



# Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

## WILD HERITAGE NEWS

Spring 2026



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Photo Banner  
Allegheny River  
Ryan Miller

## Eight Years of Mudpuppy and Salamander Mussel Work

by  
Ryan Miller, Senior Zoologist

The salamander mussel (*Simpsonaias ambigua*) was listed by the Pennsylvania Fish and Boat Commission (PFBC) as a state endangered species in 2010. The recommended actions in the 2015 Species Action Plan (SAP) for the salamander mussel included gathering information on salamander mussel habitat, demographics, and life history for informed conservation and restoration. The Pennsylvania range of this rare mussel is now restricted to the Allegheny River navigational pools 3-8 and French Creek. It also historically lived in Dunkard Creek until its population was destroyed in a pollution event in 2007.



Salamander mussels (*Simpsonaias ambigua*) are the only freshwater mussel in North America known to have a non-fish host.



The red external gills of the mudpuppy (*Necturus maculosus*) are where salamander mussel glochidia embed themselves.

The mudpuppy (*Necturus maculosus*) is the only known host for the salamander mussel. This aquatic amphibian has been spotted at salamander mussel collection locations in French and Dunkard creeks and the Allegheny River. Salamander mussel glochidia (larval stage mussels) have been observed embedded on the mudpuppy's large, external gills. We have seen mudpuppies living alongside salamander mussels in shelter rock microhabitats; this association is clearly critical to the salamander mussel's reproductive success.

The salamander mussel's Pennsylvania distribution and zoogeography are not fully understood or adequately explained. Famous malacologist Dr. Arnold Ortmann could not locate salamander mussel habitat in Pennsylvania's rivers, but in his time, populations may have been reduced or eliminated due to industrial pollution of our waterways. In areas surrounding Pennsylvania, the salamander mussel range includes the Monongahela River drainage in West Virginia and a number of tributaries to the Ohio River in Ohio.



Salamander mussel (*Simpsonaias ambigua*)

Recent surveys documented that the navigational pools in the upper Ohio River basin have suitable habitat for the salamander mussel. In addition to records in the Allegheny River's navigational pools 3-8, the salamander mussel was found in the Ohio River in the Belleville Pool approximately 160 miles downstream of the Pennsylvania and Ohio border. One of the main theories for this gap in occupancy of the salamander mussel between the Middle Allegheny and Middle Ohio Rivers is legacy pollution causing salamander mussel mortality.

At the start of this endeavor, there were no recent or historical mudpuppy observation records from Pennsylvania's portion of the Ohio River – an area where amphibian populations have been under-studied, unreported, or undetected. In the Allegheny River, there was no information on the abundance of mudpuppies and population demographics. In the only known habitat for salamander mussels in Pennsylvania, many unknowns persisted about its glochidial host.

### Presence Absence Surveys (2017-2019)

As recently as 2017, mudpuppy presence was thought to be a possible factor limiting the dispersal and recovery of the salamander mussel. We received a grant from the Wild Resources Conservation Program (WRCP) to complete intensive baseline surveys for both species.

Because these large river systems had not been surveyed for this elusive salamander, we focused our initial effort on confirming the presence of mudpuppies in the Ohio and Allegheny rivers. We placed approximately 140 modified crayfish traps in multiple locations on the rivers, then checked the traps daily during the late fall and early spring months when mudpuppies are more actively foraging in the colder water temperatures.



PFBC Senior Malacologist, Nevin Welte, placing a mudpuppy trap.

In April 2018 and 2019, we trapped mudpuppies in the Allegheny River (Pools 3-6) at 14 sites identified as salamander mussel locations or as potential habitat for both species. We captured a total of 45 individual mudpuppies at 11 of those 14 sites, 5 of which were known salamander mussel locations. We trapped in the Ohio River in December 2018 and 2019 at 12 locations in the New Cumberland, Montgomery, and Dashiels pools and captured 88 individual mudpuppies at 9 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 captured mudpuppies were counted, measured for length, weighed, sexed, examined for their overall health, checked for glochidial infestation by salamander mussels, and released.

