aquatic organisms. The Ohio River and its tributaries were the recipients of agricultural runoff, stormwater, sewage, and wastewater discharges from mines, tanneries, oil refineries, saw mills, and glass and steel factories. Noting the severe water quality degradation, Arnold Ortmann, Curator of Zoology at the Carnegie Museum of Natural History, wrote in 1909 that "both the Allegheny and Monongahela are as badly polluted as they could possibly be, and, consequently, it is not astonishing that the Ohio immediately below Pittsburgh is in a deplorable condition."

In addition to changes from pollution, the formerly free flowing river habitat was fundamentally altered when locks and dams were installed. Creating navigational pools to transport goods on the river, the dams maintain at least a nine foot depth and converted the river into slow, deep pools. By 1929, fifty locks and dams were built on the Ohio River; the Emsworth,

Alysha Trexler

The dive crew laying a transect line to survey Ohio River mussels.

Dashields, Montgomery, and New Cumberland pools comprise the length of Pennsylvania's portion of the river.

The diversity of habitats in the river, such as gravel bars, wadeable runs, and small islands, was now replaced by the simplified environment of the navigational pools. The shallow habitats are now submerged. The diary of Merriweather Lewis from the Lewis and Clark expedition describes the riffles of the Ohio River in Pennsylvania which were difficult to navigate in heavy boats. The section in Beaver County below Fort McIntosh, where in September 1803 the expedition was forced to unload their boats and drag them with horses, is no longer in evidence because of the deep waters in the navigational pool.

Today the river is a highway for barges. Coal, crude oil, petroleum products, sand, gravel, iron and steel, chemicals, and grain are among the 150 million tons of commodities transported annually on river barges. Barge propellers forcefully move water and displace particles on the river bottom. The habitat for aquatic organisms is further altered by the scour and redistribution of river substrates from the propeller wash.

Adding insult to the list of injuries, the Ohio River is also subject to direct removal of habitat for bottom dwelling organisms like fish and freshwater mussels. Dredging scoops out the river bottom taking habitat with it. The practice has left deep scars on the river bottom. Parts of the river are pocked with deep holes, which become filled with silt over time. The dredged areas are poor habitat for fish and freshwater mussels.

Despite the many challenges faced by the Ohio River, water quality is improving and aquatic life is also showing signs of recovery. In the past decades, more stringent water pollution regulations, such as the federal Water Quality Amendments (1972) to the Water Pollution Control Act and the Federal Surface Mining and Reclamation Act (1977), reduced the worst water quality pollution. Other factors like the closing of steel mills and subsequent elimination of manufacturing discharges from steel mills and the installation of municipal waste water treatment plants have vastly improved the water quality in the river.

Given the improved water quality conditions in the Ohio River, natural resource managers need a better understanding of the state of the river ecosystem. Studies of fish in the river indicate that they are returning to former habitats. While some surveys of freshwater mussels for commercial interests were conducted in recent years, very little information outside of those studies was available.

To fill the information gaps about the bottom-dwelling bivalves, the Pennsylvania Natural Heritage Program began a study of mussel fauna in the big river. The project required doing what most people wouldn't dream of doing - diving in the Ohio River. Our staff donned SCUBA gear with specialized face masks and wetsuits and descended to the river bottom. In the silty depths a pair of divers illuminated the river bottom with dive lights and followed transects to collect any live mussels or shells. We placed mussels in mesh bags and brought them to the surface. Momentarily out of the water, the species were identified and numbers of live mussels and shells were counted before they were returned to the river.

Alysha Trexler

After completing a survey, diver Ryan Miller, waits for the boat to collect him.

Alysha Trexler

Dive crew members, Mary Walsh, Eric Chapman, and Ryan Miller, measure and record the mussels encountered in the surveys.

Mary Walsh

The elongate black sandshell was found in a number of transects in the Ohio River.

The most numerous of the 16 freshwater mussel species encountered were those preferring slow waters or species considered habitat generalists, like the mapleleaf, threehorn wartyback, pink heelsplitter, black sandshell, and mucket. The best habitats for freshwater mussels were in the shallower areas of the river, less than 20 feet. These areas receive light from the surface and are more productive for algae, an important food resource for mussels. Areas near the remaining islands in the Ohio River were also important habitat for freshwater mussels. The habitat around Phillis and Georgetown islands in the New Cumberland Pool appears to be less disturbed than other areas of the river. Due to regulations requiring a buffer around islands where dredging is prohibited portions of habitat for freshwater mussels remain.

Interestingly and as good news for the river, we encountered two mussels that have not been seen in the Ohio River in many years. One, the round hickorynut, was last recorded in the river in 1906. It was good to have found it but the single shell that we recovered could have been in the river for years after the mussel died, and there is no current evidence for a living population of the mussel in the river. Another species, the state endangered pistolgrip, seems to be returning to the river. Our divers found one live individual, the second record of a pistolgrip in recent years from the river. The pistolgrip occurs in portions of the Ohio River downstream of Pennsylvania and is likely recolonizing former habitat in the commonwealth.

Mary Walsh

This project documented the second finding of a Pennsylvania endangered pistolgrip in recent years in the Ohio River.

Mary Walsh

Zebra mussels attach to the shells of native Ohio River mussels, like the mapleleaf.

