Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

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Inside This Issue

Pennsylvania's Rarest Ferns: A Case Study in Climate Resiliency 1

Bringing Life Back to the West Branch Susquehanna River: A Restoration of Freshwater Mussel Populations 6

Finds from the Four Counties 10

Two Weeks of Witchgrass Identification Complete 11

NatureServe Northeast Regional Meeting: Biotics Summit in West Virginia 11

Legendary Mammalogist Receives Recognition 12

The Gettysburg Least Shrew Project 12

A Search for Invasive Lesser Celandine 13

Fortifying iMapinvasives 14

Natural Heritage Areas Updates 15

Photo Banner
The globally rare Laurentian bladder fern (*Cystopteris laurentiana*) in its calcareous rock habitat.

Noah Yawn

Pennsylvania's Rarest Ferns: A Case Study in Climate Resiliency

by
Noah Yawn, Ecologist

Pennsylvania spans across five physiographic provinces, glaciated and unglaciated, with two coasts and many mountains in between, and so it is no surprise that this state hosts a quite rich flora and fauna. For example, sedges and their relatives in the family Cyperaceae are often touted as one of our more famous "big groups" plant diversity-wise, with over 100 species known from Pennsylvania in the genus *Carex* alone.

Ferns, a broad and ancient group of spore-producing, vascular land plants spanning over 300 million years into the fossil record—while not as large as some flowering plant groups—are yet another facet of Pennsylvania's biodiversity that offers unique insights into our state's history through time.

There are around 80 fern species known from Pennsylvania, representing 18 families. Among these, certain genera may form naturally-occurring hybrids, resulting in an even larger count when considered. Currently, PNHP tracks 20 fern species, many of which represent remarkable examples of unique biology, evolutionary history, and climate resiliency over recent geologic time.

When imagining a typical place where ferns grow, one might imagine a dark, rich, moist forest filled with wildflowers and other herbs. While many ferns do enjoy this habitat, some species have developed adaptations and resiliency that allow them to grow in very unique and sometimes harsh conditions. Others cling to stable, climate-buffered areas in unusual locations, a testament to their rise and fall with a changing climate and ecosystem since the last Ice Age 11,000 years ago.

A rich cove forest, common to the Laurel Highlands region, provides habitat for many ferns and wildflower species.

PNHP List of Tracked and Watchlist Fern Species in Pennsylvania

Scientific Name	***Common Name***	***Proposed State Status****
Asplenium bradleyi	Bradley's Spleenwort	PE
Asplenium pinnatifidum	Lobed Spleenwort	PR
Asplenium resiliens	Black-stemmed Spleenwort	PE
Cryptogramma stelleri	Slender Rock-brake	PE
Cystopteris laurentiana	Laurentian Fragile Fern	PE
Cystopteris tennesseensis	Tennessee Fragile Fern	PE
Dryopteris campyloptera	Mountain Wood Fern	PE
Dryopteris celsa	Log Fern	PE
Dryopteris clintoniana	Clinton's Wood Fern	PT
Dryopteris filix-mas ssp. *brittonii*	Male Fern	PE
Equisetum scirpoides	Dwarf Scouring-rush	PE
Equisetum variegatum	Variegated Horsetail	PE
Equisetum x ferrissii	Hybrid Scouring-rush	PE
Gymnocarpium appalachianum	Appalachian Oak Fern	PE
Lygodium palmatum	Climbing Fern	PR
Ophioglossum engelmannii	Limestone Adder's-tongue	PE
Ophioglossum pusillum	Northern Adder's-tongue	PE
Polystichum braunii	Braun's Holly Fern	PE
Woodsia ilvensis	Rusty Woodsia	watchlist
Vittaria appalachiana	Appalachian Shoestring Fern	PT

*PR – Pennsylvania Rare, PT – Pennsylvania Threatened, PE – Pennsylvania Endangered

Perhaps the best example of species resiliency in climate-buffered habitats is one of the state's smallest ferns, the enigmatic Appalachian shoestring fern (*Vittaria appalachiana*), a diminutive species in the brake fern family. At first glance, this species may be confused as being a moss or liverwort, which often grow near it in its preferred shaded acidic rock shelter habitat.

Appalachian shoestring fern (*Vittaria appalachiana*) gametophyte colonies from Butler County, PA

Similar to bryophytes, ferns and their distant relatives, the lycophytes, experience the **separation of generations**, a term used to describe their overall life history cycle. A **sporophyte**, or the adult generation, produces spores that give rise to **gametophytes**, or the reproductive generation, which in turn experience sexual fertilization to produce an adult sporophyte, continuing the cycle. The Appalachian shoestring fern represents a species that has, for unknown reasons, recently (but before the last Ice Age) lost its ability to complete sexual reproduction, and instead, exists entirely in the moss-like gametophyte stage. This species reaches its northernmost extent in unglaciated Pennsylvania and adjacent New York, where it grows in colonies in deep recesses of acidic rock shelters, most often of sandstone. These clonal gametophytes are readily identified by their overall greasy-green appearance, as well as being only a single cell thick, similar to other, solitary fern gametophytes. The shoestring ferns, *Vittaria*, reach their greatest abundance in the tropics, and so *V. appalachiana* represents a remarkable species of interest given its tropical lineage, strange life history, and distribution. PNHP botanists are actively seeking out and documenting occurrences of this species to better understand its distribution and rarity in Pennsylvania.

