Pennsylvania Natural Heritage Program

ANNUAL REPORT 2023

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

MESSAGE FROM THE PROGRAM

In 2023, PNHP began a new year after celebrating its status as a 40-year-old program. Amazingly, a number of our staff have been here for over half that time and many for over a decade. However, we are not static - Charles Bier, former PNHP Director and Senior Director of Conservation Science at WPC, retired at the end of the year and we added several new staff including a first ever conservation mycologist! We will likely add several more staff in 2024. We feel privileged to have a large and strong program and to be part of a dynamic partnership that offers opportunities to share our information and advance biodiversity protection in Pennsylvania.

Invasive species and their impacts have become more prominent and widespread. All PNHP partners are members of the Pennsylvania Invasive Species Council (PISC) and are working with other agencies and entities in the state to organize regional approaches to combat invasive species. We work closely with the invasive species coordinator at PFBC and the DCNR staff in the Forest Health Division of Bureau of Forestry. We hired a seasonal ecologist with funds from PGC to survey State Game Lands and document invasive species that could be impacting important plant populations. Additionally, we continue building the iMapInvasives database to serve the increased demand for up-to-date invasive species distribution information.

As mentioned in our last annual report, we are in the midst of a SWAP update, due by the end of 2025. The planners at PGC and PFBC are busy gathering information and coordinating a host of partners and data providers. PNHP is working on the assessment of hundreds of invertebrates and has been helping to train partner and contractor staff in the use of assessment tools developed by NatureServe. Although we have scant information for so many groups of invertebrates, there are several including freshwater mussels for which we have a good understanding of their distribution in the state. PNHP partners WPC and PFBC are working on National Fish and Wildlife (NFWF) grants that move freshwater mussel conservation to the next phase where a strategy and overall plan comes together with captive breeding and reintroduction to ensure that our native mussels are secure in the state.

This has been the second year of an old growth study to both document existing old growth forests and provide a protocol to assess forests to determine if they have old growth characters and can be considered either old growth or developing old growth. The resulting tool will offer a way for foresters, both public and private, to better manage and set aside areas for biodiversity and carbon storage.

We hope you enjoy reading about our work and share our report with all who have an interest in Pennsylvania's biodiversity.

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.

DCNR, PGC, PFBC, WPC

The primary PNHP partners involved are indicated at the end of each project description.

NatureServe

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

DCNR

Pennsylvania Game Commission 1895

Pennsylvania Fish & Boat Commission

Western Pennsylvania Conservancy
water, land, life.

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.

"All of the PNHP partners share in the mission of protecting the biodiversity of Pennsylvania. Having the information and expertise of the program available to us at the Conservancy and to our partners has allowed us to make strategic decisions in conserving properties to protect rare species and add to the lands of the Commonwealth."

– THOMAS SAUNDERS, President and CEO
Western Pennsylvania Conservancy

On this page and page 6: *Loreleia marchantiae* fruiting bodies on host liverwort, *Marchantia polymorpha*.

DISCOVERIES

MORE RARE PLANTS FOUND AT HIGH BIODIVERSITY SITES

With funding from the Richard King Mellon Foundation, we selected 10 sites of high botanical importance to evaluate impact from invasive species. During our surveys, we found more than the species the sites were known for!

- At Birmingham Slopes in Huntingdon County, we found a small population of the rare white alum root (*Heuchera alba*).
- At Barnes Gap in Fulton County, we found the globally rare northern metalmark (*Calephelis borealis*) and witnessed a freshly emerged northern metalmark resting along a creek downstream of a population of its host plant, roundleaf ragwort.
- At Rock Springs, a serpentine barren in Lancaster County, we discovered Nuttall's milkwort (*Polygala nuttallii*), possibly persisting at this site because its trailside location emulates the moist pine savannas where it often occurs. WPC

Group of blackseed needlegrass plants growing near the Susquehanna River.

