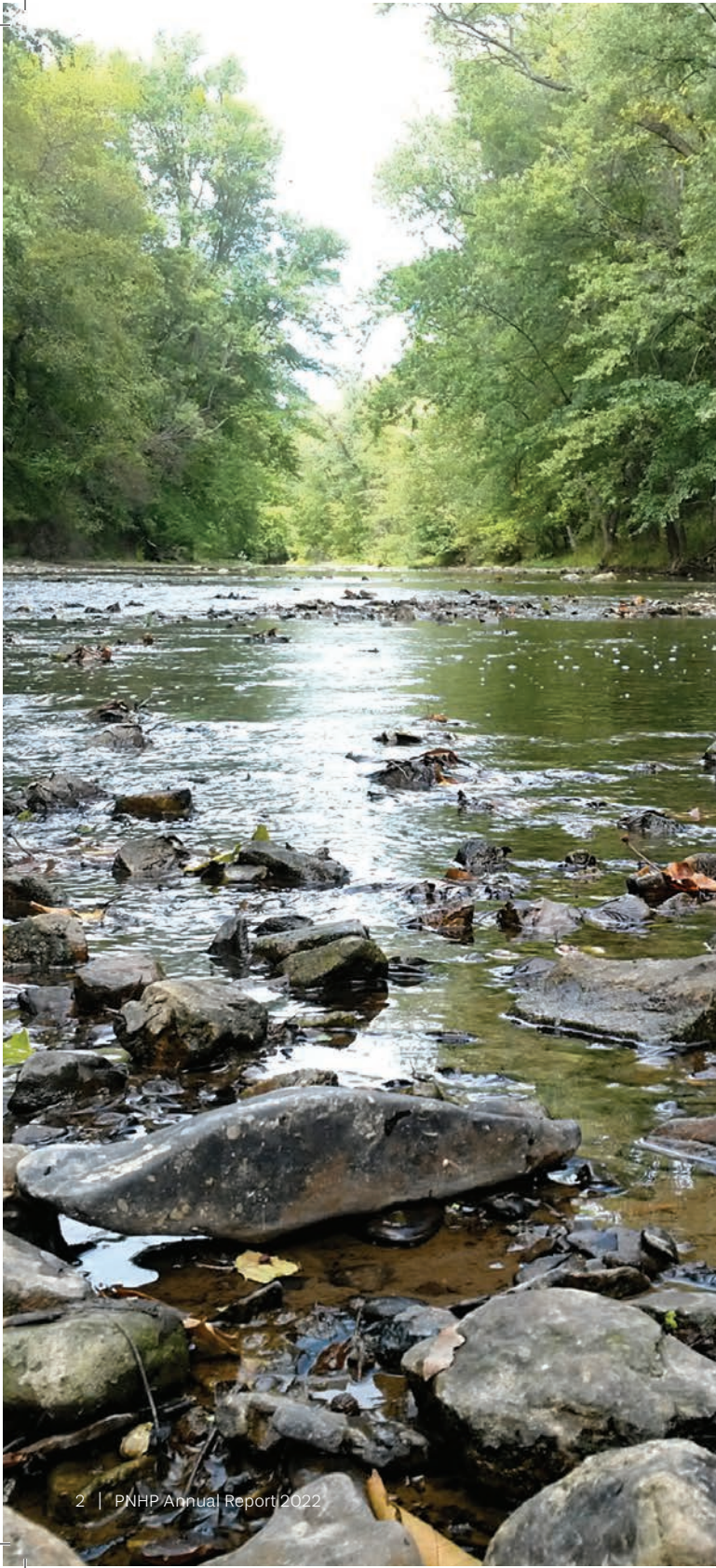




Pennsylvania Natural Heritage Program
ANNUAL REPORT 2022



MESSAGE FROM THE PROGRAM

This year presented some challenges that led us to evaluate our needs and ways of operating. With the departure of our Conservation Planning Manager and Conservation Planner, we restructured planning within the program to address our current and future needs. As part of that process and with the completion of a 10-county Natural Heritage Inventory update for southwestern Pennsylvania, we developed an approach to prioritize and update Natural Heritage Areas – a primary program product. We will be instituting that approach in 2023.

With the update of the State Wildlife Action Plan (SWAP) due in 2025, we began the substantial task of assessing invertebrate taxa. This group, of which 450 species were included in the 2015 SWAP, is diverse and challenging as data on distribution and status is often lacking. Coupled with several other projects focused on bees, other pollinators, crayfish, and freshwater mussels, the amount of effort we are spending on invertebrates has been substantial and unprecedented for us. Other zoology projects focusing on the distribution and movement of species such as the wood turtle, green salamander, and evening grosbeak will add important information for the SWAP update.

Our natural community work included studying seeps and floodplains, vernal pools, mapping habitat across the state, and conducting wetland workshops. We continued our work with the Pennsylvania Plant Conservation Alliance, completing and beginning several plant recovery plans that will be the basis for site management and stewardship. Projects funded by the U.S. Fish and Wildlife Service allowed us to continue looking at plant populations that are federally listed or considered for listing. Numerous other projects focused on the rarest plants in the state supported our core efforts to update the 16,276 plant records we maintain for Pennsylvania.

We are always prioritizing and entering records and data from many sources with the goal of entering all data as quickly as possible. We completed entering a large amount of data from the PA Amphibian and Reptile Survey (PARS), processed many bat records in preparation for new federal listings, and added over 4,027 records to the PA iMapInvasives database. We continue to maintain and add to the very large Species of Greatest Conservation Need (SGCN) database that is used for the web-based Conservation Opportunity Area tool.

In addition, we continue to collaborate with universities, non-profits, and state and local parks to provide expertise for a range of projects. Please enjoy the 2022 annual report and feel free to share with all who have an interest in Pennsylvania’s biodiversity.



OUR MISSION

The Pennsylvania Natural Heritage Program provides scientific information, expertise, and assistance to support the conservation of biological diversity.



PROGRAM STAFF & ROLES

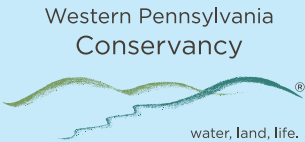
The PNHP consists of staff from the DCNR Conservation Science and Ecological Resources Division, PFBC Biodiversity Section, PGC Wildlife Recovery and Habitat Protection Divisions, and the Western Pennsylvania Conservancy Natural Heritage Program. WPC Natural Heritage Program staff work across all taxonomic groups and have primary responsibility for managing and providing information for PNHP tools and products. Partner agency staff provide support and guidance related to the conservation of their jurisdictional taxa. We collaborate on projects, leveraging capacity and complimenting expertise. Across the partnership, we collect, analyze, and provide data to effectively conserve the state’s biodiversity.



PNHP is a member of NatureServe, an international network of state, provincial, and national natural heritage programs and conservation data centers. By developing tools, creating data standards, determining global species status ranks, consolidating data across the network, and providing numerous other network services, NatureServe offers a common point of contact and guidance for programs across the Americas. Our Conservation Explorer tool is an example of a NatureServe product tailored to PNHP use within Pennsylvania. Network programs serve on the U.S. Section Council (advisory body to NatureServe) and individual programs work together with NatureServe on numerous projects. PNHP, along with NatureServe and our international network of programs, work to share innovations and expertise to make each program stronger and more efficient.

Our projects and initiatives depend on the support of our partner organizations as well as funders from both the public and private sector. We would like to thank all of the program’s funders and supporters for helping PNHP to be successful in meeting the biodiversity information needs of the state, region, and Natural Heritage Network.

Our Partners



In Cooperation With



SCIENCE

We approach each project as an opportunity to learn more about Pennsylvania's ecosystems and species, documenting new discoveries and population changes. We apply the biological and ecological science that is at the heart of our work to the conservation, management, and stewardship of biodiversity.



DISCOVERIES

NEW KATE'S MOUNTAIN CLOVER POPULATION DISCOVERED OVERLOOKING RAYSTOWN LAKE

Kate's mountain clover (*Trifolium virginicum*) is a globally rare Appalachian endemic species that reaches its northern range edge in the shale barrens of Pennsylvania. This species is adapted to the extreme temperatures, thin soils, and very dry conditions of shale barren habitats. Prior to 2022 there were 16 known occurrences of this plant restricted to four counties in south central Pennsylvania.