Despite finding a hopeful number of mussels, they face ongoing challenges. Although discharges are now regulated, continued effluents from industry, storm water, and combined sewer overflows cause declines in water quality. Since the invasive zebra mussel moved into the river in Pennsylvania in 1993, it began fouling any hard surfaces, including attaching to native mussel shells which eventually results in suffocation of the mussels. PNHP surveyors did find native mussels with much of their shells covered by zebra mussels. In other rivers, zebra mussels reduced the numbers of freshwater mussels, but both non-native and native mussels *can* coexist. In the Ohio River, the zebra mussels likely suppress the populations of native mussels, but evidence suggests that native mussels can tolerate and compete with the Asian zebra mussel.

Despite the historical pollution and modern day threats from habitat degradation, on-going water quality degradation, and invasive species, the native freshwater mussel fauna in the Ohio River continues to persist. The PNHP study helped to elucidate areas of mussel habitat and define the communities of mussels that

Mary Walsh

The shallow habitat near Phillis Island appears to be a stronghold for freshwater mussels in the Ohio River in Pennsylvania.

occur today in the river. While there are ongoing water quality and habitat improvements needed in the Ohio River, our baseline study can be used to measure future improvements in the freshwater mussel populations.

About the Author

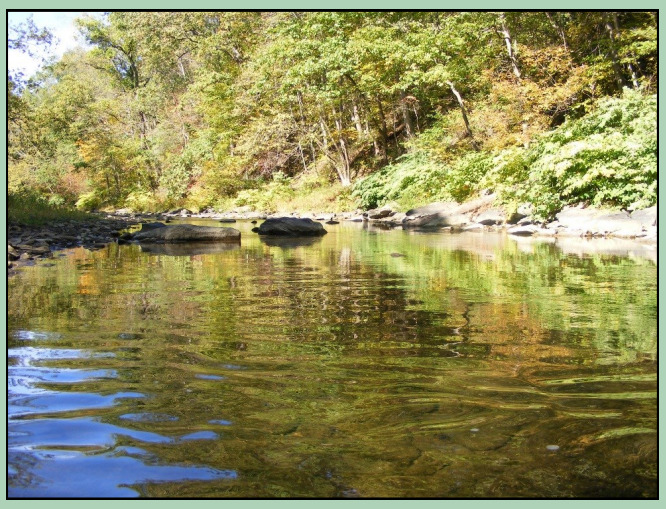
Mary Walsh coordinates the aquatic zoology program at the Pennsylvania Natural Heritage Program. She's been studying aquatic fauna with PNHP since 2003. Mary works on inventories of aquatic invertebrates and communities, assesses conservation statuses, models species distributions, and tracks invasive species. When she's not managing projects, Mary watches thriller series, reads books, and hangs out with her family.

A Study of Mussel Growth

Steps toward reintroduction of freshwater mussels in western Pennsylvania waterways

Natural resource agencies are reintroducing freshwater mussels to streams where populations have vanished. Prioritizing streams with sufficient water quality to support reintroduced populations is needed to determine where to put recovery efforts. To this end, PNHP is beginning a study of the growth and survival of juvenile live freshwater mussels in 12 streams in the Ohio River basin in western Pennsylvania. Juvenile mussels will be deployed in flow-through chambers, in which they are exposed to in-stream conditions in the study streams over four months.

The growth and survival of the juvenile mussels will be compared between reference streams, which have rich mussel communities, and those with defaunated communities (e.g., no known populations of freshwater mussels or greatly reduced richness from historically documented communities). High levels of survival and growth of mussels in study streams will be an indication that the waterway has potential for successful translocation for future restoration efforts.



Mary Walsh

Chambers with juvenile mussels will be placed in Buffalo Creek and other streams to evaluate the potential for restoration of freshwater mussels.

Initial Survey for the Endangered Salamander Mussel and Its Mudpuppy Host

by

Ryan Miller

The status and distribution of the salamander mussel and its mudpuppy host in the navigational pools of the Ohio and Allegheny rivers was unclear. Mudpuppy absence was thought to be a possible factor limiting the dispersal and recovery of the state endangered salamander mussel. We received a grant from the Wild Resources Conservation Fund to conduct intensive surveys for both species.

The first half of the survey effort was to confirm presence of mudpuppies in the Ohio and Allegheny rivers. The deep, dark waters of these large river systems have remained unsurveyed for this elusive salamander. We conducted surveys using modified crayfish traps during the late fall and early spring, months when mudpuppies are more active foraging in colder water. Because the mudpuppy is the salamander mussel's only known glochidial host, protection of mudpuppies and their habitats is necessary for the mussel's survival.

Ryan Miller

A mudpuppy captured during the survey.

We conducted mudpuppy trapping on the Allegheny River in April 2018 and 2019 capturing a total of 45 individuals at eleven locations. On the Ohio River we trapped in December 2018 and 2019 and captured a total of 88 individuals at eight locations. We believe that more mudpuppies were captured in the Ohio because the surveys were conducted in the late fall as water temperatures were dropping. All of the mudpuppies we captured were counted, measured for length, weighed, sexed, examined for their overall health, checked for glochidial infestation by salamander mussels and released.

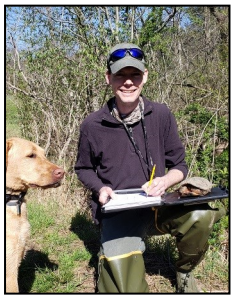
The second half of the study focused on the presence of the salamander mussel in the Ohio River. Along with the mussel surveys mentioned in the previous article (page 1), we specifically targeted salamander mussels during surveys whenever we found rock shelter habitats, which are preferred by mudpuppies and salamander mussels. Within 10 meter circles, divers teamed up to simultaneously lift rocks and search for salamander mussels, mudpuppies, or other mussel species beneath or adjacent to the rocks. We also conducted targeted salamander mussel surveys at most of the sites in the Ohio River where mudpuppies were captured during the trapping effort. Unfortunately, no salamander mussels were found during these targeted surveys.