Other groups, such as the wood ferns, *Dryopteris*, or the spleenworts, *Asplenium*, are notable in their ability

Bradley's spleenwort (*Asplenium bradleyi*) resulted from the ancestral hybridization of mountain spleenwort (*A. montanum*) and ebony spleenwort (*A. platyneuron*).

to form naturally-occurring hybrids between species. Hybridization between species isn't unique to ferns, but unlike other groups of vascular plants, it is central to fern evolution and diversification over time. The wood ferns and spleenworts for example, are famous in that the relationships between their many species and hybrids are jokingly referred to as something similar to a tangled, messy web instead of a simple, branching tree. These "messy" relationships, occurring through hybridization, are a major driver of fern diversity; an estimated 30% of extant fern species globally have originated through hybridization! In between exploring acidic bedrock rock shelter systems for the Appalachian shoestring fern, often with headlights and hand lenses at the ready, one might stumble upon some of these hybrid species, such as Bradley's spleenwort (*Asplenium bradleyi*) and lobed spleenwort (*Asplenium pinnatifidum*). Both of these spleenworts originated from ancestral hybridization events between widespread species, and

Lobed spleenwort (*Asplenium pinnatifidum*) resulted from the ancestral hybridization of mountain spleenwort (*A. montanum*) and walking fern (*A. rhizophyllum*).

have since become widespread across the eastern U.S. They are often found on steep cliff faces, sometimes with other rare or interesting species, and are tracked by PNHP given their special habitat requirements and relative rarity in the state.

Slender rock-brake (*Cryptogramma stelleri*) is a rare species that grows in neutral to calcareous rock shelters in Pennsylvania.

In contrast to some of the relictual, tropical species found in Pennsylvania and much of the eastern U.S., our state hosts remarkable northern disjunct species as well—a testament to the state's diverse landforms, abundance of microhabitats, and geologic and climatic history. Slender rock-brake (*Cryptogramma stelleri*) reaches its near southern range extent in Pennsylvania, where it grows in rock overhangs of neutral to slightly calcareous geology, often in deep, humid recesses and shaded from direct sunlight. These "rock houses," similar to cold air traps, create climatically-insulated microhabitats that have buffered temperatures and moisture levels, keeping their floral and faunal occupants (such as various salamanders) cooler in the warmer months. Similarly, Braun's holly fern (*Polystichum braunii*) reaches its near-southernmost limit in the northeastern part of the state. Unlike its widespread relative, Christmas fern (*Polystichum acrostichoides*), Braun's holly fern produces scaly, lacy fronds that are visually similar to wood ferns, instead of simple, once-pinnate fronds. This circumboreal species, known from North America and parts of Eurasia, is found only in the deep, insular gorges of this part of the state, similar in habitat to some of our other boreal refugia species like the rare clasping twisted stalk (*Streptopus amplexifolius*).

Braun's holly fern (right) occupies deep, shaded gorges in Pennsylvania, similar to other northerly, refugial species. Shown here compared to Christmas fern (left).

Clasping twisted stalk (*Streptopus amplexifolius*) is a rare species known only from climate-buffered, seepy rock outcrops and waterfall spray zones in northeastern Pennsylvania.

Appalachian oak fern (*Gymnocarpium appalachianum*) is a rare central Appalachian endemic fern species.

Pennsylvania's rarest ferns are interesting case studies in both their evolutionary history, as well as unique conservation challenges. The globally-rare Appalachian oak fern (*Gymnocarpium appalachianum*), a species endemic to higher elevations of the central Appalachians, grows in scattered locations throughout its range, where it is found in similar temperature-moderated habitats, such as cold air traps and scree slope bases in deeper ravines. The Appalachian oak fern, given its sensitive and unique habitat preference, faces challenges in the coming decades with climate change, as its preferred habitat is predicted to slowly shift north. PNHP staff are actively working with university partners to better document and understand

occurrences of Appalachian oak fern in Pennsylvania to begin discussion on conservation approaches for this species. When visiting these cold air trap habitats, particularly on a hot summer day, staff are always sure to appreciate the brief respite of summer heat by taking a lunch break in nature's own air conditioning.

Laurentian bladder fern (*Cystopteris laurentiana*) is a globally rare species known from scattered locations in the Great Lakes and northeast region.

The Laurentian bladder fern (*Cystopteris laurentiana*), similar to species in larger species complexes like the spleenworts, is a globally-rare fern that formed from multiple hybridization events. Certain ferns offer a unique opportunity to take glimpses into the past, especially when considering extinction through time. Through careful genetic analysis, scientists have theorized that the Laurentian bladder fern, as well as one of its parents, the fragile fern (*Cystopteris fragilis*), may have formed through hybridization of a now-extinct species. While this relative no longer grows on the planet, its direct lineage still survives within some of our rarest fern species. Laurentian bladder fern occurs in scattered locations throughout the Great Lakes region and is currently known from fewer than three locations in the state. This calciphilic species relies on shaded, humid, exposed outcrops of calcareous rock, a rare habitat in Pennsylvania. PNHP staff recently completed spore measurements to confirm this species' occurrence at a site in Centre County and plan to further investigate other sites.