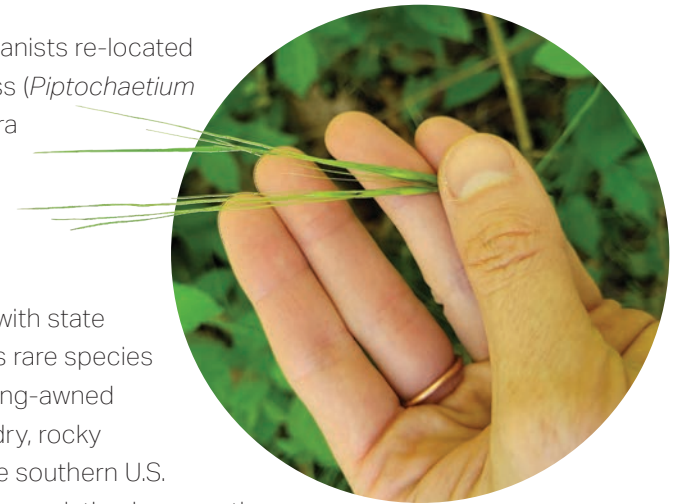
Several of those occurrences are on shale barrens around Raystown Lake accessible primarily by boat. A new population of this state endangered species was found while surveying a large shale barren with Virginia heritage botanist Johnny Townsend. The species is fairly common in the southern part of the range, but is much rarer in the northern range extent making this an exciting discovery.

NEW POPULATION OF WHITE ALUMROOT DISCOVERED DURING STEWARDSHIP VISIT

A new population of white alumroot (*Heuchera alba*), a globally rare plant species, was discovered perched above the Conococheague Creek on private property in Franklin County. The limestone woodland in which it grows was already known to be a special place and has been cared for by PNHP staff and volunteers since 2019. It is home to another globally rare plant species, spreading rockcress, as well as a rich assemblage of other rare spring-flowering species like green-and-gold and eastern shooting-star. The alumroot was first seen while removing invasive species from the site in 2021 but could not be identified to species without flowers. An individual was collected and grown in a pot where it bloomed in 2022 and was finally identified. Hopefully with continued stewardship white alumroot will be able to bloom at this site again.

BLACKSEED NEEDLEGRASS RE-FOUND AT SWATARA STATE PARK

In mid-May, PNHP botanists re-located blackseed needlegrass (*Piptochaetium avenaceum*) at Swatara State Park, where it hadn't been seen since 2006. Few individuals were seen, and PNHP is working with state parks to conserve this rare species and its habitat. This long-awned grass is a denizen of dry, rocky forests, primarily in the southern U.S. Just one other extant population is currently known in the state, although 18 occurrences were known historically. Both extant and historical occurrences were concentrated in southeastern Pennsylvania.



The bluff edge where the white alumroot is found is home to a rich assemblage of wildflowers. Flowering species in this image include eastern shooting-star, spring beauty, Virginia saxifrage, columbine, and spreading rockcress.

CLIMATE CHANGE

Climate change is altering the planet. Rising temperatures, changes in precipitation patterns, and the complex interactive effects of these ecosystem drivers will affect the species and habitats of Pennsylvania. PNHP staff are working to better understand species and habitat vulnerability through modeling efforts, further evaluation of vulnerability, and on-the-ground monitoring. The following projects are examples of climate change work being done by PNHP.

MONITORING CLIMATE CHANGE IMPACTS

It is important to understand patterns of climate change impacts from both local and regional scales. In 2010, PNHP staff began to examine climate change effects on peatland systems in Pennsylvania. Now we are applying lessons learned from our monitoring effort to help develop a regional monitoring approach. PNHP is working with partners from Maine to Virginia to define the appropriate metrics and consistent methods that can be applied to a variety of wetland systems to better track and understand regional climate change impact patterns. We are currently investigating how soils, hydrology, and vegetation can be used as good indicators of change. When completed, we plan to incorporate these regional approaches into future peatland monitoring work.



BUREAU OF FORESTRY'S USE OF THE CONNECTIVITY DATASET

In 2022, the Bureau of Forestry (BOF) integrated the WPC Climate Change Connectivity dataset into a state forest land acquisition ranking tool, adding regional connectivity to a list of characteristics used to prioritize acquisitions. BOF also added regional connectivity to a list of characteristics used to help foresters select state forest land blocks most in need of spongy moth (*Lymantria dispar dispar*) suppression each year. Suppressing this pest in highly connected forest blocks may help prevent wide-scale mortality and fragmentation of these critical parcels.



BOF and WPC partnered to provide public access to the dataset. We presented the information at the 2022 WeConservePA conference and at a webinar for agencies, land trusts, and the public to further instruct users. Meredith Seltzer gave a tutorial presentation of the dataset at an annual gathering of GIS users across all state forest districts to encourage its use and also presented the work with Ryan Szuch to the Senior DCNR Executive Staff.

PENNSYLVANIA PLANTS VULNERABLE TO PREDICTED CLIMATE CHANGE

Using the NatureServe Climate Change Vulnerability Index (CCVI) tool, we assessed nearly 3,300 data points for 120 plant species vulnerabilities across four climate variables resulting in 71 species scoring highly to extremely vulnerable and an additional 20 species scoring moderately vulnerable to climate change. Southern edge of range species tended to be extremely vulnerable in comparison to northern edge of range and core range species. Palustrine and terrestrial habitats had more extremely and highly vulnerable species than riparian and lacustrine habitats. Wetland species in northern Pennsylvania and terrestrial species in southern Pennsylvania are most vulnerable to changing climate conditions. This is especially true in calcareous habitats, whether terrestrial or wetland, where there is higher risk of rapid species shifts. These shifts lead to rare plants being subjected to increased competition from both native and non-native species.



Habitats such as this small bog mat bordering Mud Pond in northeastern Pennsylvania are home to many rare plant species such as *Andromeda polifolia*, and are among the most vulnerable habitats to changing climate conditions.

INVERTEBRATE ZOOLOGY

The Pennsylvania State Wildlife Action Plan (PA WAP) was last revised in 2015 and will be updated again in 2025. This provides an opportunity for scientists to revisit the conservation status of wildlife in Pennsylvania, including invertebrates. There are over 11,000 invertebrate species believed to occur in Pennsylvania, and to date about 750 of them have been assessed for conservation status using the standardized ranking methodology developed by NatureServe. This year, PNHP will work with natural history museums, universities, and taxonomic experts to gather data and complete conservation assessments on over 1,000 new invertebrate species. For this PA WAP revision, our focus will be on pollinator groups such as flower flies, bees, wasps, longhorn beetles, and moths. Information on species determined to be Species of Greatest Conservation Need will be entered in a comprehensive database for the PA WAP, along with recommended conservation actions, which will eventually feed into the Pennsylvania Conservation Opportunity Area Tool. Several current projects will help us evaluate some of these rare invertebrates.



HELLER CAVE SPRINGTAIL

The Heller Cave springtail (*Typhlogastrura helleri*) is a small, white, cave-adapted springtail known from one cave in central Pennsylvania. It became known to science over 25 years ago when it was first described as a new species. This year we visited 16 sites near Heller Cave hoping to find this springtail in nearby caves. We crawled, slid, and climbed through mud slicked cave passages in pursuit of our tiny quarry. Springtail expert Dr. Aron Katz taught us and partners at the Pennsylvania Game Commission and the U.S. Fish and Wildlife Service how to delicately collect springtails from drip pools and caches of leaf and wood that accumulate in a cave. We also used a special apparatus to aspirate them off piles of racoon and porcupine scat, and the carcasses of dead mice. We collected water samples from the caves and nearby springs that Dr. Katz later analyzed for traces of springtail DNA. We will share more on what we found once the results are finalized and published in a scientific journal.

DEVIL CRAYFISH SURVEYS AND STATUS ASSESSMENT

In 2022, we surveyed 94 sites in southeastern Pennsylvania for burrowing crayfishes, including all potential devil crayfish (*Lacunicambarus diogenes*) habitats that were accessible. Devil crayfish were collected from the only known site in the state, Neshaminy State Park, but were not found anywhere else in Pennsylvania. Invasive red swamp crayfish (*Procambarus clarkii*) were collected in the vicinity of the Neshaminy State Park devil crayfish site and pose a serious threat to the species. These findings indicate that the devil crayfish likely only occurs at one site in Pennsylvania and is one of the rarest, most endangered aquatic species in the state.