The rest of the study focused on the presence of the salamander mussel in the Ohio River. We conducted surveys specifically targeting salamander mussels where we found rock shelter habitats (preferred by mudpuppies and salamander mussels). These salamander mussel surveys consisted of two 10 m circle searches that were conducted in loose rocky areas consistent with mudpuppy habitat. Divers used teamwork to simultaneously lift rocks, when feasible, and searched for salamander mussels, mudpuppies, or other mussel species that might be located underneath or adjacent to the rocks. These targeted salamander mussel surveys were also conducted at most of the sites in the Ohio River where mudpuppies were captured during the trapping effort. Unfortunately, we found no salamander mussels.

### Mudpuppy Population Estimates (2019-2021)

Our 2017-2019 mudpuppy surveys confirmed mudpuppy presence at five known salamander mussel sites in the Allegheny River and at nine locations in the Ohio River where salamander mussel and mudpuppy presence had not previously been confirmed. Through a second WRCP project, we hoped to determine relative density and demography of mudpuppy populations in the Pennsylvania navigable pools of the Allegheny and Ohio rivers.



A mudpuppy in a trap.

We conducted more intensive trapping at our most successful mudpuppy capture sites in an attempt to get more accurate population density estimates in the Allegheny and Ohio rivers. All mudpuppies captured were marked with PIT tags to conduct capture-mark-recapture population estimates. During this investigation we trapped at each site for 10 consecutive nights using 30 traps per location (mark). We then took

at least a five-night recess and resumed trapping for another 10 consecutive nights (recapture).

At the three Ohio River sites where we recaptured animals, we modeled mudpuppy population size using closed mark-recapture modeling. There were no significant differences between these three sites in population size, but population estimates ranged from an amazingly high 240 to 354 individuals per site. Despite the same amount of effort, we recaptured no mudpuppies in the Allegheny River.

After discovering the large populations of mudpuppies living in Pennsylvania's stretch of the Ohio, it seems unlikely that lack of host animals is the reason there are no salamander mussels in this same stretch of river.



A silo used to house juvenile salamander mussels as part of the efforts under the third WRCP grant.

### SILOS and habitat (2021-2025)

It was hypothesized that juvenile salamander mussel survival could be a factor limiting the dispersal and recovery of the salamander mussel. We received a third WRCP grant to study survival of juvenile salamander mussels through the deployment of mussel survival silos. These small concrete dome-shaped structures have a chamber in the middle that hold a small number of juvenile salamander mussels. We placed the silos in four locations in Western Pennsylvania that either currently have salamander mussel populations (control) or where salamander mussels are no longer found, like the Ohio River. The silos remained in place for the summer (one growing season), then were removed and examined for juvenile salamander mussel survival and growth. We hoped this would determine if salamander mussels could survive in Pennsylvania's portion of the Ohio River.

Hatchery reared juvenile salamander mussels were provided from the U.S. Fish and Wildlife Service's White Sulfur Springs hatchery in West Virginia. In fall 2021, PNHP staff and partners collected gravid female salamander mussels from a robust population in the Middle Allegheny River. The females were taken to the hatchery and the juveniles they produced were returned to Pennsylvania for this study.

Unfortunately, it was difficult to propagate and grow salamander mussels in a hatchery setting. Glochidia would easily transfer and attach to recently captured mudpuppies in the holding tanks. A few months later they would transform into juvenile mussels, fall off the mudpuppy gills and begin their new lives. However, after a short period of growth they would stall and eventually die. Hatchery staff have not been able to identify the reason. The juvenile salamander mussels we used for this study were dying off as they were transferred to PNHP for the silo experiment.

There were also complications with invasive zebra mussels attaching to and covering the mussel silos, including the screens that were meant to keep fresh water flowing through the chamber that held the juvenile salamander mussels. In some cases, the zebra mussels got through the screens and attached to the juvenile salamander mussels, eventually killing them. With these complications, only 14 of the 60 juvenile salamander mussels survived the study period. Overall, the results were inconclusive.



Invasive zebra mussels (*Dreissena polymorpha*) proved to be problematic during the study and killed several juvenile salamander mussels in the silos.

We attempted to replicate the silo study in 2023 and 2024 but the hatcheries failed to produce juvenile salamander mussels that lived long enough to meet the size requirements for the study.