SHARPLEAF HOOKERIA MOSS

Sharpleaf hookeria moss (*Hookeria acutifolia*) was known from only two localities in Fayette County where it was last collected in 1917 near Cucumber Falls and in 1940 along Meadow Run. We rediscovered it in Fayette County at a new locality on State Game Lands growing at the base of a large boulder where there was some seepage coming to the surface. WPC DCNR

BLACKSEED NEEDLEGRASS

In early May, PNHP botanists visited an island on the lower Susquehanna River and documented the largest known population of blackseed needlegrass (*Piptochaetium avenaceum*) in the state. This state endangered species of dry forests is near the northern edge of its range in Pennsylvania. WPC DCNR

PURPLE SEDGE

Purple sedge (*Carex purpurifera*) is an uncommon southern Appalachian species of limestone forest habitats. We discovered a population in a rich forest habitat of SGL 51 in southwestern Pennsylvania. This is the first population known for the state, and a northern range extension for the species. WPC DCNR

An adult ostrich fern borer moth, perched on an ostrich fern sporophyte. A book that formally describes and names this moth is expected to be published later this year. Inset: It was easy to find this ostrich fern borer caterpillar because there was a single wilted frond—the one that the caterpillar had been boring through—on an otherwise healthy ostrich fern.

OSTRICH FERN BORER MOTH

During an unsuccessful search for cobblestone tiger beetles on an island in the Allegheny River last summer, PNHP biologists stopped to look at a patch of ostrich fern (*Matteuccia struthiopteris*) and found several caterpillars boring into the base of the fern fronds. We suspected these were a rare species, so we collected them and reared them to adulthood to confirm that these were ostrich fern borer moths, also known as "*Papaipema* sp. 2" because they do not yet have a formal scientific name. This species had not been seen in Pennsylvania for many decades, so this is a noteworthy rediscovery and a range extension for this globally vulnerable species. **WPC DCNR**

PENNSYLVANIA AMPHIPODS

In 2022, PNHP staff discovered an undescribed, potentially endemic amphipod crustacean belonging to the genus *Gammarus* in a stream in south-central Pennsylvania. Follow-up surveys in that stream and nearby streams in the spring and fall of 2023 resulted in the collection of several other amphipod species that are believed to be undescribed or in need of redescription, indicating that significant hidden freshwater amphipod taxonomic diversity occurs in Pennsylvania. **PFBC WPC**

SWAINSON'S WARBLER

PNHP and Bird Lab, a local bird conservation non-profit, teamed up during fieldwork in July 2023 to confirm the first breeding occurrence of Swainson's warbler (*Limnothlypis swainsonii*) in Pennsylvania at the Western Pennsylvania Conservancy's Bear Run Nature Reserve. Staff observed a family group, then captured and banded a hatch year bird, verifying this northernmost breeding record for the species. **WPC**

LIVERWORT NAVEL, A FUNGAL ODDITY

In November, PNHP staff documented the first record in the eastern U.S. of liverwort navel, *Loreleia marchantiae*, an under-documented species of potential conservation concern in Pennsylvania. This fungus uniquely associates with *Marchantia polymorpha*, a liverwort known from quality riparian areas. **WPC DCNR**