RUSTY PATCHED BUMBLE BEE

One target species that we have not found is the rusty patched bumble bee (*Bombus affinis*). This bee has disappeared from most of its range in recent decades and was last seen in Pennsylvania in 2006, but there is still hope that it persists here. This year the bee was rediscovered in Maryland, about 30 miles from Pennsylvania, so we spent some time searching for it unsuccessfully in the nearby parts of Pennsylvania. We hope to receive funding in 2023 to look for the bee in the Great Lakes watersheds of Pennsylvania.

STONEFLY SURVEYS

Every spring we try to do a few surveys for Pennsylvania's endemic stonefly, the Powdermill forestfly (*Soyedina merritti*) to better understand its distribution in Pennsylvania. It has been confirmed only from the west side of Laurel Ridge, but this year we expanded our search to southern Chestnut Ridge, where good potential habitat exists in Forbes State Forest. We found female forestflies which are likely to be Powdermill forestflies, but to confirm the identification at the species level we will have to send out tissue samples for DNA barcoding.

MOTH SURVEYS

This year we found Pennsylvania's second known population of the buckeye pinion moth (*Lithophane joannis*) on the border between Washington and Greene counties. We found new populations of several globally rare moths, including the starry campion moth (*Hadena ectypa*), the yellow stoneroot borer moth (*Papaipema astuta*), and the dark stoneroot borer moth (*P. duplicatus*). Other noteworthy moth finds include a turtlehead borer moth (*P. nepheleptena*) in Somerset County (far from known populations in the northwest part of the state), a large bomolocha moth (*Hypena edictalis*) in a limestone valley in Somerset County, and two populations of brick red borer moth (*Papaipema marginidens*) on shale barrens in Bedford County. An exciting find that came out of the regional barrens study was the first Pennsylvania record of the pearly indigo borer moth (*Sitochroa dasconalis*), whose caterpillars specialize on yellow wild indigo (*Baptisia tinctoria*).



ZOOLOGY

WHO, WHO, WHO PUT THIS NET HERE?

To fulfill conservation measures in the State Lands Bat Habitat Conservation Plan, a group of bat biologists from PGC, DCNR, and WPC conducted weeks of bat surveys on the Delaware State Forest District. Our goal is to locate the roosts of reproductive female northern long-eared bats by using radio telemetry. We successfully captured several females and affixed transmitters to them, then telemetry crews followed the receiver beeps as the bats moved across the landscape. Despite this effort, all the northern long-eared bats flew beyond our search envelope (approximately 250 square miles). With slight shifts in tactics, we hope to have better success at locating the roosts in 2023. We frequently capture southern flying squirrels and eastern screech owls, as bycatch, while netting for bats, but on one net check this summer we encountered a barred owl. The owl's formidable profile was many times the size of our typical bycatch yet was easily removed, posed for a photo, and released unharmed. We were apparently in his territory as he called from different perches around us throughout the night.

This barred owl was captured incidentally in our bat nets. This photo is a case of a "fish story" as the perspective makes the owl appear far larger than it was in hand.



PREY ANALYSIS FOR MARTEN REINTRODUCTION FEASIBILITY STUDY

The American marten (*Martes americana*) was lost from Pennsylvania's forests around 1900 due to habitat destruction and unregulated harvest. As part of a marten reintroduction feasibility assessment conducted by the PGC, there was a need to determine the relative abundance and species richness of small mammal prey species overlapping modeled suitable marten habitat, and to highlight areas of overlap with several Species of Greatest Conservation Need (SGCN). For decades, biologists from Pennsylvania agencies and organizations have been methodically collecting data on small mammals through various survey efforts. Analyses of these data helped to provide a reasonable estimate of potential prey availability for marten. Across the study region, 387 surveys documenting 8,368 small mammal captures of 20 species were used for the analyses. Results showed that there appears to be a healthy prey base across the modeled marten habitat. Additionally, we identified areas where future marten reintroduction plans should avoid locales where there could be conflict with several SGCN.



SURVEYS FOR THE WORLD'S SMALLEST CARNIVORE

Weighing approximately two ounces and achieving a total length of eight inches, the least weasel (*Mustela nivalis*) is the smallest carnivore in the world. In Pennsylvania, it's been found primarily in the western third of the state and inhabits meadows, fields, brushy land, and forests. Sightings are extremely rare with reports and specimens in the last 20 years numbering in the single digits. Despite the paucity of data, there has been very little survey effort targeting this species in the state. PNHP and the PGC have implemented passive survey efforts for least weasel, employing a number of techniques using game cameras baited with scent and audio lures. The goal of this project is not only to detect least weasels, but also determine which techniques are most efficient and which microhabitats should be targeted when surveying for this elusive species. Our results will also help inform a conservation status assessment of Pennsylvania's least weasel population.



BOG TURTLE HABITAT MANAGEMENT

The PFBC and PNHP are in the midst of implementing a Competitive State Wildlife Grant for a regional project to protect and maintain the northern population of the bog turtle (*Glyptemys muhlenbergii*) in the northeast United States. A major focus of the grant is the management of bog turtle habitats, which are groundwater-fed emergent wetlands. Without management or grazing, these wetlands become overgrown with shrubs, trees, and invasive species that shade the areas the turtles need for basking in the sun and incubating eggs. PFBC and PNHP staff with contractors and landowner cooperation cleared shading woody and invasive plants from more than six bog turtle wetlands in the winter of 2022. Stems were cut by hand and treated with herbicide to prevent or slow regrowth. We are monitoring turtle populations at these managed sites to measure the response to the habitat improvement. The additional sun exposure should improve nesting success and lead to stabilized or growing populations at these sites.



Eastern massasauga basking on woody debris after a habitat management project.

MASSASAUGA RATTLESNAKE— IF YOU CUT IT, THEY WILL COME

In 2022, Zoologist Ryan Miller conducted surveys for the federally threatened eastern massasauga in cooperation with state agency partners. Massasauga populations have declined in Pennsylvania due to habitat loss from woody vegetation shading preferred open field habitats. One survey location recently had overstory trees removed adjacent to high quality habitat to expand the area of habitat available to the snakes. The surveys were used to document massasauga use of the newly created habitat. Snakes were discovered basking on fallen tree tops and foraging for small mammals shortly after emergence from hibernation. This demonstrates that massasauga immediately begin to utilize newly created habitat if it is adjacent to occupied habitat. PNHP will continue efforts to advocate for habitat restoration on state and private land, and in some cases utilize PNHP staff to conduct habitat restoration projects.

WOOD TURTLE POPULATION MONITORING

PFBC and partners are continuing their participation in a multi-state Competitive State Wildlife Grant for the conservation and management of the wood turtle (*Glyptemys insculpta*) across the northeast states. PNHP and PFBC biologists with help from enthusiastic volunteers conducted population surveys at more than 30 stream reaches in 2022 looking for wood turtles. All captured turtles were measured, photographed, and marked for future reference before being returned to their habitat. The biologists are also studying movements of the wood turtles at a few priority sites, where the habitat will then be managed to promote nesting success. This will entail removal of invasive woody plants that shade preferred nesting areas and possibly creation of sand mounds to supplement nesting habitats.

Surveyors search both in the water and on land for wood turtles in fall of 2022.

BOTANY

OLD GROWTH SURVEYS ONGOING

PNHP staff visited several old growth forests in the summer of 2022 and tested the draft version of the old growth rapid assessment. This method involves walking a transect in the forest and collecting data on the presence of old growth characters, such as large trees or pit and mound topography. Eventually, this method will result in a weighted ranking system that will be used to evaluate a stand for old growth status. Although the old growth rapid assessment is still evolving, the preliminary analysis of the 2022 transects suggests that some of the best and well-known examples of old growth in Pennsylvania are scoring the highest. Surveys in old growth forests will continue the next few years with new funding and will include associate species inventories and applications of the old growth rapid assessment on state land.