We hope to continue to work on and highlight Pennsylvania's rarest fern species as yet another component of our state's biodiversity and conservation goals. Ferns are a fascinating group of organisms that are remarkably resilient, and, in some instances, offer quite a unique testament to climate, adaptability, and a glimpse into the recent geologic past.

About the Author

Noah Yawn is an Ecologist with the Pennsylvania Natural Heritage Program (PNHP) and the Western Pennsylvania Conservancy. Noah conducts plant community vegetation sampling and documentation, ecological assessments, and rare species inventorying and monitoring. In his free time, he is usually out exploring a natural area, cliff system, cave, or looking to photograph a target species, with a particular emphasis on ferns, a favorite subject of his.

Bringing Life Back to the West Branch Susquehanna River: A Restoration of Freshwater Mussel Populations

by
Mary Walsh, Invertebrate Zoology Manager

In Moshannon Creek, the river rocks are coated in orange ferrous oxide precipitate, an indicator of pollution from mining. A tributary to the West Branch Susquehanna River, the creek is one of many in the region with a legacy of pollution from abandoned mines that closed in the mid-20th century. The water pollution began in the early 1800s during the earliest mining for coal and clay in the West Branch Susquehanna River watershed. Coal mining production peaked in 1918, when 276.7 million short tons were mined. Regulation lagged behind coal production, but by the 1970s state and federal laws regulated water discharges from the operations. The mines, which ceased operations before clean water regulations were in effect, were not required to curb pollution and are the source for the effluent pouring into the creeks. The result was widespread pollution in the region; as of 2008, there were 1,205 miles designated as impaired by mine drainage in the West Branch Susquehanna River watershed.

Ferrous oxide precipitate armors the substrate in Moshannon Creek.

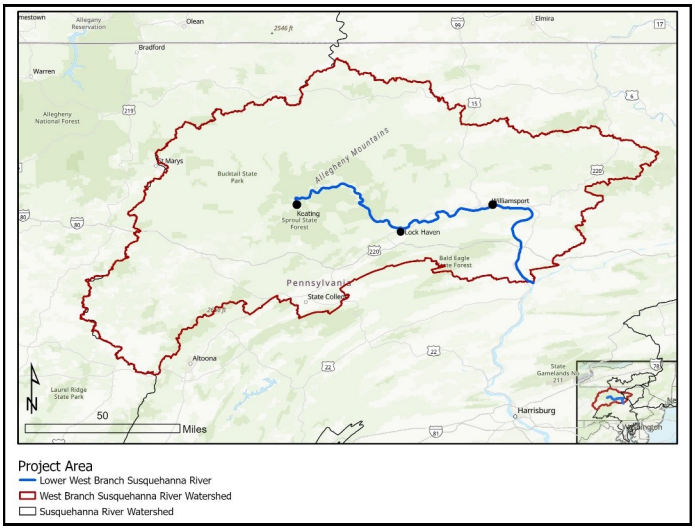
The acidic and metal-laden effluents caused severe declines in the aquatic life in the West Branch Susquehanna River. Surveys of the river in Clinton and Clearfield counties by Pennsylvania Fish and Boat Commission (PFBC) in the 1930s found that fish could not survive. Benthic macroinvertebrate communities were depressed in a nearly 200 mile stretch of the West Branch Susquehanna River as recently as the 1990s and the river did not meet the designated water quality standards for alkalinity, iron, or aluminum in reaches from its headwaters to the confluence with Pine Creek at Jersey Shore, Lycoming County.

West Branch Susquehanna River

As a result of the degraded conditions, freshwater mussels were eliminated in much of the West Branch Susquehanna River watershed. PNHP's 2011 study of freshwater mussels in the watershed found that they were notably absent in streams with historic mine drainage. In the river, no live freshwater mussels were found from the headwaters of the river to an area downstream of Lock Haven. However, in the lower reaches of the West Branch Susquehanna River near the confluence with the mainstem Susquehanna River, mussel richness rebounds and several species, classified as Species of Greatest Conservation Need (SCGN) in the 2015-2025 Pennsylvania Wildlife Action Plan, occur here. The water quality of the river improves in this reach; the mine drainage from upstream sources is diluted by inputs from tributaries with little or no mining, such as Bald Eagle Creek and Pine Creek.

In the recent decades, a concerted effort to remediate mine drainage has improved the water quality in the West Branch Susquehanna River. Acidity and metals, like iron, manganese, and aluminum, are removed by treatment systems. Decreasing contaminant loads from tributaries, like Bennett Branch Sinnemahoning Creek, Kettle Creek, Tangascootack Creek, and Clearfield Creek, is cleaning up the waters in the West Branch Susquehanna River. Increasing pH and macroinvertebrate index scores documented by monitoring efforts are indications of improved water quality in the watershed.

Today, river reaches upstream of Lock Haven have ameliorated conditions compared to the high pollution levels previously documented and fish populations are increasing.