The next part of the study was intended to gauge the efficacy of attracting mudpuppies and (hopefully salamander mussels) to placed habitat. In early June 2023, we placed large flat sandstone rocks at four sites that were known to have mudpuppy populations. Three of the sites had known salamander mussel populations as well. In August 2025, the rocks were gently lifted and checked to see if they attracted mudpuppies or salamander mussels.



PNHP Zoologist, Ryan Miller, and Invertebrate Zoology Manager, Mary Walsh, placing habitat to attract mudpuppies.

After a little over two years, four Species of Greatest Conservation Need (SGCN) were discovered living under our placed rock habitats. We observed mudpuppies at two sites, three eastern hellbenders at one site, and a federally endangered rayed bean mussel under the edge of one of the rocks.



The placed habitats were successful in attracting mudpuppies.

endangered rayed bean mussel under the edge of one of the rocks. Lastly, numerous rainbow mussels were observed under the placed habitat at one of the locations. Rainbow mussels are known to live under rocks in flowing water situations. This demonstrates that placed habitat in the right areas will attract and benefit numerous species, both rare and common.

Although no salamander mussels were observed during this check, it may have been too early for them to colonize the new sites. Another investigation of the placed habitat may be warranted in five years after they have become well established.

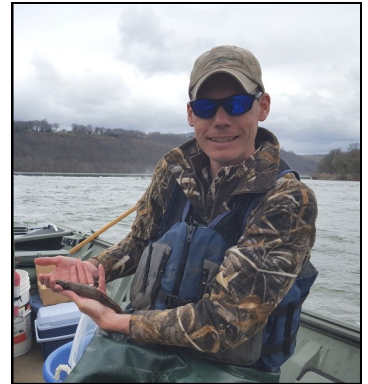


Habitat and silos ready to go!

After the completion of these three studies, we have a greater understanding of the status of the salamander mussel and mudpuppy in the state. Restoration areas have been prioritized for the salamander mussel. We have proven that mudpuppies (and other rare species) will utilize strategically placed habitat, which may be a useful tool in habitat restoration. Areas where mudpuppies can be collected and used in a hatchery for propagation have been identified. Further testing on the effects of contaminants on salamander mussel survival is definitely warranted but may be best explored in a controlled laboratory setting. Overall, we are much closer to understanding how to protect these two uniquely bound species and what we can do to aid their recovery.

### About the Author

Ryan Miller is a Senior Zoologist with the Pennsylvania Natural Heritage program based at the Western PA Conservancy in Pittsburgh. He has been with the program since 2005. Most of his projects over the years have focused on reptiles, amphibians, freshwater mussels, and vernal pools.



## Notes from the Field

### Putting Conservation Planning into Action

Kathy Gipe, Senior Non-Game Biologist/Herpetologist

PNHP staff and partners are finishing up work on a planning and technical assistance grant from the National Fish and Wildlife Foundation for “Conservation Planning for Wood, Spotted, and Eastern Box Turtle, and Eastern Hellbender” in the Chesapeake Bay watershed. These four species are all Species of Greatest Conservation Need (SGCN) in the Pennsylvania [Wildlife Action Plan](#) and the Northeast Association of Fish and Wildlife Agencies [regional assessment](#) in the northeast U.S. The SGCN turtles are long-lived species with low reproductive rates; they face many threats including habitat loss and fragmentation due to development, natural succession of historical nesting sites, vehicular traffic, agricultural machinery, increased predator populations, and illegal collection.



Turtles such as the Wood Turtle (shown here munching on a slug) require sun-exposed loose soils for digging nests and laying eggs, which are then covered up and left to incubate for several months.

Initial activities of the grant entailed information gathering about key habitats used by these species on some state park and state forest tracts previously determined to have robust populations of the turtles. Staff and partners tracked wood turtles with radio telemetry to determine where they nested and what threats they faced in addition to visual surveys for turtles during nesting season to identify important habitat needs. Using this information, as well as regional

conservation plans previously written for these three turtle species, staff are writing habitat management plans for the Department of Conservation and Natural Resources (DCNR) to incorporate conservation goals into ongoing maintenance of the state properties. Some proposed actions include removal of invasive shrubs and forest succession to expand open canopy nesting sites, as well as installing a fence along a busy road to prevent turtles from being hit. Expanding turtle nesting habitat in state parks and forests will increase the likelihood of long-term persistence of the SGCN turtle species populations within properties that are already protected from development threats.