Nevin Welte

Zoologist Ryan Miller weighing a mudpuppy captured in the Allegheny River.

While we were unable to locate any salamander mussels within the Pennsylvania portion of the Ohio River, we are hopeful for their return. Since salamander mussels have been located approximately 40 miles downriver near the town of Wheeling, West Virginia and are also in the Allegheny River above our survey sites, we feel it's only a matter of time before they recolonize here. Their absence is likely due to a pollution/water quality issue, limited habitat, or limited movement of mudpuppies hosting glochidia into this area. Data from this study will inform Pennsylvania Fish and Boat Commission managers by identifying areas of good salamander mussel and mudpuppy habitat and prioritizing potential river conservation and salamander mussel restoration areas. We are currently in the middle of a mudpuppy population density estimate project so more on that in a later newsletter.

About the Author



Ryan Miller has been working with PNHP as a zoologist since 2005. Most of his conservation efforts over the years have been focused on reptiles, amphibians, freshwater mussels, and vernal pools.

Pennsylvania's Long Road to Mussel Recovery

by

Nevin T. Welte & Jordan R. Allison

The road to recovery of Pennsylvania's freshwater mussels is an uncertain one, full of promise but with detours, potholes, and other obstacles to overcome.

As biologists and partners in the Pennsylvania Natural Heritage Program (PNHP) we occasionally pinch ourselves when we realize how lucky we are to still have the diversity and abundance of freshwater mussels that persists in the Allegheny River. The Allegheny downstream of Kinzua Dam is home to ~25 species including robust populations of the state and federally listed northern riffleshell (*Epioblasma rangiana*), clubshell (*Pleurobema clava*), and rayed bean (*Villosa fabalis*), as well as smaller populations of snuffbox (*Epioblasma triquetra*), sheepnose (*Plethobasus cyphyus*), and rabbitsfoot (*Theliderma cylindrica*). Some common species, such as mucket (*Actinonaias ligamentina*) and spike (*Eurynia dilatata*) are also locally very abundant. For the northern riffleshell and clubshell, the Allegheny may harbor the largest populations in North America. Given the imperilment of mussels in general, it is a rare occasion to have the opportunity to conduct a large-scale restoration effort using wild individuals once, let alone twice.

Charles Bier

The Hunter Station bridge salvage site.

The first mussel restoration effort emerged from the Hunter Station bridge replacement project over the Allegheny River in Forest County near Tionesta. Consultation between the U.S. Fish and Wildlife Service (USFWS), Pennsylvania Fish and Boat Commission (PFBC), and PennDOT allowed for the adoption of measures designed to limit impacts to mussels living beneath the bridge. One of these measures resulted in the salvage of 131,494 mussels from the work site during the summers of 2015 - 2017. These mussels would have been killed by the installation of cofferdams and causeways, and from dropping the bridge spans into the river. Instead, the mussels were collected and transported to waterways they formerly inhabited in an effort to restore these species. The second project involved moving mussels salvaged during the replacement of a natural gas pipeline. National Fuel's Line Q project, which crossed the Allegheny near the town of Tidioute in Warren County also underwent extensive consultation and resulted in the salvage of 25,435 mussels in 2018.

Dale Dunford, EnviroScience, Inc.

Volunteers tagging mussels at Hunter Station.

Historically mussel salvages for various projects have had mixed follow-ups, i.e., monitoring was not always conducted or required, thus making it difficult to gauge the success or failure of the effort. The relocation of mussels from these two projects into Pennsylvania waterways offered an opportunity to reverse that trend.

Northern Riffleshell and Clubshell

The Hunter Station bridge project presented a unique situation – two endangered species, the northern riffleshell and clubshell, were the dominant species within a diverse mussel community. Collectively, 95,611 endangered northern riffleshells and clubshells were available for species restoration projects. Fortunately, the Pennsylvania populations of these species are considered stable, with both species still occurring in most Pennsylvania streams they historically inhabited; however, there are a few exceptions. Concurrent with the national species restoration effort, Pennsylvania undertook its own efforts to identify streams that would benefit from population augmentation.

Beginning in 2014, we initiated pilot studies by relocating a small number of northern riffleshell and clubshell mussels to several sites on Conewango Creek and the Shenango River to test the proverbial, and literal, waters. We stocked 90 mussels of each species at varying densities into two separate monitoring plots at each site. As in other states, monitoring of relocated mussels in Pennsylvania was required. To make life easier – as it can be quite difficult to find an animal that looks like a rock in a river full of rocks – mussels were fitted with 12.5 mm long passive integrated transponder (PIT) tags to facilitate their recapture. The survival of these animals was used to gauge whether the streams selected for restoration could support a large number of potential new residents and to determine appropriate stocking densities should survival be high enough to warrant a full-scale relocation. A 60% survival rate a year after stocking is required to ensure any relocated mussels stand a fair chance of surviving long enough to start a self-sustaining population.

Dale Dunford, EnviroScience, Inc.

PIT-tagged northern riffleshells ready to be shipped to their new homes.