West Branch Susquehanna River Map

As some of the worst pollution has abated, there is great potential for biodiversity to return to the West Branch Susquehanna River. However, dams on the river are an impediment to natural recolonization. While some fish have moved into the river from source populations in tributaries, migratory fish, including those that are freshwater mussel hosts, cannot pass the Hepburn Street Dam in Williamsport and the Grant Street Dam in Lock Haven on the river. The dams separate the area of relatively good water quality in the lower reaches of the river from the recovering section of river upstream. This hampers the recovery for freshwater mussels, like the eastern elliptio, whose fish host the American eel, cannot migrate upstream past the barriers.

Eastern elliptio

To facilitate the recovery and overcome impediments from the dams, partners from Pennsylvania and Maryland organizations are joining forces to bring freshwater mussels and migratory fish back to the section of the West Branch Susquehanna River from Lock Haven to Keating. PNHP is collaborating with PFBC, Maryland Department of Natural Resources (MDNR), Susquehanna River Basin Commission (SRBC), and Commonwealth University of Pennsylvania at Lock Haven to restore three species important to the basin, yellow lampmussel (*Lampsilis cariosa*), eastern lampmussel (*Lampsilis radiata*), and eastern elliptio (*Elliptio complanata*). Funding from the National Fish and Wildlife Foundation Chesapeake WILD supports this effort. The project is also an extension of MDNR's plan, Large Scale Mussel Restoration in the Susquehanna River: Potential Benefits for Nutrient Reduction.

Yellow lampmussel

Eastern lampmussel

Freshwater mussels will be placed in areas upstream of Lock Haven by two methods: directly stocking mussels at planned sites and as larval mussels, also called glochidia, attached to American eels. The infestation of the fish with eastern elliptio glochidia occurs in a laboratory or hatchery prior to stocking. When the fish

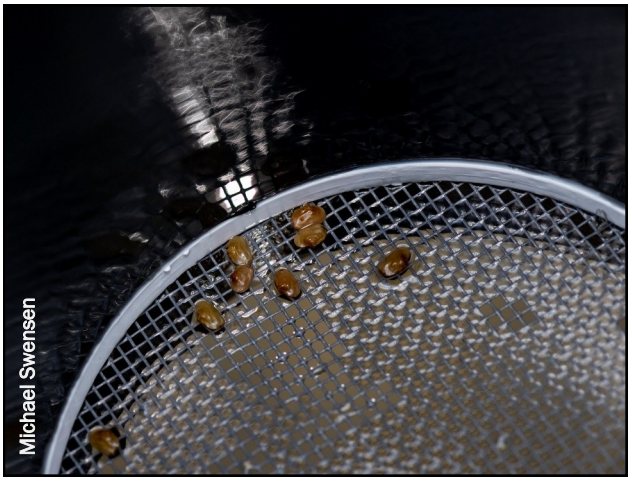
American eels to be stocked in the West Branch Susquehanna River

are placed at the stocking locations, the mussels are also transported to their future habitat. The tiny eastern elliptio (<0.4 mm), attached to American eel gills, mature over a period of weeks, then fall off to settle in the river bottom and establish in appropriate habitat. The American eels will persist in the river after the eastern elliptio release and have the potential to again be hosts to other reproducing mussels. This method was chosen for eastern elliptios because of success with experimental stocking of American eels increasing mussel populations. Overall, 10,000 American eels with attached glochidia will be transported to stocking sites at the West Branch Susquehanna River.

Partners from PNHP, PFBC, and Commonwealth University of Pennsylvania after collecting broodstock from the West Branch Susquehanna River

Simultaneous with fish stocking, yellow lampmussel and eastern lampmussel will be placed directly into the West Branch Susquehanna River at the stocking sites. Over the course of the project, we plan to release 10,000 propagated individuals of each species. Gravid yellow lampmussel and eastern lampmussel from the river were collected in the lower West Branch Susquehanna River watershed in 2025; the glochidia will be cultured by MDNR. In a hatchery, freshwater mussels will be grown to a size suitable for stocking in 2026 and 2027.

Juvenile mussels in an enclosure within a mussel silo



Juvenile mussels in an enclosure within a mussel silo

Before beginning stocking, project partners are evaluating the sites' readiness. In October 2024 the partners stocked small numbers of yellow lampmussel at sites in the West Branch Susquehanna River as a test case. Individuals from downstream locations were relocated to five sites planned for large scale stocking in a later project phase. The mussels were checked for survival and measured in June 2025. Additionally, juvenile mussels, known to be sensitive to water quality, were placed in concrete flow-through enclosures, termed silos, at stocking locations to evaluate the conditions for young mussels in the river. The juveniles, reared from yellow lampmussel broodstock collected in the lower West Branch Susquehanna River, will be evaluated by PNHP and PFBC staff monthly from July to

September 2025. Information from the preliminary mussel placement and silo study will inform the large-scale stocking planned. Adjustments may be made to the locations of stocking depending on the survival of the mussels in the preliminary study.

Yellow lampmussel with numbered tags that were measured after nine months at a stocking location in the West Branch Susquehanna.