A wood turtle nest.

A separate aspect of the grant was the planning of habitat enhancement projects for the eastern hellbender, our state amphibian. The eastern hellbender is fully aquatic, living in cold-water streams, and breathes through capillaries in the folds of their skin, making them vulnerable to pollutants and poor water quality. It is also threatened by stream habitat alteration including substrate removal, siltation, increased water temperatures, and climate change (i.e., more extreme flood events and rising temperatures). This grant funded PNHP partners to develop six workplans to install slab rock habitats in streams known to support hellbenders but found to be lacking in nesting habitat. The eastern hellbender workplans are modeled after a successful instream rock placement project completed by the Pennsylvania Fish and Boat Commission in 2023 in the Susquehanna watershed where hellbenders

were found nesting under the newly placed habitat within weeks of installation. Now that these workplans and management plans have been prepared, the project partners are applying for a grant to put the plans into action in the coming years.

## Harnessing the Power of Community Science

Molly Moore, Heritage GIS Manager

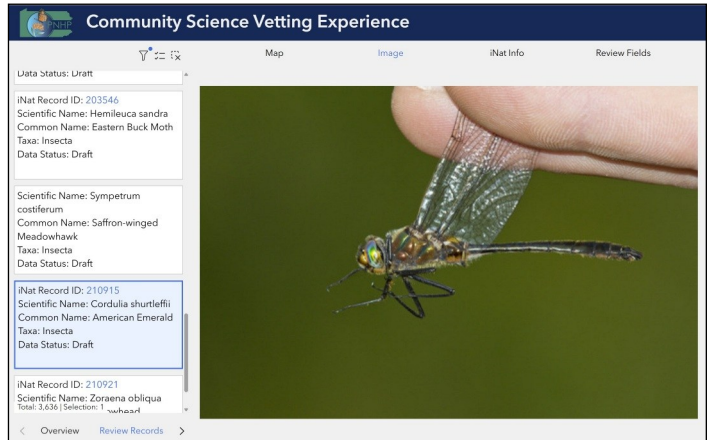
Community science platforms like iNaturalist and eBird have made it possible for anyone with a smartphone to be a practicing naturalist. Hundreds of thousands of observations are submitted by community naturalists every day, contributing to a fuller picture of biodiversity that would have been unimaginable just a generation ago. At PNHP, this vast wealth of data has expanded what we know about species populations and distributions across Pennsylvania, helping us fill data gaps and strengthen the conservation planning tools we offer. Data from platforms like eBird, iNaturalist, GBIF, and InvertEBase account for over 85% of the records powering the Conservation Opportunity Area (COA) Tool, showing just how much everyday observers can contribute to conservation action. Community science data has even led to the rediscovery of several species that had not been observed in decades.



This photo of the striped whitelip (*Webbhelix multilineata*) was submitted to iNaturalist in 2019.

In 2012, an observation was submitted to iNaturalist of a three-horn wartyback (*Oblivaria reflexa*) shell, a mussel species that had been considered extirpated in Pennsylvania and had not been seen in nearly a century. The shell, which appeared fresh enough to have been recently alive, spurred surveys that led to the discovery of several live three-horn wartyback individuals along the Ohio River and the lower Allegheny River. Similarly, in 2019, a photo of a snail submitted to iNaturalist was identified by snail experts as the striped whitelip

(*Webbhelix multilineata*), a species that had not been recorded in Pennsylvania since 1948.



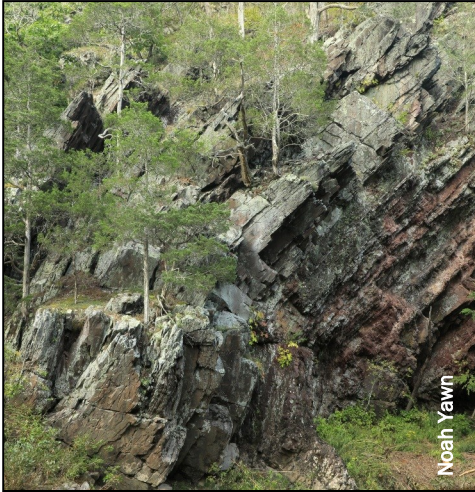
The Community Science Vetting dashboard provides biologists with an interface to efficiently review species identification, location accuracy, and land owner permission and document confirmations.