RED-BELTED BUMBLEBEE

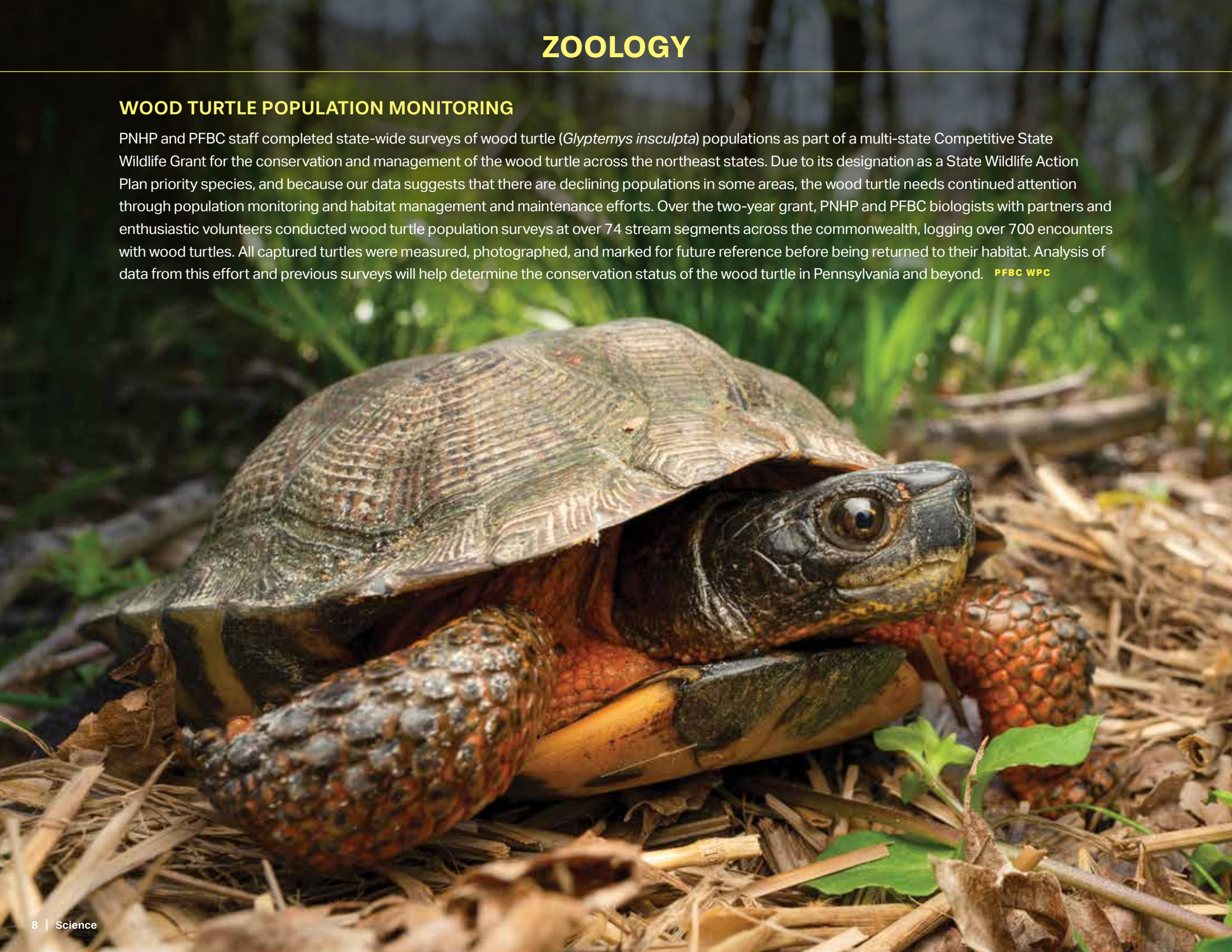
This year PNHP staff surveyed bumblebees in the Great Lakes watersheds of Pennsylvania. While we were working in the northeast corner of Erie County, we kept a lookout for the red-belted bumblebee (*Bombus rufocinctus*), because a single individual of this species—the first ever reported from the state—had been found there in 2017 by the Pennsylvania Department of Agriculture. As we were leaving the area, we decided to stop just once more, at a roadside patch of coneflowers, and found several red-belted bumblebees collecting nectar and pollen from the flowers, confirming that there actually is a resident population in this area. **WPC USFWS**

This red-belted bumblebee is collecting nectar and pollen from a cutleaf coneflower.

ZOOLOGY

WOOD TURTLE POPULATION MONITORING

PNHP and PFBC staff completed state-wide surveys of wood turtle (*Glyptemys insculpta*) populations as part of a multi-state Competitive State Wildlife Grant for the conservation and management of the wood turtle across the northeast states. Due to its designation as a State Wildlife Action Plan priority species, and because our data suggests that there are declining populations in some areas, the wood turtle needs continued attention through population monitoring and habitat management and maintenance efforts. Over the two-year grant, PNHP and PFBC biologists with partners and enthusiastic volunteers conducted wood turtle population surveys at over 74 stream segments across the commonwealth, logging over 700 encounters with wood turtles. All captured turtles were measured, photographed, and marked for future reference before being returned to their habitat. Analysis of data from this effort and previous surveys will help determine the conservation status of the wood turtle in Pennsylvania and beyond. **PFBC WPC**