Once the stocking phase of the project is complete, the project partners will monitor the mussels. Yellow lampmussel and eastern lampmussel in permanent plots will be checked at three and nine months post-stocking to determine the survival. Using electronic shellfish tags glued to mussel shells and a PIT tag reader, we will locate stocked individuals in the plots. Beginning one year after the stocking is complete, mussel abundance will be determined from surveys at stocking locations and over subsequent years evaluated against the goals for stocked densities.

The project is bringing to fruition the recommendations for restoring freshwater mussels to a river in recovery including those made by the USFWS Northeast Region Conservation Strategy for At-Risk Freshwater Mussels and the Pennsylvania Statewide Freshwater Mussel Restoration Plan, recently completed by the WPC Watershed Conservation Program, PNHP, and PFBC. In addition, the partnership established for this project between PNHP and state and regional organizations brings together staff and resources for the restoration for freshwater mussels. We anticipate future projects to expand this effort in the West Branch Susquehanna River and other regional waterways. Where polluted waters once flowed, the river will once again be teaming with aquatic life.

About the Author

Mary Walsh is the Invertebrate Zoology Manager with the Pennsylvania Natural Heritage Program. For 22 years with PNHP, Mary Walsh has worked on aquatic ecology and conservation projects with freshwater mussels in the Atlantic Slope and Interior basins. With the iMapInvasives Program, she manages the iMap database and projects related to invasive species control.

Notes from the Field

Finds from the Four Counties

Rachel Goad, Botanist

The Four County project – a two-year effort to update what is known about the biodiversity of Adams, Cumberland, Franklin, and York counties - has been occupying PNHP biologists. We are in our last field season of the project and are happy to report a number of interesting finds and updates.

Vase-vine leather-flower

Botanists revisited and surveyed the only two known populations of vase -vine leather-flower (*Clematis viorna*) in the project region, and only the population most difficult to access was escaping deer browse and producing flowers. This state Endangered plant reaches the northern edge of its range in southern Pennsylvania.

Downy phlox

While surveying a population of downy phlox (*Phlox pilosa* ssp. *pilosa)* in Adams County, we found that it was larger than previously thought, and also discovered a new sub-location of the plant. While still very small, it's clear the population of this state Endangered species is more robust than previously known.

We also found what is likely a new location of Nuttall's tick-trefoil (*Desmodium nuttallii*), a state Threatened legume, in the project area. Although the plants were found in a vegetative state, their dark red, reflexed stipules, densely hairy stem and leaf undersides, and relatively narrow leaflets, strongly suggest this identity. We will be returning to document later in the season when plants are fruiting.

Zoologists have been detecting and expanding what we know about least shrew (*Cryptotis parva*) distribution in Adams County. These small mammals are endangered in Pennsylvania, occurring in grassland habitats like sedge meadows and hayfields, which are increasingly uncommon on the landscape.

They have also collected a yet to be identified cave isopod from Franklin County at a new site. This find may be Price's cave isopod (*Caecidotea pricei*), an uncommon, sub-aquatic crustacean that lives in the springs and seeps of caves in Pennsylvania, West Virginia, and Virginia. Further determination is ongoing.

Unfortunately, the severe drought across Southcentral Pennsylvania last fall through this spring has hampered the turtle work that was planned, with many seasonal ponds dry at normally wet times of year.

Gray petaltail dragonflies (*Tachopteryx thoreyi)* – a vulnerable species - were confirmed to occur in two seepage wetlands in Michaux State Forest. These same seepage wetlands were found to be home to a pretty robberfly that appears to be *Laphria sericea*, or part of that complex. While not yet ranked, this interesting species still caught the eye of Invertebrate Zoologist Betsy Leppo.

Gray petaltail dragonfly

Laphria sericea, a robber fly

Two Weeks of Witchgrass Identification Complete

Claire Ciafré, Ecologist

In April, I went on a whirlwind trip across Pennsylvania to examine as many specimens of *Dichanthelium* (witchgrasses) as possible in just 14 days. I was joined by Justin Thomas (Institute of Botanical Training, NatureCite), who was an enormous help in working through this complex genus. Together we examined 5,801 specimens and assigned new identifications to approximately 23% of those. Some of these redeterminations will change the known distribution of the less common species found in the state. The next step in this project is to figure out whether any species' rank or status will need to change.

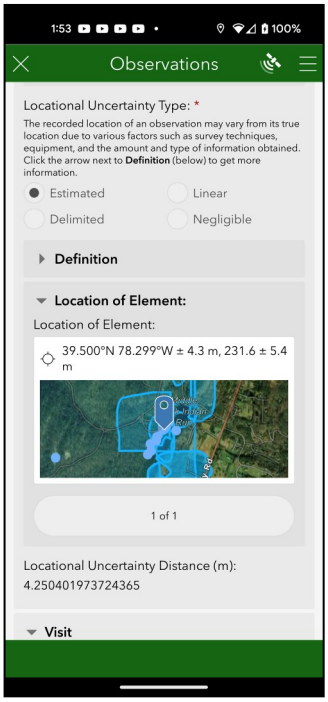
Rachel Goad, Justin Thomas, and Claire Ciafré take a break from their work at the Philadelphia Academy of Natural Sciences to pose for a quick picture near the end of the two-week identification spree.