STATUS OF LARGE YELLOW LADY'S SLIPPER

PNHP ecologists completed a project that focused on expanding the knowledge of large yellow lady's-slipper (*Cypripedium parviflorum* Salisb. var. *pubescens* (Willd.) Knight) in Pennsylvania. A literature review along with field visits were done to better understand the life history of the orchid, the distribution and health of known populations, and the threats associated with the species. Fifteen sites were visited during this project. However, there are likely more undocumented populations in the state. Additional survey efforts are suggested. Along with more surveys, we recommend using a consistent approach for estimating population size. The life history of the species, timing of site visits, and documentation of threats should all be repeatable components of a monitoring effort. Consistent data collection will allow for more confidence when comparing multi-year population estimates and would help in the determination of the actual vulnerability and conservation needs of the species.

FLOODPLAINS OF THE LEHIGH AND SCHUYLKILL RIVERS

PNHP ecologists continued their EPA-funded project to characterize plant communities associated with under-sampled large river systems in Pennsylvania. In 2022, the focus was on floodplains located along the Lower Lehigh and Schuylkill rivers; both are main tributaries of the Delaware River. Although historical and current use of the rivers and surrounding landscapes have resulted in changes to these river systems, a variety of floodplain communities persist. Scour and periodically exposed shoreline patches were present and dominated by annual herbs and grasses. Small patch floodplain meadows were seen on more elevated areas. Sycamore dominated palustrine shrublands were documented on exposed gravel/cobble bars either riverside or in the active river channel. Palustrine forests dominated by either sycamore or silver maple were often present before transitioning into either upland forest or more urbanized areas. The same forest types were also common on in-stream islands. Work will continue to further classify these communities and assess their conditions.

An example of the floodplain complex typically found along less impacted sections of the Schuylkill River.

NATURE'S WATER PURIFIERS: FRESHWATER MUSSELS

For more than 40 years, PNHP has been studying the freshwater mussels of Pennsylvania's waterways, documenting their life history and distribution. Now PNHP scientists are focusing on the streams where they have declined.

Burrowing into the sand and rock bottoms of rivers and lakes, freshwater mussels often go unnoticed by boaters and anglers. Mussels are typically yellow or brown, occasionally adorned with dazzling rays, or ornamented with unique or bizarre shell sculpturing. These mollusks range in size from quite small (rayed bean, *Paetelunio fabalis*) to quite large (mucket, *Actinoonaias ligamentina*), but average around 3-6 inches in length. Despite their beauty and occasional large size, mussels live a hidden life, largely camouflaged among the sand and gravel of Pennsylvania waterways. Each freshwater mussel serves as a natural water filter, removing particles from gallons of water each day, benefiting water clarity and quality.

Freshwater mussel declines have been documented across Pennsylvania. In the commonwealth, 80% of the species are considered Species of Greatest Conservation Need according to the State Wildlife Action Plan, meaning that they need concerted conservation actions. Fourteen species are considered historical or extirpated, having no records since the early 1900s.

Declines in Pennsylvania are largely a result of pollution, primarily from manufacturing and resource extraction. Uncontrolled runoff and effluents from coal mining, timbering, tanneries, manufacturing, and other industries made many creeks and rivers uninhabitable during and after the industrial revolution. Large rivers, home to the greatest species diversity in Pennsylvania, were severely degraded. Habitat-altering dams and invasive species (e.g., zebra mussels, Asian clams, and round goby) are also contributing factors to the decline of native freshwater mussels. While mussels can move short distances, the ability to relocate to a more hospitable environment during a pollution or extreme environmental shift (e.g., a drought) is limited. Declines in populations of rare and common mussels due to pollution or other stressors are cause for concern among natural resource managers.



Zebra mussels on Mapleleaf native mussel.

SPECIES HIGHLIGHT:

FRESHWATER MUSSELS

Mussel displaying a lure that resembles a fish.

Mussels are Parasites

Because of their life cycle, mussels are vulnerable to population declines. The mussel larvae require a brief period as a parasite on a host, usually a fish. Fish are tricked into carrying larval mussels by a mussel lure designed to attract their attention, such as a food item like a small fish. When a fish comes close to inspect the lure, the gravid mussel (a female with fertilized eggs which have developed into larvae) will release its tiny larvae (<1mm), called glochidia, which attach to the fish gills and fins. After a period of a few weeks to months during which the larvae undergo a transformation to small juveniles, they drop off the fish. A mussel species requires particular host organisms; some are specialists on just one or two fish species. The fish host must be present for a mussel species to persist.



MUSSELS OF LARGE RIVERS

Delaware River – Tidewater Mucket

Highly restricted to Northeastern Atlantic Coastal rivers the tidewater mucket (*Atlanticaconcha ochracea*) and its hosts (e.g., white perch) occur in estuaries and the freshwater rivers that flow into them. The tidewater mucket's habitat can be found in the tidally-influenced freshwaters of the Delaware and Schuylkill rivers just upstream of the salty Delaware Estuary.



Susquehanna River – Green Floater

A small greenish-yellow mussel, the green floater (*Lasmigona subviridis*) is found in large rivers in eastern Pennsylvania, like the Susquehanna River. While it is declining in many locations across its range, Pennsylvania appears to be a stronghold for the species. The green floater is hermaphroditic (each mussel has male and female gametes) and in some cases the green floater does not require a fish host, unlike most other freshwater mussels.



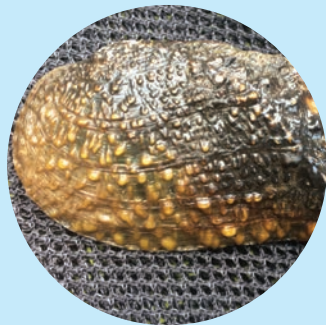
Ohio River – Salamander Mussel

The state endangered salamander mussel (*Simpsonaias ambigua*) is one of Pennsylvania's most enigmatic species. Sheltered beneath large rocks, these small, yellow-brown mussels easily escape detection and are only known from the Allegheny River, French Creek, and Dunkard Creek. It is the only North American freshwater mussel known to use an amphibian host, the mudpuppy (*Necturus maculosus*). PNHP staff have been studying mudpuppy distribution in the large navigation channels of the Allegheny and Ohio rivers and, in 2023, will be evaluating the feasibility of restoring salamander mussel to the Ohio River.



Shenango River – Pistolgrip

The state endangered pistolgrip (*Tritogonia verrucosa*) derives its name from its unique shape and ornate exterior. This large mussel uses the mighty and much sought-after flathead catfish (*Pylodictis olivaris*) as its host. Pennsylvania's functional populations are limited to the Ohio and Shenango rivers, and recent recovery efforts by partnerships with PA DEP, White Sulfur Springs National Fish Hatchery, and PFBC have resulted in propagated animals being placed into the Allegheny River and Dunkard Creek.



Allegheny River – Round Hickorynut

The round hickorynut (*Obovaria subrotunda*) is an aptly-named mussel. This state and federally-proposed endangered species is limited to the Shenango and Allegheny rivers. A formerly widespread and dominant species, it ranged from the headwaters of the Beaver River drainage, the Allegheny River as far as Crooked Creek, far up the Monongahela, and all the way down the Ohio River. This species utilizes darters to complete its life cycle, and restoration efforts are ongoing in areas where suitable habitat remains for this species and its hosts.



RECOVERY OF MUSSEL POPULATIONS

Active mussel restoration is only possible because of years of PNHP partnership research and surveys. PNHP and its partners have documented species declines, river recovery following historical pollution, and identified areas with mussel recovery potential. Using this hard-earned information and taking advantage of some unique opportunities, PNHP and its partners have recently contributed to both large-scale species restoration and river recovery efforts.

Two recent Allegheny River projects (2015 – 2018) resulted in the removal of over 157,000 mussels from tiny slices of the Allegheny River and out of harm's way. The endangered mussels (northern riffleshell, *Epioblasma rangiana* and clubshell, *Pleurobema clava*) were carefully collected and relocated to Kentucky, Illinois, Indiana, Ohio, New York, West Virginia, the Seneca Nation, and parts of Pennsylvania to facilitate federal endangered species recovery efforts. The bridge and pipeline projects were rare, unique opportunities to not only benefit the recovery of state and federally listed species, but also to restore two Pennsylvania streams that have been historically or recently degraded, the Clarion River and Dunkard Creek. A total of 37,000 common mussels were placed into 10 sites along the Clarion River and 15,000 mussels were stocked into four sites along Dunkard Creek.

In 2022, PNHP staff worked with PA DEP and the U.S. Fish and Wildlife Service's White Sulphur Springs National Fish Hatchery to stock propagated and tagged pistolgrips and round hickorynuts back into the Allegheny River and Dunkard Creek.