SALAMANDERS DISCOVERED IN TREES—LEADS TO NEW STUDY

In late June PNHP zoologists observed four individual green salamanders climbing on one red oak tree. This is not the first time green salamanders have been observed using arboreal habitat in Pennsylvania, but it is the first documented successful targeted nighttime survey of trees for the salamanders in the state. This discovery led to the funding of a Wild Resources Conservation Program Grant to study the arboreal habits of green salamanders in Pennsylvania in 2024. Data from this upcoming study will be used to inform landowners and land managers about occupied habitat use, appropriate forestry buffers, and forest age preferences of this state threatened species. **WPC PFBC PGC DCNR**

CAMERA SURVEYS DOCUMENT PA'S WEASELS

PNHP and the Pennsylvania Game Commission (PGC), along with other cooperators, are testing a variety of passive detection methods using game cameras to develop survey and trapping protocols for weasel species in suitable habitats. While we are interested in locating occurrences of all three Pennsylvania weasel species (long-tailed weasel, American ermine, and least weasel), PNHP's focus is on the least weasel. Sightings for this species in Pennsylvania are extremely rare, with reports and specimens in the last 20 years numbering in the single digits. Despite this lack of recent information, little survey effort targeting this species has occurred in the state. In fact, Pennsylvania's 2015 State Wildlife Action Plan did not include this species because there was not enough data to make any informed determination on its status. After a year of numerous camera deployments and over 500,000 survey photos taken, we have detected long-tailed weasels, possibly American ermine, and one least weasel. The least weasel observation from Erie County is the first targeted detection of a least weasel in the state. **WPC PGC**

BAT SURVEYS – IT TAKES A TEAM!

To locate maternity roosts used by the state-endangered little brown bat, PNHP zoologists teamed with the Pennsylvania Game Commission (PGC) Recovery Division staff to follow up on hot leads where data records indicate recent captures of foraging reproductive females of little brown bat, but where roosts remain unknown. The bat netting crews conducted two weeks of surveys in May and June focusing on one location in Perry County and another in Pike County. Thankfully, a handful of reproductive females were captured, affixed with radio transmitters, and tracked to their roosts. Over the following weeks, PGC staff kept tabs on the transmitter outfitted bats and were successful at locating several newly known roosts. Plans are in place to continue these efforts during the 2024 field season, likely following up on what we learned about these areas in 2023. **PGC WPC DCNR**

CONSERVATION CONTINUES ON EASTERN MASSASAUGA AND ITS HABITAT

PNHP and state and federal agency partners conducted surveys for the federally threatened eastern massasauga. Many observations for the massasauga were last reported during the previous state status assessment conducted by PNHP staff from 2002-2005. Massasauga populations have declined in Pennsylvania due to habitat loss from woody vegetation shading preferred open field habitats. Since some of the extant massasauga site accounts and observations are around 20 years old PNHP is focusing on updating these records. PNHP and agency partners conducted visual encounter surveys during the spring of 2023 with one massasauga observed. PNHP will continue efforts to partner on surveys and to advocate for habitat restoration on state and private land, and in some cases utilize PNHP staff to conduct habitat restoration projects. WPC PFBC PGC

INVERTEBRATE ZOOLOGY

TIGER BEETLES

We finished the first of two field seasons of our WRCP-funded Globally Rare Tiger Beetles of Pennsylvania project. For two of those species, the northern barrens tiger beetle (*Cicindela patruela*) and the Appalachian tiger beetle (*C. ancocisconensis*), surveys were conducted in the spring, when their adults are active. By midsummer, most of those adults had died off, and we switched to surveys for the cobblestone tiger beetle (*C. marginipennis*), whose adults were just emerging. For the spring-active species, we relocated most of our known populations, verified and mapped populations that had been reported from various sources, and found a few new populations. For the cobblestone tiger beetle, we learned that our one known remaining population appears to be limited to a small group of islands, and no additional populations were found. After we complete our 2024 field work, we will use our new data to update the conservation status of these species. For more details about this project, see the fall 2023 newsletter. **WPC DCNR**

Tiger beetles are difficult to catch. An Appalachian tiger beetle in the hand is worth two in the bush.

Mating pair of northern barrens tiger beetles.