Conewango Creek

Conewango Creek historically supported populations of northern riffleshell and clubshell. Today these species are only found at a limited number of sites within the watershed. During the summer of 2014, northern riffleshell and clubshell were placed into permanent monitoring plots at two Conewango Creek pilot study sites near the town of Russell in Warren County. In August 2015, the plots were monitored using a PIT tag reader in order to recollect stocked individuals to see how they fared over their first year in their new homes. Both species experienced relatively high survival (northern riffleshell x = 63%, clubshell x = 86%) exceeding the recommended 60% threshold at both sites. Subsequently, 1,500 northern riffleshell and 3,900 clubshell salvaged from Hunter Station were stocked at the Conewango sites in 2016. Coupled with recent dam removals (2009, 2014) that eliminated major barriers between our stocking sites and the Allegheny River, we're hopeful that these augmentations will help jumpstart species recovery.

Nevin Welte

Each mussel is hand-placed into the stream substrate.

Shenango River

The Shenango River in Mercer County historically supported populations of the northern riffleshell. Northern riffleshell were last collected from the river in the early 1900s, but it has not been observed since despite numerous surveys and it may be extirpated from the Shenango. However, the river does still support a low-density population of clubshell with only a few individuals at a few sites. In August 2014, northern riffleshell and clubshell were placed into their own permanent monitoring plots at three sites between Jamestown and Greenville to test whether the river could support populations of either species.

Nevin Welte

Tagged clubshells for the Shenango River near Greenville, PA

Warren Times Observer

Preparing a PIT tag reader for mussel monitoring.

A little over a year later, in September 2015, the plots were monitored using the same methods as Conewango Creek. All three sites experienced high survival for clubshell (x = 83%), while northern riffleshell survival varied greatly between sites and was low overall (x = 27%). Mussels stocked at one of the pilot sites, located on the inside of a river bend, suffered mortality due to heavy bed load deposition. After considering the results and lessons-learned during the pilot study, 5,100 clubshell mussels from Hunter Station were stocked during the 2015 and 2016 field seasons at the two stable Shenango River sites.

Streams

Endangered mussel species receive the lion's share of attention due to their imperilment status; but ecologically, common mussel species do most of the heavy lifting. The presence of common mussels in large numbers is beneficial to humans and wildlife alike as they perform a myriad of ecosystem services (e.g., water filtration, streambed stabilization, habitat for aquatic macroinvertebrate, etc.) essential to maintaining water and habitat quality. The Hunters Station and Line Q projects contained thousands (~59,000) of common mussels that also stood in harm's way. Their presence at these project sites represented an opportunity to restore two streams whose entire mussel communities were decimated by past land use practices or recent environmental catastrophe.

Dale Dunford, EnviroScience, Inc.

Using superglue and glitter to tag common mussels. The glitter color indicates the year the mussels were stocked.

Clarion River

The Clarion River winds its way through Clarion, Elk, Forest, and Jefferson counties before joining the Allegheny River near Foxburg. This waterway was described in 1909 by Pennsylvania's preeminent malacologist, Dr. Arnold Ortmann, as "one of the worst in the state" with waters running "black like ink." Land use practices and water quality in the Clarion River watershed were atrocious. Timber harvesting, tanneries, and other extractive industries left the river's aquatic community not just decimated, but nearly absent over much of its length. Since Ortmann's observations, water quality has improved dramatically and is now suitable for mussels.

Nevin Welte

Improved water quality in the Clarion River made this site suitable for mussel stocking.

Working in close partnership with the U.S. Forest Service and the Western Pennsylvania Conservancy (WPC), 402 PIT-tagged mussels were reintroduced at ten sites along the river from Portland Mills to Clear Creek State Park in 2015. Of the initial 402 mussels reintroduced, 382 were recaptured the following year with 377 surviving the test period (94% survival). Given the initial success at these ten sites, an additional 23,944 common mussels from Hunter Station, representing 12 species, were relocated in 2016. This stocking included an additional 50 PIT-tagged individuals/site to help monitor the success of the large-scale reintroduction effort.

In 2018, the Line Q project provided an additional infusion of 12,704 mussels. These mussels were stocked at a handful of the original sites to supplement species with low initial stocking numbers. Additionally, four new sites were established; two filled in long gaps between upstream and downstream sites while the

other two sites extended the recovery area downstream to Clarington and Cooksburg. PIT-tagged individuals were also stocked at these sites to facilitate future monitoring. This stocking brought the grand total of common mussels reintroduced into the Clarion River to 36,648 over a four-year period.

PIT-tagged mussels stocked during the 2015 and 2016 field seasons were monitored in 2018 and 2019 to determine whether our survival rates remained high. The 2019 sampling effort provided survival estimates ranging in duration from one year for sites established in 2018, to three to four years for mussels stocked in either 2015 or 2016. As an example, PIT-tagged mussels stocked near Clear Creek State Park in 2015 had an initial survival rate of 96% one year after stocking and 78% four years after stocking, The mussel cohort stocked in 2016 as part of the full scale restoration effort, had a survival rate of 88% which was three years after stocking. These values indicate there is a gradual decline in survival due to either death or emigration from the site, as we assume mussels not recollected have perished. It also suggests that mussels stocked as part of the large-scale restoration effort in 2016 have a similar survival rate as those stocked as part of the initial, small-scale, pilot study. All in all, common mussels distributed over nearly 39 miles of river appear to be doing well and with any luck they will continue to take a shine to their new home.