These rediscoveries speak to the sheer reach of community science and its power to fill data gaps that traditional survey efforts alone may never uncover. What's next for community science data at PNHP? Although we have been drawing on community science data for years, we lacked a formal system for incorporating these observations into Biotics, our core database underlying our Natural Heritage Areas, Environmental Review, and other conservation planning products. Our newly released Community Science Vetting (CommSciVet) database and web application changes that. Currently implemented for iNaturalist, the workflow allows us to import observations for species of interest into CommSciVet, where biologists work through a structured set of vetting fields to confirm and document identification, location, and land access permissions. Records that pass this review are incorporated into Biotics and other downstream products. With CommSciVet, we finally have an efficient, yet accountable, way to bring community science observations into our core products and put them to work for conservation.

## Winter Staff Workshop: Geology for Botanists

Noah Yawn, Ecologist

Geology and ecology, two broad branches on the tree of natural sciences, intersect at the surface and often go hand-in-hand, especially when considering species distribution patterns, biophysiology, and ecological processes.



Sideling Hill shale barren, an example of a high biodiversity “geobotany area,” characterized by outcrops of steep, tilted shale beds with specialist plant species.

So, why is geology important, and how does it relate to natural communities and plant species within Pennsylvania? In the broad sense, earth history offers explanations for major biogeographical patterns seen across the globe, all the way down to

the local level. Minerals, the discrete units that much of our bedrock are classified by (using their own taxonomy, similar to plants), release chemical elements into their environments that influence pH, nutrient availability, and subsequent soils (or lack thereof). Vegetation relies on a web of interconnected processes, namely geomorphology, disturbance regime, climate,



Ecologist, Noah Yawn, discusses the rock cycle during the DCNR “Geology for Botanists” workshop.

paleoclimate, hydrology, slope and aspect, and soils, which are all in some form functions of geologic history and bedrock type. Many of Pennsylvania’s plant conservation species of concern are specialists on certain bedrock groups, and are often found in “geobotany areas.” Geobotany areas are communities and habitats that are constrained by a combination of geomorphology, slope and aspect, bedrock chemistry, and hydrology. In sum, geologic diversity begets biological diversity!

PNHP staff from DCNR and WPC participated in an in-house workshop at Kings Gap Environmental Center led by ecologist Noah Yawn, that focused on exploring these intrinsic relationships within Pennsylvania’s own diverse bedrock geology, geologic history, and diverse flora. Over the course of a day, our group discussed fundamental geologic concepts and “how-to’s” for interpreting outcrops, learned common bedrock types present within the state and their specific mineral assemblages and chemistries, their effects on the environment, relationship to ecological communities and conservative species, and a broader view of these topics and how they relate to regional physiography. We also took a virtual “tour” of Pennsylvania, ranging from botanists’ and geologists’ long-favored serpentine barrens, calcareous ravines, sandstone cliffs, mafic meadows, glacial kettle bogs, alkaline hanging fens, to the sand spits of Lake Erie. This workshop was built from a similar workshop developed for the 2025 Pennsylvania Botany Symposium in State College, Pennsylvania.

### **Welcome Corinne Garda, New iMapInvasives Information Assistant**

Amy Jewitt, Senior Coordinator,  
Pennsylvania iMapInvasives Program

I am pleased to introduce Corinne Garda, our new iMapInvasives Information Assistant. Based in our Pittsburgh office, Corinne joins WPC/PNHP after recently graduating from Chatham University in December 2025 with a B.S. in Environmental Science and a minor in Sustainable Natural Resources. She has professional experience working as a Library Access Services Aide at Chatham’s JKM Library and as a Botany Intern for the Carnegie Museum of Natural History where she worked with the museum’s scientific plant archives.