We couldn't have done this much work in such a short amount of time without the accessibility of the specimens and assistance of herbarium staff at the Carnegie Museum of Natural History, Philadelphia Academy of Natural Sciences, Morris Arboretum, Pennsylvania State University, and Muhlenberg College. The assistance of PNHP botanists at the larger collections also made our work go much smoother. Thank you to everyone involved!

NatureServe Northeast Regional Meeting: Biotics Summit in West Virginia

Kierstin Carlson, Associate Information Manager

From April 14 to 17, 2025, six PNHP Information Management staff participated in the NatureServe Northeast Regional meeting - Biotics Summit at Cacapon State Park in Berkeley Springs, West Virginia. It was a two-and-a-half-day workshop that included instruction, collaboration, and problem-solving for Heritage staff that work with the Biotics database or field data collection. The objectives of the workshop were to increase Biotics competency from beginner to advanced skill levels, ensure consistent data collection and management across the Northeast network, and to create a community of support among Biotics users in the northeast.



West Virginia Survey123 field survey on cell phone for the field data collection exercise

Thirty-five participants from nine Natural Heritage Programs across the northeast U.S. shared current issues and solutions, new software, techniques, queries and scripts, and of course comradery. NatureServe and other Heritage program staff presented trainings on basic and advanced tasks in Biotics such as EO creation, mapping, ranking, and bulk loading; RARECAT (a tool to help with Heritage ranking of species); and the latest news on the upcoming Biotics 6 migration. There were other sessions to discuss topics like minimum data standards, how different programs manage staffing and workflow, and processing priorities.

Megan Kresse, Heritage GIS Technician II, dipping her toes at Berkeley Springs State Park after days of technical meetings

Pennsylvania Heritage gave an impromptu presentation about a new issue we are working on – how to best document and represent intentionally translocated populations in the database and derived products for planning and environmental review - that was well-received.

It was great to connect with so many others who deal with the same issues day-to-day and work out new approaches and ideas. Whether you have been with the network for a week or thirty years, there was something to be learned here.

Legendary Mammalogist Receives Recognition

Charlie Eichelberger, Vertebrate Zoology Manager

In May, the Mammal Technical Committee of the PA Biological Survey met at Gettysburg National Military Park for a field view of the PNHP efforts to survey for North American least shrew (*Cryptotis parva*), before convening the technical committee meeting. Part of the reason for assembling at Gettysburg was to inspect and discuss PNHP's use of the AHDriFT technique, a system which pairs modified trail cameras with a drift fence to passively monitor populations of small mammals and herptiles. This project builds off of the knowledge gained by past survey efforts conducted by former PNHP Mammalogist, Jim Hart. His survey efforts in the 1990s and early 2000s found least shrew still existing in small numbers around Gettysburg; yet since then, no specimens had been recorded until our most recent least shrew documentation using AHDriFT. The species deserves some long-overdue attention.

Jim dangles off of a cliff in Michaux State Forest while instructing other PNHP biologists on the use of ropes for safe surveys.

Similarly, Jim deserves some long-overdue recognition. While at PNHP, Jim kickstarted survey efforts for a number of under-surveyed and underappreciated species and coordinated the monumental move of the lion's share of the Shippensburg Vertebrate Museum's collections to the State Museum of Pennsylvania. In that collection, Jim prepared thousands of specimens.

Jim Hart works to corroborate sighted rock outcropping with previous survey efforts for Allegheny woodrat.

Those from the MTC who've worked with Jim in his capacity at PNHP, are centered around the legend: (L to R) Dr. Tom Serfass (Frostburg State University), Greg Turner (PGC), Charlie Eichelberger (PNHP), Dr. Scott Bearer (PGC), Chris Hauer (PA DMVA, Fort Indiantown Gap).

With this in mind, the PA Biological Survey and the Pennsylvania Game commission honored Jim with a Lifetime Service Award "in recognition for decades of dedicated and honorable service to the conservation of wildlife within the Commonwealth of Pennsylvania."

Jim found greener pastures and left PNHP in 2009 but continued to dedicate much of his adult life to understanding Pennsylvania's small mammals and sharing that knowledge. Anywhere small mammal work is being conducted in the state, his name always comes up. Jim's impactful career with PNHP and other outfits is evidenced by published literature, museum specimens, Element Occurrences, and the many biologists and mammal enthusiasts who cite his mentorship. Congratulations Jim!

The Gettysburg Least Shrew Project

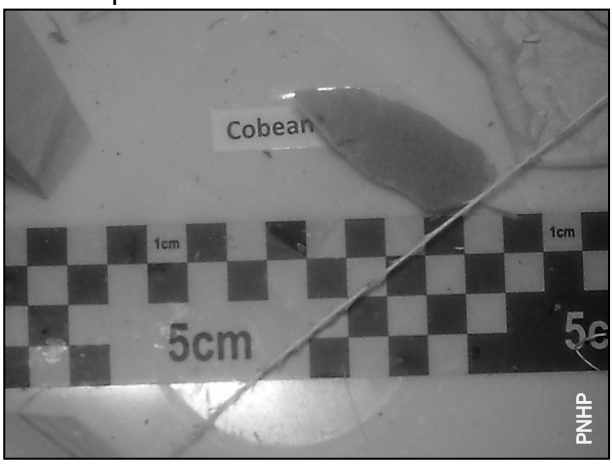
Lauren Sherman, Zoologist

It will be 20 years in October since the last Element Occurrence (EO) of the least shrew (*Cryptotis parva*) was recorded in Pennsylvania. Since that 2005 EO, there have been no confirmed captures, sightings, or whispers of its presence in the state, though it was once believed to occur statewide. Gettysburg was the location of that most recent record, and that is where our search for the state endangered least shrew began in October 2024.