Ryan Miller

Using a PIT tag reader to monitor mussels stocked into Conewango Creek

Dunkard Creek

Unlike his description of the Clarion River, Dr. Ortmann described Dunkard Creek in 1909 as "splendid in every respect." However, Ortmann noticed the destruction of Pennsylvania's freshwater fauna in the other streams and rivers near Dunkard and

Nevin Welte

Dunkard Creek fish kill in 2009

throughout the Monongahela River basin, primarily by industrial activities that supported the burgeoning steel industry.

Amidst the surrounding devastation, Dunkard Creek's position as the crown jewel of mussel diversity (22 species, including four endangered) in the Monongahela River basin would persist for 100 years until a 2009 pollution event destroyed the creek's fauna. An estimated 15,382 mussels perished due to the discharge of highly saline mine water and a subsequent invasive golden alga bloom (*Prymnesium parvum*).

Concurrent with our other efforts, we established monitoring sites on Dunkard Creek in 2016 using mussels collected and PIT-tagged during the Hunter Station mussel salvage. These sites were monitored in 2017 to assess survival. Our monitoring results indicated that our Pennsylvania Fork of Dunkard Creek monitoring site was not suitable due to an unstable and

Nevin Welte

Stocking Dunkard Creek with mussels salvaged from the Line Q site.

shifting streambed. However, the four mainstem sites showed promise. Survival rates across these sites averaged 74%, with all sites exceeding the 60% threshold for initiating full-scale restoration efforts. These results also informed a separate project led by the Pennsylvania Department of Environmental Protection (PADEP). In 2017, PADEP stocked 4,003 juvenile plain pocketbooks (*Lampsilis cardium*) at our four mainstem pilot sites, the first hatchery-reared mussels released into western Pennsylvania waters for recovery purposes.

Rick Spears

White Sulphur Springs hatchery-reared baby mussels are a source of optimism for Dunkard Creek.

Survival rates of PIT-tagged mussels stocked in 2016 were reassessed in 2018. However, because the same mussels had already been excaveted the previous year, we altered our sampling method to minimize impacts to the sites. We scanned the site using the PIT tag reader to determine how many mussels we could detect and excavated ~50% to determine whether they were alive. Of the 391 mussels originally stocked at the four pilot study sites in 2016, we detected 175 two years after stocking and estimated the survival of those mussels to be 42% when averaged across sites.

With two years of favorable data in hand, the PFBC decided to stock common mussels at four sites along the Dunkard mainstem. In 2018, 10,488 common mussels representing seven species were stocked into Dunkard from the Line Q salvage effort, bringing the total number of individuals stocked from 2016 – 2018 to 14,985 mussels representing 12 species from three different sources.

Conclusion

On the long road to mussel recovery, it feels like we've only just backed out of the driveway. Our effort to jumpstart these populations using mussels from the Hunter Station and Line Q projects faces an unknown, but hopeful future. While not entirely certain where the road ahead will lead us, we do know these mussel recovery efforts are worth attempting and with data driving our decisions we think we're heading in the right direction.

Acknowledgements

We wish to acknowledge the many partner organizations and numerous associated individuals who worked to make these efforts possible, including EnviroScience, PADCNR, PADEP, PennDOT, PFBC, USFWS, U.S. Forest Service, and Western Pennsylvania Conservancy.

About the Authors

Nevin Welte has worked with the PNHP since 2006 as a Malacologist / Nongame Biologist for the Pennsylvania Fish and Boat Commission. When he's not doing environmental review, he enjoys teaching freshwater mussel conservation through appreciation and correct identification.

Jordan Allison has worked with PNHP staff since 2011 as a Fisheries Biologist and as the Resource Extraction Section Chief for the Pennsylvania Fish and Boat Commission. In addition to his professional passion of waterway encroachment permitting, he is also interested in freshwater mussel conservation and species restoration.

Notes from the Field

Announcing the Bees of Barrens Project

Betsy Leppo

PNHP is happy to announce that we received funding from the Pennsylvania Department of Agriculture for a study of pollinators. The 'Bees of Barrens' project, affectionately nicknamed B.O.B., will help fill gaps in our understanding of native bees and their distribution in Pennsylvania. We will survey the bees and vegetation of several unique barrens habitats. Barrens support unique combinations of plants and animals adapted to well-drained, seasonally dry (xeric) soils that are typically sandy or shaley, and historically were kept in an early successional condition by wildfire.

Deb Peterson, https://bugguide.net/node/

The splendid sweat bee (*Agapostemon splendens*) is a ground nesting bee found only at sites with sandy soils and may turn up in our barrens study.

This project contributes to another effort by the Northeast Association of Fish and Wildlife Agencies (NEAFWA) to conduct a regional study of native bees and their response to vegetation management in barrens habitats. Barrens are a priority for plant and wildlife management because of the unique grouping of species that live within them. Studies like this are needed to gauge how well management efforts are improving the habitat for characteristic or rare barrens species. We are applying the protocols that NEAFWA developed for bee and vegetation monitoring in Pennsylvania. These same protocols are being used at other xeric sites across ten states in the northeast and will provide science-based, repeatable, and comparable results. Access to taxonomic expertise is often a major hurdle for studying a diverse and technically challenging group like the bees. Participating in the NEAFWA project will provide us with access to the expertise and resources of the U.S. Geological Survey's Native Bee Inventory and Monitoring Lab in Patuxent, Maryland, which will provide dependable identifications of bees. The bee data we collect will be available for future research, as specimen records will be available online through the Discover Life database, and voucher specimens will be preserved in museum collections. We look forward to working with partners and volunteers who will help make this project a success.