MUSSEL MONITORING AND ASSESSMENT OF RESTORATION POTENTIAL IN WESTERN PENNSYLVANIA

PNHP staff studied freshwater mussels in two separate projects – one to monitor mussel populations in French Creek after invasion by the non-native, molluscivorous round goby and another to study survival of juvenile salamander mussels through the deployment of mussel survival silos; both projects are supported by the Wild Resource Conservation Program (WRCP). The silos, small concrete dome-shaped structures, hold a small number of juvenile salamander mussels and allow water to flow through a central chamber. We placed the silos in four locations in western Pennsylvania that either currently have salamander mussel populations (control) or where salamander mussels are no longer found, like the Ohio River. After leaving the silos out for the summer we found inconclusive results. All sites had some juvenile mussels survive; however, numerous silos were affected by zebra mussel infestations leading to low growth rates and high mortality. We will attempt a second silo deployment in 2024. In the monitoring project in French Creek, we assessed populations at six sites with and without round gobies. We are finalizing the mussel population data in 2024; it will be used to evaluate changes over time in the freshwater mussel distribution and numbers due to impacts by the round goby. **WPC PFBC DCNR**

CRAYFISH FAUNA OF THE SUSQUEHANNA AND DELAWARE BASINS OF PENNSYLVANIA

From 2021-2023, we sampled more than 700 sites across the Delaware and Susquehanna basins of Pennsylvania for crayfishes. Twelve species were collected: nine from the Susquehanna basin and eleven from the Delaware basin. Crayfish were found at 85% of the sites. Most species were found in both basins and were likely introduced to at least one of them suggesting a high degree of mixing between basins, much of which was likely anthropogenic. Several new state and basin records were recorded during this study. Invasive crayfishes have expanded their ranges substantially in the 15 years since the last survey, especially in the Susquehanna basin. Rare crayfishes were collected from drainages where they were not previously known, although in other drainages they were eliminated by invasive crayfishes. Several rare crayfish discoveries, some immediately across drainage divides suggest natural stream capture events, providing important zoogeographical information for crayfishes and other aquatic fauna. **PFBC**

PLANT COMMUNITIES

INVENTORY OF MESIC COVE FORESTS

Mesic cove forests occur in sheltered ravines and lower slopes where moisture and nutrients accumulate, which results in a high number and diversity of plants in relation to the surrounding forests. One of the more diverse mesic cove forest types in our state is the relatively rare Mixed Mesophytic Forest. This type, found in southwestern Pennsylvania, was the focus of inventory efforts by PNHP ecologists over the past year, along with other mesic cove forest types occurring in southern counties in the state. Defined by an extraordinarily high diversity of vascular plants, this type supports species that are more common in western Pennsylvania. Protection and implementation of best management strategies to sustain these high conservation value forests is a goal of the Penn State Extension and American Forest Foundation and our work will contribute to their efforts by continuing to define and catalogue them. **WPC DCNR**

MESIC TILL BARRENS

Mesic till barrens are critically imperiled shrub savanna communities known only from the Pocono Plateau and small patches in southeastern New York. In this community, scattered pitch pines tower over a blanket of low shrubs like lowbush blueberry, sheep laurel, and rhodora, a boreal wetland shrub at the southern edge of its range. This uniquely wet barren type is the result of moist, loamy soils derived from glacial till, a cold climate, and fire history. Without fire many of these barrens are becoming oak and maple forests. Fortunately, many mesic till barrens are protected and managed by The Nature Conservancy, the Wildlands Conservancy, and the Pennsylvania Game Commission. Our ongoing efforts to document this community's composition and distribution will hopefully help our partners protect, conserve, and manage these special places. **WPC DCNR**

STUDYING THE HABITATS OF GLOBALLY RARE PLANTS

In partnership with the Pennsylvania Plant Conservation Alliance, we started an effort to collect plant community data associated with populations of globally rare plant species. This year we focused our efforts on bog Jacob's-ladder ahead of a planned prescribed fire at one of its populations; we also collected data at populations of box huckleberry and Canby's mountain-lover. The data we collected will provide critical baseline data to detect trends in each population and its community over time and help determine whether management objectives are being met. The data will be used to identify appropriate restoration techniques, streamline survey efforts, and fill gaps in our knowledge of our rare plant species and their habitats. **DCNR WPC**