Corinne’s personal interests include wildlife (animals and plants), conservation, sustainability, and ecology. In her new role, she will be supporting initiatives of WPC’s Pennsylvania iMapInvasives Program where she will contribute her time and talents to data entry and quality control, education and outreach, researching information about invasive species, and communicating with database users. Corinne commented that, “Now that I am part of

WPC, I am most looking forward to working with other passionate people to have a positive impact on the environment.”

Welcome, Corinne! We look forward to seeing the positive changes you will surely bring to WPC, PNHP, and the PA iMapInvasives Program.

### PNHP Begins Search for Elusive Skunk

Ryan Miller, Senior Zoologist

There are very few Alleghanian (aka eastern) spotted skunk records for Pennsylvania. The Pennsylvania Mammal Survey, conducted between 1946 and 1951, found less than 10 individual spotted skunks reported by trappers and fur buyers in southern Bedford and Fulton counties. More recently, an incidental spotted skunk was photographed by trail cameras in Fayette County in 2012. Late last year, PNHP began surveying for the spotted skunk in coordination with the Pennsylvania Game Commission and DCNR Bureau of State Forests at known historic spotted skunk locations. At this time, systematic trail camera surveys are ongoing and no spotted skunks have been observed out of almost 94,000 survey photos taken. However, other interesting birds and mammals have been visiting the camera sites baited with roadkill deer legs. These surveys will help update the species' conservation status in Pennsylvania.



A fisher (above) and a golden eagle (below) were among the interesting species that visited the spotted skunk traps.



### Time for the Hunt: Penn's Woods Invaders Edition

Corinne Garda, iMapInvasives Information Assistant

This May, the Pennsylvania iMapInvasives Program will host its 7<sup>th</sup> annual Invasive Species Scavenger Hunt. A training webinar on April 30 will invite people to participate in the Hunt from May 1-31. Register to attend by visiting WPC's "Events & Volunteer Opportunities" webpage.

Scavenger Hunt participants are encouraged to get outdoors and search for this year's five target species, each of which can be found in Pennsylvania's forested areas. Species include the golden oyster mushroom (*Pleurotus citrinopileatus*), multiflora rose (*Rosa multiflora*), ragged robin (*Silene flos-cuculi*), five-leaf aralia (*Eleutherococcus sieboldianus*), and princess tree (*Paulownia tomentosa*).



Golden oyster mushrooms (*Pleurotus citrinopileatus*) cluster on hardwood logs and standing trunks of trees.

Both presence and not-detected findings should be submitted to iMapInvasives using the iMapInvasives mobile app, Survey123 app, and/or iMapInvasives online database. Not only do these submissions help members of the public learn about and identify invasive species in Pennsylvania; they also provide the iMapInvasives program with valuable invasive species distribution data. Additionally, Scavenger Hunt findings help the program better track and address emerging invasive species, such as the ragged robin.

Ragged robin (*Silene flos-cuculi*) is an herbaceous perennial plant that is native to Europe and Asia. After its introduction to the U.S. in the late 1800s, this ornamental species began to naturalize in Pennsylvania. Today, it frequently outcompetes native vegetation by self-seeding each year, which allows it to form abundant monospecific patches. Its seeds can remain dormant in the soil for over five years, and the plant itself is highly adaptable, often establishing in

disturbed environments. While many people are eager to plant ragged robin this spring, it is important to note the wide variety of native alternatives that are equally as beautiful, including fire pink (*Silene virginica*), swamp milkweed (*Asclepias incarnateae*), and wild bergamot (*Monarda fistulosa*).



Jan-Age Pedersen, iNaturalist

Ragged robin reaches peak bloom in June.

To learn more about ragged robin and other species featured in this year's Invasive Species Scavenger Hunt, please visit (<https://arccg.is/KnK090>).

### Green Salamander

Ryan Miller, Senior Zoologist

The state threatened green salamander is a habitat specialist that resides in sandstone rock outcrops and formations. In 2024, zoologists at WPC created a GIS-based habitat model to map potential habitat for the green salamander in Pennsylvania. We hope to ground truth the habitat model, and confirm/document that these habitats are occupied. This project has the potential to find additional and hidden populations of the



Ryan Miller

Charlie Eichelberger surveys for green salamanders with a flashlight on a sandstone outcrop.

species across its extremely restricted range in southwest Pennsylvania. Over the next two active seasons, we will visit areas of unsurveyed habitat including north of the Youghiogheny River, which is outside of the known range in the state for the species.