Betsy Leppo

Barrens habitats typically have exposed patches of rocks and sandy soil. Characteristic vegetation includes pitch pine, scrub oak, and heaths like blueberry and huckleberry.

Allegheny River Flow Recommendations

Ephraim Zimmerman

Following years of ecological conservation actions and improvement of water quality in the watershed, the Upper Allegheny River supports a robust community of freshwater mussels and other aquatic life. Additionally, high quality floodplain forests, scour prairie grasslands, and wetlands along the river support rare plants and wildlife.

PNHP

Federally endangered sheepnose, northern riffleshell, and clubshell mussels from the Allegheny River.

The Nature Conservancy and partners, including the Western Pennsylvania Conservancy, have been working with the Army Corps of Engineers to further improve conditions for aquatic life and mitigate ecological stressors brought on by climate change. WPC scientists have helped develop ecological flow prescriptions for the river to benefit freshwater mussels, fish, and floodplain communities. These scientific prescriptions address the timing and level of water flow that must occur downstream of dams in order to revive and sustain critical ecological functions and habitats. Our Watershed team mapped the bottom of two stretches of the river that will serve as representative or sentinel reaches where we will work; one at Tidioute and the other at West Hickory, Pennsylvania. We will use sonar and GPS to measure the depth of the river along multiple transects spanning each reach.

WPC

WPC's dive team searching for freshwater mussels in the Allegheny.

This year, through a partnership grant to The Nature Conservancy by the Army Corps of Engineers, WPC scientists will return to the two areas to inventory populations of freshwater mussels and assess their habitat, map and describe submerged aquatic vegetation (SAV) beds, and assess the quality of floodplain plant communities expected to be impacted by changes to the amount of water released by Kinzua Dam operations. Obtaining this baseline data is necessary prior to implementing ecological flow prescriptions for the dam. Surveyors will map and describe mussel habitat, including substrate characteristics, mussel abundance, and shell length. We will also map and describe communities of SAV and determine the location of historic floodplain scour patches, which are known to support a rare plant species. These results will help guide development of an Adaptive Management Plan for Kinzua Dam and a Monitoring Plan for the Allegheny River downstream of Kinzua Dam.

Moths by the Numbers

Betsy Leppo

Numbers inform our everyday life. We use stock market values, sports statistics, report cards, and health measurements to make comparisons and reach informed decisions. Biologists with the Pennsylvania Natural Heritage Program want to know how many different kinds of plants and animals we have in the commonwealth. Documenting the species we have is the first step towards maintaining all biodiversity in the state. The next step is to assess the conservation status of each species. Is a species secure and likely to sustain populations into the future, or is it in decline or otherwise at risk of disappearing from the state? This step is done with tools like the Conservation Rank Calculator developed by the NatureServe network. Conservation rank assessments can be done at the state, national, and global level, and generate a standardized rank number that allows us to make comparisons and develop priorities for conservation efforts.

Among the insects there are many groups (bees, beetles, flies, etc.) with hundreds or thousands of species in each group. It would be too overwhelming to tackle them all at once. We tend to work on groups where there are taxonomic experts available to share their time and expertise with us. To date we have developed complete or nearly complete species lists of aquatic and terrestrial snails, butterflies, crayfish, dragonflies and damselflies, freshwater mussels, stoneflies, and tiger beetles. The moths are another group we have been working on with help from colleagues at museums and other friends with a passion for moths. This winter and spring biologists compiled numerous updates to improve the moth list for Pennsylvania. We are adding 656 species, including 233 macromoths and 423 micromoths, which brings our total moth species list to approximately 1,725 species.

Pete Woods

The cinnamon fern moth (*Olethreutes osmundana*) is a new addition to our list. This micromoth is very distinctive, but has been reported from Pennsylvania only several times.

Pete Woods

Little is known about the ecology of the white-eyed borer moth (*Iodopepla u-album*). This specimen was found in a wet meadow in Fayette County and is one of only a few that have been found in Pennsylvania

We will continue to add more species over time, and realize it is a shifting target as species populations fluctuate and climate change causes species ranges to shift. PNHP is thankful to all the people who have contributed moth data directly to us or to other data networks like BugGuide, Butterflies and Moths of North America, iNaturalist, and Moth Photographers Group. We especially thank Paul Dennehy, Steve Johnson, Curt Lehman, Jerry McWilliams, John Rawlins, Sam Smith, and Dale Schweitzer, for their many contributions to moth research in Pennsylvania and the Natural Heritage Program. We also are grateful to Kierstin Carlson and the rest of our amazing data management team who will enter all these changes into Biotics!

Pete Woods

The sordid hypena (*Hypena sordidula*) is newly recognized as occurring in Pennsylvania and as a possible species of conservation concern.

As our moth list spreads its wings, we realize how much work lies ahead of us to assess the conservation status of all these species. We currently have state ranks for about 138 moths. We are adding state ranks for 627 common species which we feel confident are secure in the state. We are also updating the taxonomy and/or conservation status of an additional 164 species. Based on a preliminary review of the expanded moth list, we identified another 500 species that could merit status assessment with the NatureServe rank calculator to determine if they are species of conservation concern. These revisions will be very useful as we approach the next update of the State Wildlife Action Plan in 2025. We have better numbers now to help us assess which species are common, and which may be rare and merit a more comprehensive conservation status assessment.