PNHP zoologists are actively engaged in our search and nearing the end of our original projected goal. Utilizing the passive method of the adapted-Hunt drift fence technique (AHDriFT), we have deployed bucket cameras in potential habitat patches all across the

Our AHDriFT setup at McPherson Farm in Gettysburg, PA, one of many sites where we've found least shrews so far.

battlefield. Sites within the Gettysburg National Military Park and the Eisenhower National Historic Site were selected by former NPS biologist Dafna Reiner, who used the little available information on the species to narrow down potential habitat to grassland areas in close proximity to running water. Of the 19 selected sites I've surveyed and 115,175 collected and reviewed photos, we are thrilled to report that 8 of these sites have had positive detections of the least shrew!



The first evidence of the least shrew in Pennsylvania since 2005!

Based on our results so far, we are optimistic about our ability to learn more about this species and make more effective management recommendations for the park and for sites of any future detections. Charlie Eichelberger and I will continue surveying the battlefield through the end of the year, and hopefully gain momentum for future studies of the least shrew in Pennsylvania. Armed with this successful survey strategy and a better understanding of their ecology, we could eventually start to piece together a more accurate estimate of their current standing in the state through an extended search. For the time being, we can rest assured that they're still present in Gettysburg!

A Search for Invasive Lesser Celandine

Amy Jewitt, PA iMapInvasives Program Coordinator
Brian Daggs, Invasive Plant Ecologist

"You don't know what you don't know" is a common phrase used to indicate an unrecognized lack of knowledge. It means that not only are there things we are unaware of, but we are also unaware of our lack of awareness about those things. One aim of the Pennsylvania iMapInvasives Program is to expand our own knowledge of lesser-known (emerging) invasive species in Pennsylvania and then disseminate that information to our user base of natural resource professionals and community scientists.

Lesser celandine in flower

This spring, we highlighted an invasive plant called lesser celandine (*Ficaria verna*), a spring ephemeral that was introduced to North America in gardens and horticulture as early as 1867 in Philadelphia, Pennsylvania. Although this species is long-established in the urban landscapes of Pennsylvania, it is still an emerging threat for many of our natural areas. Many people who see lesser celandine in the landscape today would likely remark on its beauty as a showy, yellow flower, pleasing in appearance to passers-by. However, since its introduction, lesser celandine has spread from cultivation into natural areas where it outcompetes native flora and grows uncontested in lowlands, floodplains, and disturbed areas. These detrimental environmental impacts to our native species make it an undesirable invader, unwanted by land managers and informed community scientists alike.

After hosting a new statewide survey event called the "Lesser Celandine Seekers" in March and April of 2025, project staff succeeded in making more people aware of this problematic species in Pennsylvania and beyond, giving them the tools to identify and report their findings. Thirty-six "seekers" submitted over 240

confirmed reports for lesser celandine to iMapInvasives from 25 counties across the state. In addition to location details, many of these community science reports contained details concerning flower development, pollinator interactions, and the extent of infestation.

Information gathered from this event will help inform public understanding of lesser celandine's distribution across the commonwealth and aid land managers in targeting areas where control efforts for lesser celandine may be warranted.

A large patch of lesser celandine, this herbaceous invasive plant outcompetes native spring ephemeral flowers.

Fortifying iMapinvasives

Jeff Wagner, Senior Director Natural Heritage Program

Almost 20 years ago, PNHP decided to adopt a new Natural Heritage Network product that had been developed by NatureServe. That product was iMapinvasives – the database tool designed to track invasive species and their treatment. We began entering records and also building our capacity and the iMapinvasives program itself.

Pivotal to getting the effort moving was the hiring of an invasive species coordinator, Amy Jewitt, who could devote all of her time to iMap. She quickly developed the iMapinvasives website for Pennsylvania (https://www.paimapinvasives.org) and began training people and organizations in the use of the online tool including the newer mobile application. Her outreach efforts have been strong and extensive. PNHP's and WPC's work with the PA Invasive Species Council have resulted in iMapinvasives being the designated tool for the state to track invasive species. Additionally, our partnership with PA Sea Grant to develop and run the Lake Erie

Amy Jewitt, Pennsylvania iMapInvasives Program Coordinator

Cooperative Weed Management Area (LEW-CWMA) has allowed a very direct application of the data collected for PA iMapinvasives.