### No Stone(Fly) Left Unturned

Pete Woods, Senior Invertebrate Zoologist

This winter, PNHP biologists began field work for a new project focused on regionally rare stoneflies. Stoneflies are aquatic insects that spend most of their lives in streams and rivers, where they graze on algae, diatoms, and other organisms. They emerge above water as adults any time from mid-winter to early summer, depending on the species, and are considered important indicators of water quality.



Pete Woods

Most stoneflies are brownish to blackish, but stoneflies in the family Chloroperlidae are greenish to yellowish.

This project is targeting 11 rare species of stonefly that are focal species for a larger regional study. Our specimens will help the regional study determine the distribution and conservation status of these species. Our first surveys of the year were for the Illinois stonefly (*Allocapnia illinoensis*) in streams near where a specimen was collected many years ago in Greene County.

Our surveys are funded by a Wild Resources Conservation Grant. Our collaborator Scott Grubbs at Western Kentucky University will identify the specimens that we collect this year and next year.

## Historic Botany Project Launches in 2026

Rachel Goad, Senior Botanist

A new project starting in 2026 will focus on re-surveying for occurrences of rare plant species last observed 20 or more years ago. Such records are often difficult to survey for, requiring specific and dedicated survey effort beyond what normal survey preparation requires. Some are only recorded from singular collections, and some have not been seen in as long as 88 years, but they document important finds of very uncommon, listed plants in Pennsylvania.

Such listed plants, (e.g., those that are Pennsylvania Endangered or Pennsylvania Threatened) often have numerous historic occurrences in the state that, for the reasons discussed above, are rarely revisited. The listed status of these species is applied based on an understanding of their occurrences, distribution, threats, and needs. These statuses need regular review, optimally incorporating high quality survey data, to maintain their

relevance. When an occurrence is not seen for many years, there may be a suspicion of extirpation. Surveys are needed to update the status of individual occurrences, and to provide supporting evidence for changing or retaining the conservation statuses for individual species.



Steve Matson, iNaturalist

Miners lettuce (*Montia chamissoi*), a disjunct species with historic occurrences in Pennsylvania being included in the project.

Survey work conducted over the next three seasons will target multiple occurrences of at least ten species that occur primarily in the eastern and central portions of the state, with a small amount of work in the northwest, too. These species are mostly ranked as Critically Imperiled (S1) or Imperiled (S2), and have a status of Pennsylvania Endangered.

## Viva Vernal Pools!

Betsy Leppo, Senior Invertebrate Zoologist

This spring PNHP staff, partners, and volunteers embarked on a whirlwind of vernal pool monitoring and outreach activities. We completed our fourth season of monitoring of a vernal pool at Gifford Pinchot State Park for the regional Vernal Pool Phenology Project. This six-week program documents the migration of wood frogs and mole salamanders to vernal pools to breed and lay eggs. We also tracked the development of leaf and flower buds on the trees that surround the wetland to allow us to compare key moments in plant and amphibian phenology. We assisted the Kings Gap Environmental Education Center with their annual five-week amphibian monitoring program of eleven vernal pools through an interesting spring with a hard extended freeze in early spring and low water levels. Some pools began filling later than usual and missed out on the explosive wood frog breeding, but still yielded some good surprises like a hatch out of fairy shrimp!



Betsy Leppo

Fairy shrimp

We are entering our third year of all-season monitoring at Gifford Pinchot and Kings Gap to document habitat and hydrological changes in 28 vernal pools using CrowdHydrology water level and Chronolog photo stations. We also utilize automatic water sensor data to give a more detailed picture of the patterns of flooding and drying in each wetland. We have been reenergized by new funding from DCNR's Community Conservation Partnerships Program to continue this work, and expand the monitoring program at Jacobsburg Environmental Education Center and Kinzua Bridge State Park. We also continue to plan for a wetland restoration project at Gifford Pinchot with the support of a Pennsylvania Fish and Boat Commission (PFBC) habitat improvement grant. Wetland restoration expert Thomas Biebighauser helped us implement our first restoration project there in 2016. Ten years later, he is back to work with us on restoring

three more wetlands at Pinchot, and to help bring back functioning wetlands to York County, which has lost many wetlands to agriculture and development.