The 2019 startup of the Union City Aquatic Conservation Center has given the partnership a new tool for active mussel restoration via the ability to propagate freshwater mussels in Pennsylvania. This facility continues to rear common mussels for Dunkard Creek restoration (plain pocketbook, *Lampsilis cardium* and fatmucket, *L. siliquoidea*) in addition to collaborating with the U.S. Fish and Wildlife Service on pistolgrip and round hickorynut recovery efforts. Another effort to restore the state endangered salamander mussel (*Simpsonaias ambigua*) to its former range in the Ohio watershed is an additional example of this current phase of mussel conservation. The strategy for now and going forward will be to recover fauna extirpated by pollution and restore populations of mussel Species of Greatest Conservation Need.



INFORMATION

PNHP information is far from static. Each year brings new records and new ways of distributing our information. New projects that add data focused on specific species, groups of organisms, and natural features will build on and make available a wealth of information.

WORKING WITH PARTNERS TO UPDATE AND SHARE OUR HERITAGE DATA

PNHP Information Management staff work with our biologists and partner agencies to update and standardize our data and to contribute to regional data products. In 2022, we worked with our ecologists to crosswalk our data to the National Vegetation Classification, our botanists to update our plant lists to a newer regional taxonomy, and our zoologists to update our species lists for animals. With the Pennsylvania Game Commission and Pennsylvania Fish and Boat Commission, we are identifying new and updated records to be processed.

In Pennsylvania, our data can be viewed through the Pennsylvania Conservation Explorer. We also contribute data to larger-scale products. In 2022, we sent data to NatureServe for inclusion in the NatureServe Explorer, where users can view data at regional scales. We have also contributed data to NatureServe for range-wide distribution modeling for at-risk species and for tools being developed for better conservation planning at multiple scales.

Records Added to Biotics in 2022

TAXONOMIC GROUP	COUNT
Birds	1
Butterflies & Moths	6
Communities	10
Fish	150
Mammals	3
Mussels	44
Non-vascular Plants	12
Other Invertebrates	10
Reptiles & Amphibians	543
Vascular Plants	115
Total	894

Total Number of Records in Biotics

TAXONOMIC GROUP	COUNT
Birds	2,669
Butterflies & Moths	1,168
Communities	977
Fish	1,008
Geological & Hydrological Features	502
Mammals	1,434
Mussels	1,333
Non-vascular Plants	71
Other Invertebrates	1,829
Reptiles & Amphibians	4,332
Vascular Plants	16,212
Total	31,535

PROCESSING DATA FOR FISH, AMPHIBIAN, AND REPTILE SPECIES OF GREATEST CONSERVATION NEED

In 2021, WPC received a State Wildlife Grant administered by the Pennsylvania Fish and Boat Commission (PFBC) to process fish, amphibian, and reptile Species of Greatest Conservation Need records into the Pennsylvania Natural Heritage Program databases and the Pennsylvania Conservation Explorer. Amphibian and reptile data for the grant were primarily acquired from the Pennsylvania Amphibian and Reptile Survey (PARS), a project of the PFBC and Mid-Atlantic Center for Herpetology and Conservation. Fish records were from data compiled for the Fishes of Pennsylvania (2016), by Jay R. Stauffer, Douglas P. Fischer, and Robert W. Criswell. By the end of the project in 2022, we had processed over 5,000 amphibian, reptile, and fish observations. Project data will be used for environmental review and the non-regulatory PA Wildlife Action Plan - Conservation Opportunity Area Tool, supporting better conservation planning to protect Pennsylvania's Species of Greatest Conservation Need.



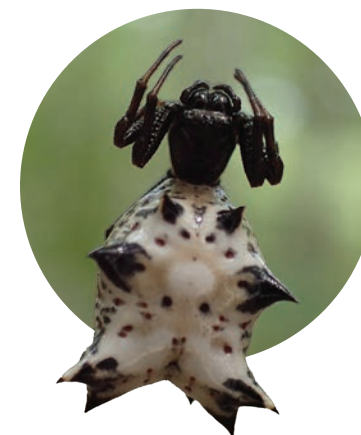
WEEDING THROUGH THE INVASIVE SPECIES OF NORTHWEST PENNSYLVANIA

Invasive species remain one of the most prevalent threats to native biodiversity. PNHP Invasive Plant Ecologist Brian Daggs has strengthened efforts to capture and catalogue the problematic weeds in the northwest corner of the state. In 2022, we surveyed 82 different sites, covering roughly 2,400 acres of wetlands, floodplains, forests, and other habitats in 7 different counties. We recorded 113 invasive plant species, with 9 of those classified as early detection and rapid response priorities, and another 13 species as emerging or unassessed threats. Common, high-impact weeds like Eurasian common reed and multiflora rose remain omnipresent on the landscape. Early detection priorities, such as hydrilla, mile-a-minute, and lesser celandine are expanding their range and may soon pose a greater threat to the biodiversity of the region.



SPIDER CHECKLIST

Good news for arachnophiles! A literature review confirmed the presence of over 400 spider species in Pennsylvania. However, based on predicted ranges, hundreds more species probably occur in the state. This draft checklist will expand as new state records are observed by PNHP staff, researchers, and citizen scientists. Spiders that are uncommon, range restricted, currently undescribed, or associated with rare habitats were flagged to help guide survey efforts. Like many invertebrates, spiders can be challenging to inventory, so taxonomic keys were collected and organized into a library to make species identification more efficient and accessible.

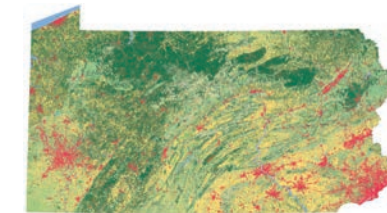


APPLICATION

New technologies have allowed PNHP to collect more detailed and extensive information, which we distill into forms that can be used to help with planning and decision-making for the conservation of the state's biodiversity.

AN UPDATED HABITAT MAP FOR CONSERVATION PLANNING

In 2022, we completed an update to the Northeast Terrestrial and Palustrine Habitat Classification and Map (NETPHCM). The NETPHCM was produced by The Nature Conservancy to provide consistent habitat classification and mapping across the Northeast region, and has been foundational in supporting the development of the Pennsylvania Wildlife Action Plan (PA WAP), the Conservation Opportunity Area (COA) Tool, and other PNHP conservation planning efforts. By using improved habitat location data available in Pennsylvania and by decreasing the scale of the map, we were able to incorporate higher confidence and higher resolution data, resulting in a more precise and accurate habitat map for Pennsylvania. The updated habitat map will be used to improve species-habitat associations for the 2025 PA WAP, provide higher accuracy geospatial data for PNHP conservation planning and decision-making tools, and improve precision for smaller-scale management actions, such as those found in the COA Tool.



PIONEERING AVIAN CONSERVATION AND RESEARCH

For seven years PNHP and its partners at Carnegie Museum of Natural History and Finch Research Network have tracked movements of Pennsylvania's winter population of steeply declining evening grosbeak (*Coccothraustes vespertinus*). We have been on the cutting edge of new avian tracking technology as one of the first to use solar nanotags. In 2022, as part of the Road to Recovery (R2R) effort and with support from the Knobloch Family Foundation, we traveled to Maine and Minnesota to deploy the first ever Lotek Sunbird satellite tags on this species. Using Argos satellites and doppler, we can track positions of individual grosbeaks down to less than 250 meters in near real-time! Together with nanotag detections from the Motus network, these data will help us measure migratory connectivity of populations across the species' annual cycle and begin to unlock factors behind its 92% population loss since 1970. As one of just four R2R pilot projects, we are co-leading an international evening grosbeak working group and will continue using new technology to track winter populations in New York, Pennsylvania, and Minnesota over the next year.