Still with all of that work, much of the funding for our invasive species program and for iMapinvasives specifically has been from federal and some state grants. In the spring of this year, DCNR decided that the iMapinvasives program was too critical in the support of invasive species control and outreach to rely on the cobbling together of grants for support. We now have funds for iMapinvasives incorporated into the core funds that WPC receives from DCNR. Unfortunately, invasive species are an accelerating issue for everyone who owns and manages land, but with iMapinvasives and our other invasive species work, we are responding and ultimately addressing another in a long line of threats to our rare species and natural communities in Pennsylvania.

iMapInvasives

Natural Heritage Areas Updates

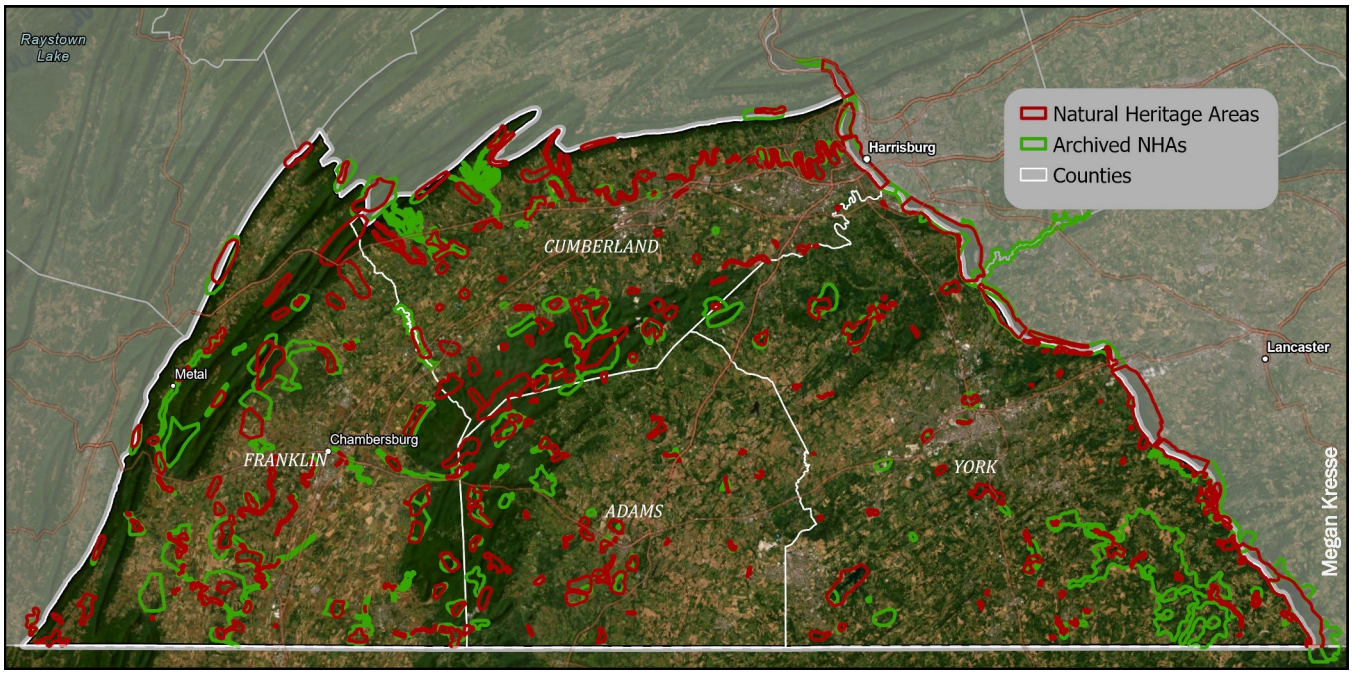
Megan Kresse, GIS Technician II

With over 4,000 Natural Heritage Areas in Pennsylvania, you've most likely found yourself in one whether you were kayaking along French Creek or hiking through one of the state's many parks. Natural Heritage Areas, NHAs for short, are sites containing one or more tracked species or natural communities of conservation concern in Pennsylvania. NHAs simplify biodiversity information by consolidating mapped species' occurrences into units that can more easily be used for conservation planning purposes. As one of PNHP's core public products, NHAs serve as a great tool to explore sites of biodiversity importance and proactively plan and prioritize conservation projects across the state.

Over the past year, we rolled out a new system that allows us to more efficiently create, update, and maintain NHAs which has presented the opportunity to put our new tools to the test. Since November, we have undertaken a major effort to database, review, and update NHAs in Adams, Cumberland, Franklin, and York counties as a part of the four southcentral county inventory project. To date, the spatial boundaries of 260 existing NHAs in the four counties were reviewed or updated and over 50 new NHAs have been drawn. Additionally, species lists for NHAs in the four counties have been updated to reflect the current boundaries.

Mercersburg Woods NHA, in Franklin County, one of the NHAs updated during the four-county inventory project.

While the four-county inventory has been the main focus, there have been NHA updates to the other counties as well. Of the approximately 4,000 NHAs in Pennsylvania, all NHA site accounts have been reviewed and almost all have been entered into our new database. NHA site accounts include information pertaining to the NHA, such as a site description, threats and recommendations, and a photograph. Shout out to Jennifer Larson, a Heritage volunteer, who databased over 3,080 NHA site accounts over the last two and a half months! There is still a lot of work to do, but we have more exciting NHA updates and developments to come!



Map of spatially updated NHAs within the four southcentral counties.