For the benefit of future generations, we need to gather more data on other invertebrate groups, many of which are in desperate need of study. In an unlimited world of possibility, we would love to partner with experts to better document and assess species in all invertebrate taxa. How many of these groups do you recognize? (adapted from the Pennsylvania Biological Survey Box Score, 2013): bristletails, two-pronged bristletails, springtails, earwigs, cockroaches, beetles, true flies, gnats, crane flies, mayflies, true bugs, water striders, cicadas, leaf hoppers, aphids, scale insects, wasps, bees, ants, sawflies, termites, mantids, scorpionflies, hangingflies, dobsonflies, fishflies, katydids, walking-sticks, chewing lice, sucking lice, booklice, barklice, coneheads, fleas, twisted-wing insects, thrips, silverfish, firebrats, caddisflies, angel insects, centipedes, millipedes, pauropods, symphylans, mites, ticks, spiders, daddy-longlegs, pseudoscorpions, scorpions, crabs, scuds, grass shrimps, fairy shrimps, water-fleas, pill bugs, woodlice, fishlice, copepods, opossum shrimps, seed shrimps, tongue worms, leeches, earthworms, polychaetes, bryozoans, hydras, freshwater jellyfish, entoprocts, hairy -backs sporozoans, roundworms, horsehair worms, proboscis worms, tapeworms, flukes, flatworms, sponges, rotifers, spiny-headed worms, and water-bears.

Rock Vole and Big-tailed Shrew Surveys in Sullivan County

Joe Wisgo

While many of Pennsylvania's mammals are habitat generalists, others are habitat specialists requiring microhabitats with some distinct characteristics. In the case of the rock vole (*Microtus chrotorrhinus*) and the big-tailed shrew (*Sorex dispar*), shaded rock or talus fields in cool moist forests are a must. The deep and

Joe Wisgo

Big-tailed shrew and rock vole habitat

Charlie Eichelberger

Big-tailed shrew (*Sorex dispar*)

complex boulder interstices provide safety and foraging areas for both species. Typically, these sites consist of large deep boulder fields topped with a rich herbaceous layer of ferns and mosses, which are either adjacent to water or have subterranean streams flowing beneath. While big-tailed shrew can tolerate some habitats that are drier in nature, rock voles are almost exclusively found at sites with water present. Currently in Pennsylvania, the rock vole is only known to inhabit the northeast portion of the state, and it has only been documented at a small number of sites. While the big-tailed shrew has a larger distribution within the state, its occurrences are also limited. The cryptic nature and habitat preferences of both species make detection difficult.

In order to update some old records and search for new occurrences of both species, PNHP zoologists conducted surveys along the steep, rocky, fern covered hillsides of State Game Lands 13 in Sullivan County during September of 2019. Unfortunately, rock voles were not encountered over the two-week trapping endeavor, but several big-tailed shrews were captured at multiple sites. Additionally, several northern water shrews (*Sorex palustris albibarbis*), which typically inhabit cool, shaded streams with rocky streambanks, were also captured during our surveys. Over the coming field seasons, PNHP zoologists plan to continue surveillance of both the rock vole and the big-tailed shrew at both known and suspected sites.

Botanical Crown Jewels

Rachel Goad

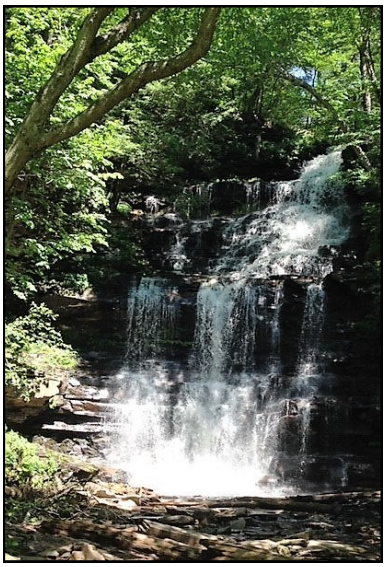
Although Pennsylvania isn't a monarchy, the state does have *Crown Jewels*. These aren't objects, but places that are unimaginably precious and that serve as a critical link to our history and our natural heritage.

These important sites have been identified as part of a larger effort by PNHP botanists and data scientists to prioritize sites across Pennsylvania for the ongoing task of collecting up-to-date information on rare plant occurrences. Those that rise to the top, the ones we're affectionately calling Pennsylvania's *Crown Jewels*, host concentrations of locally or globally rare plant species. Thankfully, many of these sites are already protected, but some may be under-recognized or in need of additional conservation.

Pete Woods

Lyre-leaved rock cress (*Arabis lyrata*) is very uncommon in western Pennsylvania, but this plant thrives in the sand dunes at Presque Isle. This plant only blooms once, in its second spring, before producing seeds and dying.

Some examples you may be familiar with include Ricketts Glen, where deep ravines, waterfalls, and thickly shaded forests support a suite of rare, northern species; and Presque Isle, where dunes, swales, ponds, and woodlands host species with an affinity for the Great Lakes. Both of these special sites are owned and managed by Pennsylvania DCNR, Bureau of State Parks.



Mary Ann Furedi

The seepy rock faces of waterfalls at Ricketts Glen provide habitat for the white twisted-stalk (*Streptopus amplexifolius*), a threatened plant in Pennsylvania.

We are exploring ways to share more information about these sites with the public, so please stay tuned as this work develops. In the meantime, when you visit places with interesting and beautiful plants, remember

that you may be in the presence of a *Crown Jewel*. Minimize your impact by staying on the trail, packing out any trash, and not picking or collecting any plants, animals, rocks, or artifacts. As the saying goes: take only pictures, leave only footprints.