HABITAT MAPPING FROM A BIRD'S EYE VIEW

Since the inception of PNHP, our staff have periodically used small aircraft to conduct reconnaissance before surveying large areas. Today, most reconnaissance can be done from our computer desks, which greatly improves our mapping precision, accuracy, and efficiency. Since 2018, PNHP has taken our mapping precision a step further by adding a drone to our tool chest. Surveying for rare species can be dangerous work, and the drone allows us to conduct species surveys in areas where it's too dangerous (think cliffs) or impractical (think massive wetlands) for our staff to survey. We've also been using the drone to help map complex habitats and precise locations of rare species, including the green salamander. This species inhabits mature dense forests around complex rock outcrops, float blocks, and rock cities. When surveying these areas, it can be difficult to recognize exactly which areas have been covered and which still need to be searched. Highly detailed drone imagery is proving important for navigation at these sites and allows us to precisely locate individuals. This information is needed for monitoring green salamander populations, to help understand habitat use at each site, and ultimately to inform sound conservation.



After planning the flight on his desktop, GIS Manager and drone pilot Brad Georgic is ready to collect imagery at a green salamander site using the PNHP drone.

STEWARDSHIP

PNHP collects information that is essential to understanding the status of the plants and animals existing in the state. However, applying what we've learned to the species and sites of concern is another facet of our work. One of our important roles is to provide guidance and tools to those taking on the daunting task of stewardship.

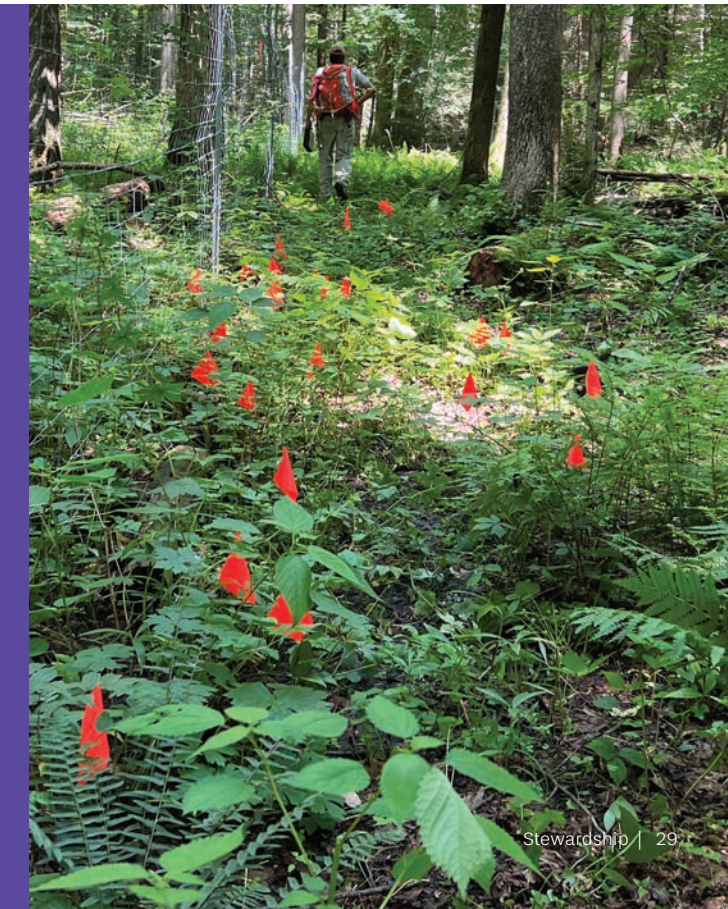
STEP ON A CRACK, BREAK A GLOBALLY RARE PLANT'S BACK

Beautiful Barbara's buttons (*Marshallia pulchra*) is an Appalachian endemic and globally at-risk plant that reaches the northern limit of its range along the Youghiogheny River in Pennsylvania. It grows in uncommon places that experience regular intense flooding by ice and water known as river scour. The number of species that can thrive in these harsh conditions are limited, and a disproportionate number of them are rare.

Flat areas of exposed rock are attractive places for hikers, anglers, and sunbathers to enjoy the beautiful Youghiogheny River at Ohiopyle State Park. Unfortunately, this has led to some *Marshallia* plants getting repeatedly trampled. We began a comprehensive monitoring program for *Marshallia* several years ago, and in 2022 we added more intense monitoring of a few areas where *Marshallia* and significant foot traffic occur together. We want to help park personnel determine how they can best accommodate park usage and also protect rare species. A detailed understanding of the problem can help to facilitate effective management. Taking steps to assure the continued survival of rare species is a core function of PNHP and its fellow affiliates of NatureServe.

PENNSYLVANIA PLANT CONSERVATION ALLIANCE

The Pennsylvania Plant Conservation Alliance (PPCA) is a program established in 2018 and reinvigorated in 2022 with the goal to safeguard and steward Pennsylvania's rare plant species. Currently PPCA is facilitating projects related to over a dozen species, primarily those that are G1-G3 (ranked as globally imperiled, threatened, or rare by NatureServe). Ongoing projects include seed collection and propagation, populations genetics, pest and invasive species management, and monitoring. We have formed or reinitiated partnerships with over a dozen groups and institutions across Pennsylvania including academic institutions, gardens like Longwood, and others. One highlight from the past field season includes fencing multiple bog Jacob's ladder plants in partnership with staff from several Heritage partners including WPC, DCNR, and PGC. PPCA Coordinator, Cheyenne Moore, and Claire Ciafre and Rachel Goad (WPC) also worked with Peter Zale to collect seed for propagation and future outplanting.



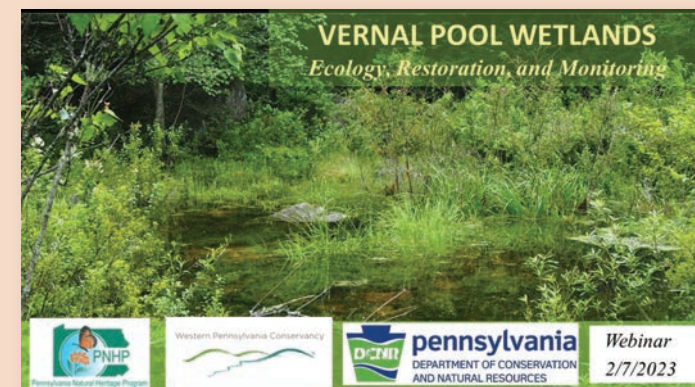
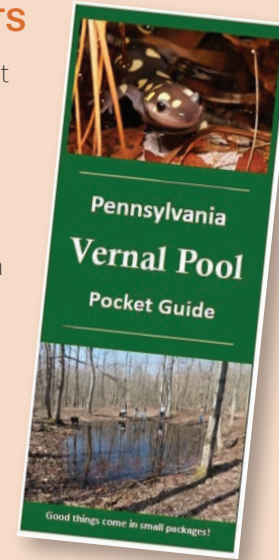


Top photo: pre-construction photo of a large cement swimming pool that was restored to a natural spring-fed pool and wet meadow. Below: shown two years post-construction.



VERNAL POOL HIGHLIGHTS

This year we wrapped up our current vernal pool technical assistance grant funded by a Pennsylvania Department of Conservation and Natural Resources, Community Conservation Partnerships Program grant. Over the past five years we worked with landowners with vernal pools on their properties, created new materials for vernal pool outreach and education, built wetland datasets, and implemented a wetland restoration project at Ohiopyle State Park. Our recent outreach efforts included developing a new vernal pool pocket guide and a wetland restoration webinar that is now available on the PNHP YouTube channel. We also secured funding for a new citizen science project at two state parks in Pennsylvania that will engage trained volunteers (Master Watershed Stewards) and park visitors in the monitoring of vernal pools. This program will include a variety of innovative monitoring techniques and enrollment of a subset of pools in the regional Vernal Pool Phenology Project.



STEWARDSHIP CONTINUES AT LUTZVILLE LIMESTONE CLIFFS

PNHP staff continued work at Lutzville Limestone Cliff, a biodiverse site in southern Pennsylvania where ongoing stewardship is needed to reduce impacts of invasive species. Stewardship efforts in 2022 included treating Canby's mountain lover (*Paxistima canbyi*) plants to control a damaging invasive scale insect, pulling young woody invaders like round-leaved bittersweet and invasive bush honeysuckle, and using a variety of methods to control invasive stiltgrass. While we made inroads, all this intensive work also turned up something new: jumping worms (*Amyntas* spp.). These invasive earth worms voraciously consume organic material on the forest floor and in the topsoil. Their presence can alter plant community composition and prevent tree seedlings from establishing. PNHP and the Pennsylvania Plant Conservation Alliance are working together closely to support this site and its many rare species.