A photo submitted to iNaturalist user "insectmyheart" illustrates the peril that amphibians face on roadways.

Our monitoring program is sustained by the enthusiastic efforts of volunteers from the Penn State Master Watershed Steward program and Pennsylvania Parks and Forests Friends Groups. We are also beginning new partnerships with Messiah University, LaFayette University, and the University of Pitt-Bradford. Together,

we will use new and ongoing wetland restoration and monitoring projects to engage students in real world research, data analysis, and application of data. Monitoring wetlands is essential for identifying management needs and emerging threats. With information gained from past monitoring efforts, we coordinated with the PFBC, Pennsylvania Game



Cecil Leppo, a student at Juniata College, assisting with an amphibian road crossing.

Commission, PennDOT, and Master Watershed Stewards to conduct an amphibian road crossing and mortality survey at a site where a busy road intercepts the migration of hundreds of vernal pool amphibians each spring. Monitoring of vernal pools at Kings Gap discovered the presence of sick and dead amphibians at

one wetland. It was not a pleasant discovery, but with that knowledge we are now working with partners to conduct further testing for common causes of disease like ranavirus and chytrid fungus.

A few highlights from this spring included conducting egg mass surveys with Messiah University students and seeing how well several restored wetlands are supporting amphibian populations. Another egg mass survey at a large natural vernal pool outside of our routine monitoring sites yielded an astonishing 1,221 spotted salamander egg masses.

We could not even survey the entire pond due to the presence of a Canada goose nest guarded by the steely-eyed mother. We also enjoyed game camera footage we collected of wood frogs causing a ruckus, a barred owl catching a tasty frog, and raccoons kneading the bottom of a vernal pool looking for snails (see the PNHP YouTube channel!) Thanks to all our partners and volunteers whose dedicated efforts keep this work going year after year.



Messiah University students, Peter Tanis (left) and Isaiah Durham (right) conducting an egg mass survey.



A female Canada goose keeps a close eye on the PHNP crew.

## Pondweeds are Plants Too

Scott Schuette, Botany Manager

Aquatic plants are often relegated to the “I’ll learn them, when I have to” category among most botanists. It is this attitude that creates a fairly large gap in our understanding of these highly specialized plants habitat preferences and ecological roles. This is certainly true for the genus *Potamogeton*, commonly referred to as “pondweeds,” in Pennsylvania. There are 27-32 *Potamogeton* species native to the commonwealth and they often occupy slow moving water, generally in backwater channels and pools of streams, creeks, and rivers. They also are found in ponds and lakes along the shoreline.



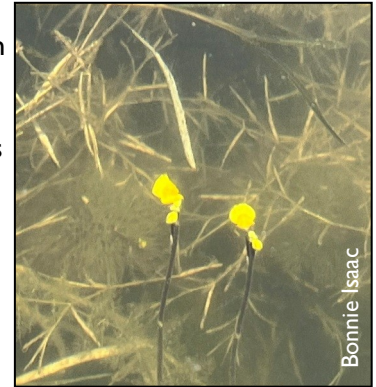
White-stemmed pondweed (*P. praelongus*)

We currently track 17 *Potamogeton* species, of which there are 11 that currently receive environmental review considerations and actions, including three species of global conservation concern. Yet we know very little about the habitat preferences, distributions, and abundances of these plants. To fill some of these data gaps, PNHP received funding from DCNR for the next



Richardson's pondweed (*P. richardsonii*)

three years in the form of two grants - one from WRCP and one from the USFWS Section 6 program. These projects will conduct targeted herbarium research to address particular unresolved taxonomic questions, review historic and extant occurrences of all the tracked species, and perform field surveys to



Flatstem pondweed (*P. zosteriformis*)

update these records as well as surveying new localities to increase our understanding of the species' habitat tolerances. All of this information will inform DCNR about the appropriate regulatory status for each species so that they receive consummate regulatory protections.