PPCN Tackles Plant Conservation Best Management Practices

Kristi Allen

Pennsylvania is home to approximately 3,400 plant species; roughly two-thirds of those are considered native to the commonwealth. Of these native plants, the Department of Conservation and Natural Resources has classified 349 as rare, threatened, or endangered in Pennsylvania.

To the lay person, conserving these rare plants might seem pretty simple and straightforward. The steps seem to be as follows:

1. Identify a plant that is threatened with extinction.
2. Plant as much of that plant species as possible.
3. Voila, a previously endangered plant is no longer under threat.

As it turns out, plant conservation is a much more nuanced endeavor. It requires all sorts of considerations, from obtaining permits and building relationships with landowners, to understanding the genetics, natural history, and reproduction of a plant.

The Pennsylvania Plant Conservation Network hopes to advise conservationists in our state on how to best engage in conservation horticulture. PPCN is developing a guidance document for conducting best management practices for native plants of conservation concern with assistance from the Pennsylvania Natural Heritage Program and the Vascular Plant Technical Committee. Together, we are tackling important questions related to conservation horticulture.

Kristi Allen

PNHP botanist Rachel Goad assists at a site where PPCN is augmenting a population of checkered rattlesnake plantain (*Goodyera tesselata*).

This forthcoming document strives to provide an overview of relevant techniques and considerations for enhancement of rare plant population viability and maintenance of genetic integrity. While other states and organizations already have similar best practices in place, this will be the first of its kind in Pennsylvania.

Story Map Highlights Native Plant Conservation

Amy Jewitt

Brad Georgic

Drone footage of Presque Isle State Park utilized in the story map

Storytelling is an effective way to communicate important messages; often done in an engaging and visually appealing way that remains in one's memory. This basic concept inspired the creation of a new ArcGIS story map recently published by PNHP staff in March 2020 titled *Protecting Pennsylvania's Native Plants and Habitats.* This story map highlights the successes, actions, and values of partnerships in protecting native plants and wildlife through invasive species management. If you're unfamiliar with the term "story map," it simply refers to the combination of one or more maps with narrative text, images, and multimedia content, designed to create a compelling, user-friendly web app that tells a story about a particular topic.

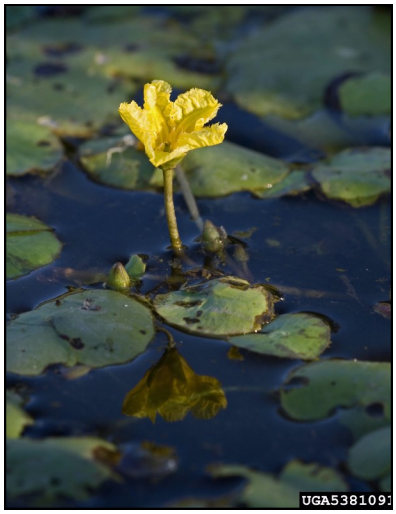
This new story map discusses the term "plant blindness" and how the inability to notice the diverse world of plants around us can lead to a lack of recognition regarding the important role of plants in our daily lives. We highlight two programs that focus on protecting and preserving native plants; one through data collection of invasive species locations and treatment efforts (iMapInvasives) and the other through on-the-ground stewardship activities (Pennsylvania Plant

Conservation Network). Case studies at six sites in Pennsylvania showcase invasive species management activities conducted by natural resource professionals and their partners to protect rare plants and wildlife.

View PNHP's *Protecting Pennsylvania's Native Plants and Habitats* at https://storymaps.arcgis.com/stories/04849d247d014464b496e2daf8258d8e

New Additions to Noxious Weed List

Amy Jewitt



David Cappaert, Bugwood.org

Yellow floating heart (*Nymphoides peltata*)

As you might already know, invasive weeds cause harm to the economy, environment, and human health. For a select number of invaders deemed especially harmful, states and provinces maintain lists of species considered to be noxious weeds. In Pennsylvania, that list, which already contains 24 noxious plants, has recently grown to include eight new species. Among those recently added are Brazilian waterweed (*Egeria densa*), water soldier (*Stratiotes aloides*), parrot feather (*Myriophyllum aquaticum*), yellow floating heart (*Nymphoides peltata*), wild parsnip (*Pastinaca sativa*) [except for non-wild cultivated varieties], Japanese knotweed (*Reynoutria japonica*), giant knotweed (*Reynoutria sachalinensis*), and Bohemian knotweed (*Reynoutria x bohemica*).

G. Vandebrake

Brazilian waterweed (*Egeria densa*)

Once a plant is deemed a noxious weed, it is placed in one of three categories: Class A, Class B, or Class C. Category definitions and classification of newly added species are listed below:

- Class A: Preventing new infestations and eradicating existing infestations of noxious weeds in the class is high priority. *Brazilian waterweed, yellow floating heart*
- Class B: The Pennsylvania Department of Agriculture may require control to contain an injurious infestation, or may provide education or technical consultation. *Parrot feather, wild parsnip, and the three species of knotweeds*
- Class C: Preventing introduction and eradication of infestations of noxious weeds in this class is the highest priority. Class C noxious weeds are any federal noxious weeds listed on the Federal Noxious Weed List that are not yet established in the commonwealth. *Water soldier*

The Pennsylvania Department of Agriculture administers the Noxious Weed Control List. View the entire list of Pennsylvania's noxious weeds at https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/NIPPP/Pages/default.aspx