Japanese stiltgrass at Lutzville Cliffs. Inset: Brian Daggs unearths a jumping worm above the limestone cliff.

COLLABORATION AND COMMUNITY

Collaboration helps PNHP expand our knowledge and capacity, and also provides a way to help our partners manage ecological resources by using our expertise and unique datasets.

PNHP and Pashek+MTR Landscape Architects visiting the Walnut Creek Floodplain at Asbury Woods Nature Center in spring 2022.

NEW JERSEY CLIFF SURVEYS

PNHP staff collaborated with our neighbors at the New Jersey Natural Heritage Program to survey vegetation along I-80 near Mount Tammany in preparation for work by the New Jersey Department of Transportation to mitigate rockfall potential. The survey area is steep and challenging to access, and it required rappelling as well as foot surveys. We were also able to collect information from a distance by utilizing a drone, binoculars, and a spotting scope. From 2021 through 2022, our team documented 253 plant taxa including five Species of Concern within the project area including mountain spleenwort (*Asplenium montanum*) – a rare plant (S2) in New Jersey. The team also documented one species that was previously thought to be historic in New Jersey – wild bleeding heart (*Dicentra eximia*). This data will be used to assess the potential environmental impacts of mitigating rockfall in this area.

Claire Ciafré uses a spotting scope to assess vegetation from across the Delaware River.

BOG JACOB'S LADDER SEED COLLECTION AND CONSERVATION

This summer PPCA Coordinator Cheyenne Moore and WPC Ecologist Claire Ciafré joined Dr. Peter Zale of Longwood Gardens to collect seed from three populations of bog Jacob's ladder (*Polemonium vanbruntiae*), a globally rare plant species. A Longwood intern, who will be studying the germination requirements of the species joined us to help collect seed. The seed will be grown into plants at Longwood Gardens; some will be kept for off-site conservation and the rest will be reintroduced to supplement populations. These reintroductions will be important at sites where deer are browsing the flowering stems of the plant before they can set seed. Seed may also be exchanged between sites to increase the genetic diversity of the populations and make them more resilient to change. The reintroductions will be guided by a range-wide study on population genetics to be led by Dr. Melody Sain of Bucknell University and funded through a WRCP grant.



Photo: Bog Jacob's ladder produces beautiful indigo flowers over several weeks.

PROVIDING CONSERVATION INFORMATION

A main component of the PNHP mission is to provide current, reliable, objective ecological data and analysis to help guide conservation work and land-use planning. PNHP works with many organizations and consultants to develop recommendations for conservation and management activities to sustain our rare biodiversity. In 2022, PNHP began working with Pashek +MTR Landscape Architects on a site master plan for Asbury Woods Environmental Education Center located within the headwaters of Walnut Creek – a Harbor Creek Township property in Erie County. This area is a biodiversity hotspot, supporting lake plain and floodplain forests and several rare plant and animal species. PNHP also began a conservation planning project with Woods and Waters Consulting for two properties protected by Patton Township in the State College area: Gray's Woods and the newly acquired Haugh Property, adjacent to State Game Lands 176. These properties are important linkages to protected areas in the region and provide significant habitat for animal Species of Greatest Conservation Need and rare plants, while also providing recreational opportunities for the community.



Photo: PNHP Ecologist/Science Director Ephraim Zimmerman and Pashek+MTR Landscape Architects visiting the Lakeplain Woodland at Asbury Woods Nature Center in spring 2022.



ROADSIDE PLANT SPECIES OF CONCERN

Roadsides provide important habitat for some of Pennsylvania's rare plants by mimicking the open conditions found in ecosystems like rocky barrens and fire-maintained woodlands. Species such as lupine (*Lupinus perennis*; PA Rare), sida (*Ripariosida hermaphrodita*; PA Endangered), and dwarf iris (*Iris verna*; PA Endangered) frequently rely on roadside and utility right-of-way settings. In 2022, PNHP staff visited 21 roadside populations of rare, threatened, and endangered species, spanning 12 counties. In partnership with PennDOT, PNHP collected data on roadside populations and evaluated them for threats from routine roadside maintenance, such as mowing and herbicide application. Some populations were found to be growing within several feet of a roadbed or even between guiderail posts. PennDOT and PNHP staff collaborated to develop protection strategies for at-risk populations, including installing signage and developing notifications in PennDOT's electronic management system.



COLLABORATIVE CONSERVATION WITHIN AND BEYOND THE NETWORK

This year our botanists assisted heritage programs and universities seeking to document plant diversity in Pennsylvania and beyond. Working with Drs. Chris Martine and Tanisha Williams at Bucknell University, we sampled populations of three globally rare plants to determine the overall genetic health of these species. Likewise, we conducted surveys with Dr. Jon Shaw from Duke University to collect *Sphagnum* samples in Pennsylvania that culminated in the publication of two new endemic species of *Sphagnum*. Virginia Heritage botanist Johnny Townsend spent a week with us surveying shale barrens and woodlands in the state in search of a recently described witchgrass species known only from Virginia and Pennsylvania. Arkansas Natural Heritage Commission contracted PNHP bryologist Scott Schuette to provide bryophyte inventories for two counties and a statewide checklist of bryophytes to assist their efforts to include these plants in conservation decisions.



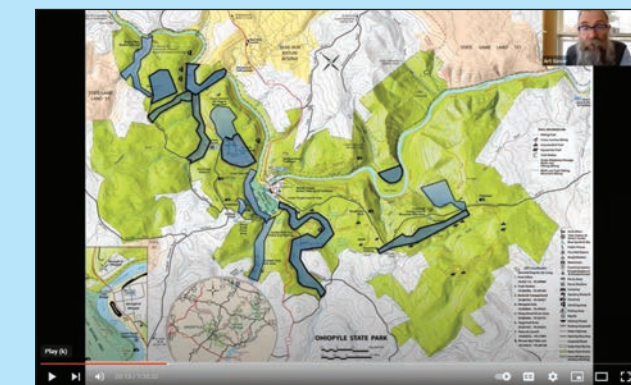
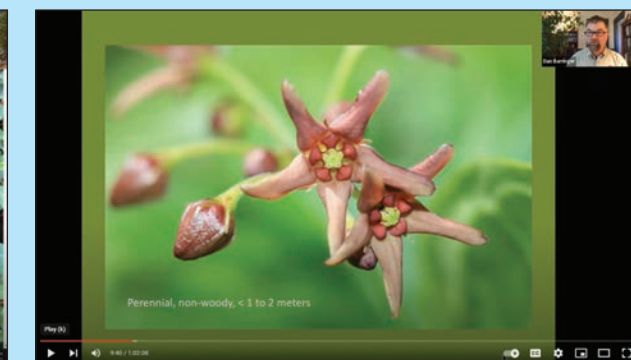
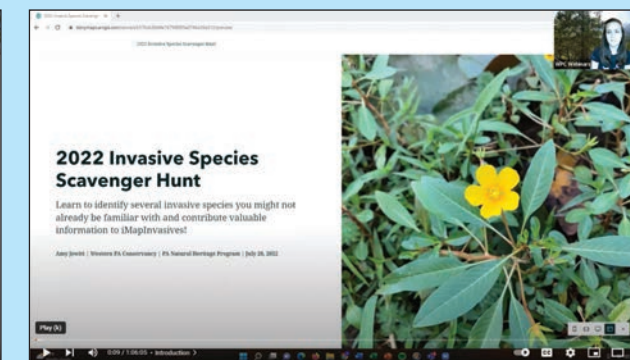
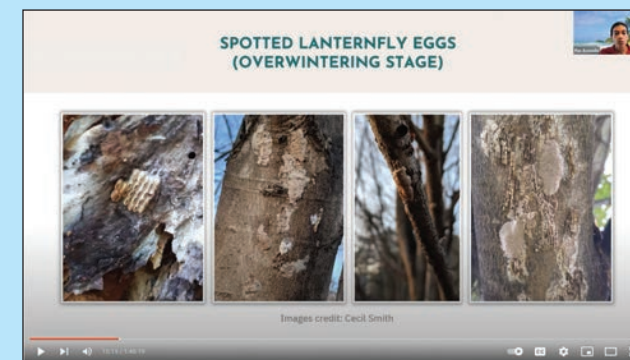
HARRISON HILLS PARK ECOLOGICAL ASSESSMENT

We completed an ecological assessment of Harrison Hills County Park in Allegheny County. This is the fifth of seven county parks we assessed. As in other county parks, mature forest communities in steep stream ravines where the landscape is protected against past cutting and tillage serve as ecological reservoirs for native species. In Harrison Hills Park, this includes the slopes and wetlands of Rachel Carson Run, as well as a dramatic steep slope above the Allegheny River that includes several rock outcroppings that host unique biodiversity. Intensive browse pressure from white-tailed deer has reduced the abundance and diversity of native species across the park. Stewardship recommendations to protect the long-term viability of the mature forested areas include deer fencing and replanting native species, as well as continued efforts to reduce the presence of invasive non-native species.



SPREADING THE WORD

In addition to social media and our quarterly newsletter, we engage with smaller, more focused groups to share information and expertise. Whether workshops to consider the taxonomy of certain plants or trainings in the recording of invasive species data, we look at these opportunities as extremely valuable in mobilizing other scientists and the public to act in conserving biodiversity.



EDUCATING THE PUBLIC ON INVASIVE SPECIES

The Pennsylvania iMapInvasives Program strives to engage natural resource professionals and community scientists on the topic of invasive species by providing a variety of education and outreach events. In 2022, we were excited to offer a new webinar series that invited land managers and university professors to share their expertise on a range of subjects. Their presentations focused on invasive vines, strategic land management, and invasive snails.

We also encouraged community scientists to conduct their own field surveys for early detection and high priority invasive species by offering two unique events titled "Identify and Report Spotted Lanternfly (SLF) and Tree-of-Heaven (ToH)" and the "Invasive Species Scavenger Hunt." Both events provided species identification tips and iMapInvasives reporting instructions.

DEMYSTIFYING DESMODIUM DISTRIBUTION IN PENNSYLVANIA

A WRCP funded project to understand Pennsylvania's rare tick trefoils wrapped up in 2022. We reviewed literature, built expertise through training and collaboration, reviewed herbarium material, and collected field survey data to evaluate the status of *Desmodium glabellum*, *D. perplexum*, *D. nuttallii*, *D. viridiflorum*, *D. obtusum*, and *D. laevigatum*. We found that *D. glabellum* is more common than previously thought, being distributed nearly throughout the state with many known extant locations. *Desmodium perplexum* is less common than *D. glabellum*, having an affinity for more shaded habitats. *Desmodium nuttallii* and *D. viridiflorum* have been difficult to discern from each other; we found that most records from the state represent *D. nuttallii*, though a single extant occurrence for *D. viridiflorum* was documented. *Desmodium obtusum* may have vanished from the state, though its historic occurrence is confirmed. *Desmodium laevigatum* is extant at just one or two locations in the state. With these results, the conservation statuses of these species are now being updated.



Desmodium workshop participants (left to right: Chris Frye, Justin Thomas, Janet Ebert, Bonnie Isaac, Steve Grund, and Joe Isaac.)

PARTNERSHIPS TO IMPLEMENT
INVASIVE SPECIES WORK

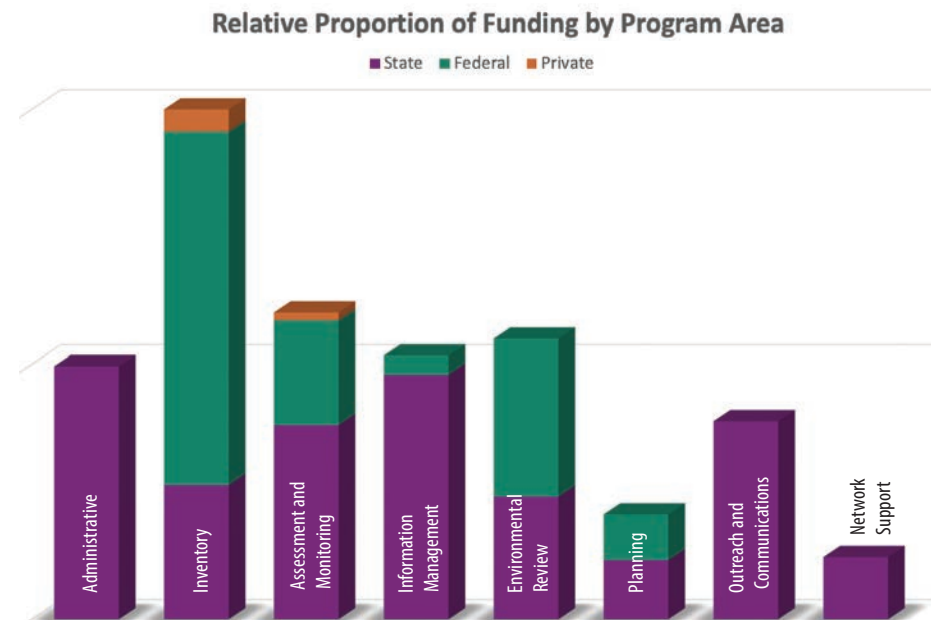
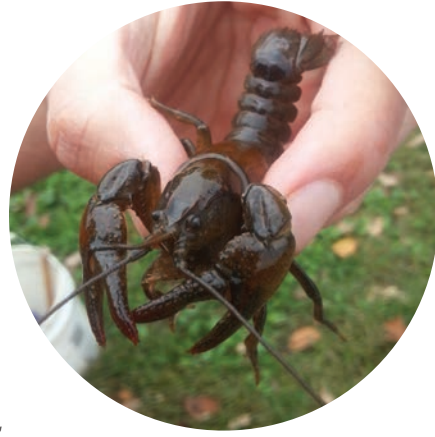
There are several Cooperative Weed Management Areas (CWMAs) in Pennsylvania. WPC and PNHP have been very active in the Lake Erie Watershed CWMA, partnering closely with Pennsylvania Sea Grant. For the last 10 years, we have worked with an advisory committee to prioritize and discuss projects and undertaken many invasive control projects. Related and part of a bigger effort through the Pennsylvania Invasive Species Council (PISC) is the initiative to create Partnerships for Regional Invasive Species Management (PRISM). Modeled on the structure in place in New York, PRISMs would cover all regions in the state and function similarly to the CWMAs – engaging agencies, organizations, and businesses in prioritizing and implementing invasive control efforts in a given region. PRISMs will be administered through the Pennsylvania Department of Agriculture and will require funding approved by the legislature. PISC committees are working to secure funding to realize the PRISM vision for the state.



FINANCIALS & STAFF

PROGRAM FUNDING

Our funding reflects the large amount of work we do with state and federal agencies. Local sources of funding include counties, municipalities, and NGOs. We also raise funds from private sources including businesses and private foundations. Inventory work represents the largest single investment of funds in the program. Environmental Review, Assessment and Monitoring, Information Management along with Inventory represent over 75% of the program expenditures, these being the core functions of PNHP.



WE RECOGNIZE THE MANY ENTITIES
AND PROGRAMS THAT SUPPORTED
OUR WORK IN 2022:

- Department of Conservation and Natural Resources**
- Bureau of Forestry
 - Wild Resources Conservation Program
 - Community Conservation Partnership Program Grants
 - Bureau of Forestry Research Fund
 - U.S. Fish and Wildlife Service, Section 6 grants
 - U.S. Environmental Protection Agency, Wetlands Program Development Grants
- Department of Environmental Protection**
- U.S. Environmental Protection Agency, Wetlands Program Development Grants
 - Clean Water Fund

- Pennsylvania Game Commission**
- State Wildlife Grants
 - Pittman-Robertson Fund
- Pennsylvania Fish and Boat Commission**
- State Wildlife Grants
- Pennsylvania Department of Agriculture**
- Research Grants
- U.S. Forest Service**
- Allegheny National Forest
 - Great Lakes Restoration Initiative Funds (Cooperative Weed Management Program)
- U.S. Fish and Wildlife Service**
- Great Lakes Restoration Initiative Funds
 - Science Application Funds

- U.S. National Park Service**
- Pennsylvania State University, Pennsylvania Sea Grant**
- Great Lakes Restoration Initiative Funds
- Pennsylvania Department of Transportation**
- The Charles Kaufman Fund**
- The New Jersey Department of Transportation**
- Longwood Gardens**
- NatureServe**
- Allegheny County Parks Foundation**
- Nuttall Ornithological Club**
- The Knobloch Family Foundation**





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