WETLANDS

STATE WETLANDS CONSERVATION PLAN

A recent model of wetland distribution in Pennsylvania completed by the Pennsylvania Department of Environmental Protection (DEP) estimated that there are nearly 700 km2 of wetlands on lands managed by the Department of Conservation and Natural Resources, which includes state forests and state parks. We received an EPA Wetland Program Development Grant to identify goals and objectives in conservation of wetlands on state lands and to develop and implement an on-the-ground assessment program to determine the condition of these wetlands to guide conservation activities. In this project, we are also developing outreach and education materials related to wetlands. We are working with DEP's Clean Water Academy to create plant identification courses for wetland professionals and potential integration into K-12 education opportunities. **WPC DCNR**

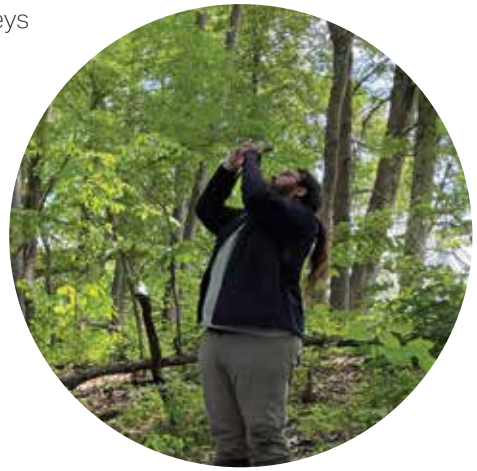
SEEPAGE WETLANDS

Over the last four years, PNHP staff have conducted an EPA-funded study to better understand the composition and condition of seepage wetlands (aka seeps) in Pennsylvania. Seeps are a unique wetland group that form at groundwater discharge areas on slopes and topographic transition points. Seeps help supply water and nutrients to headwater streams. They have saturated soils and an assemblage of wetland plants that differ from the surrounding uplands. We have located and characterized several plant communities associated with seeps. A potentially new community type for the state is the vertical seep. It is more of a seepy cliff, usually found along streams and rivers, that remains wetted by groundwater discharge. This seep may be colonized by bryophytes, liverworts, and scattered plants. Several uncommon species have been identified and we hope to find more as we continue our exploration of this community type. **WPC DCNR**

INVASIVE SPECIES

The impact of invasive species on our native species and ecosystems cannot be ignored. Our efforts to better understand their distribution and partner to actively control invasive species are finding roots as more agencies and organizations turn attention to this enormous threat to rare species and ecosystems.

DOCUMENTING INVASIVE SPECIES IN PA'S "SWAMP COUNTRY" WITH IMAPINVASIVES



PNHP ecologists continued surveys to document invasive species distributions within Natural Heritage Areas (NHAs) in northwestern Pennsylvania and the Lake Erie watershed to determine sites with greatest treatment need and priority. iMapInvasives continues to be a primary tool and database for documenting invasive species presences, as well as treatment results and follow up need. Over 2,550 presence records were recorded by two PNHP staff members across 7,860 surveyed acres, encompassing 27 State Game Lands, 8 state and municipal properties, 3 WPC properties, and other private lands in the 2023 field season. Valuable treatment priority information, landowner and continued partner relationships, novel rare species occurrences, and NHA status updates were generated from this work. WPC USFWS

DEVELOPING INVASIVE SPECIES PARTNERSHIPS THROUGH THE R.K. MELLON FOUNDATION

The Richard King Mellon Foundation awarded PNHP funding to engage partner organizations for collaborative invasive species monitoring and management efforts. This project targets both local and large-scale invasive species priorities through site assessments and a statewide management model. PNHP staff assessed invasive plant populations at ten ecologically rich sites throughout the state and are working with stakeholders at each site to develop monitoring strategies that will inform management decisions. We engaged nine partners through these sites, including the Pennsylvania Game Commission and the Lancaster Conservancy. On a larger scale, PNHP is collaborating with NatureServe and the New York Natural Heritage Program to develop a statewide model for invasive species management prioritization which will be integrated into the iMapInvasives database. This model will provide guidance for management based on invasive species distributions and other geospatial datasets. WPC

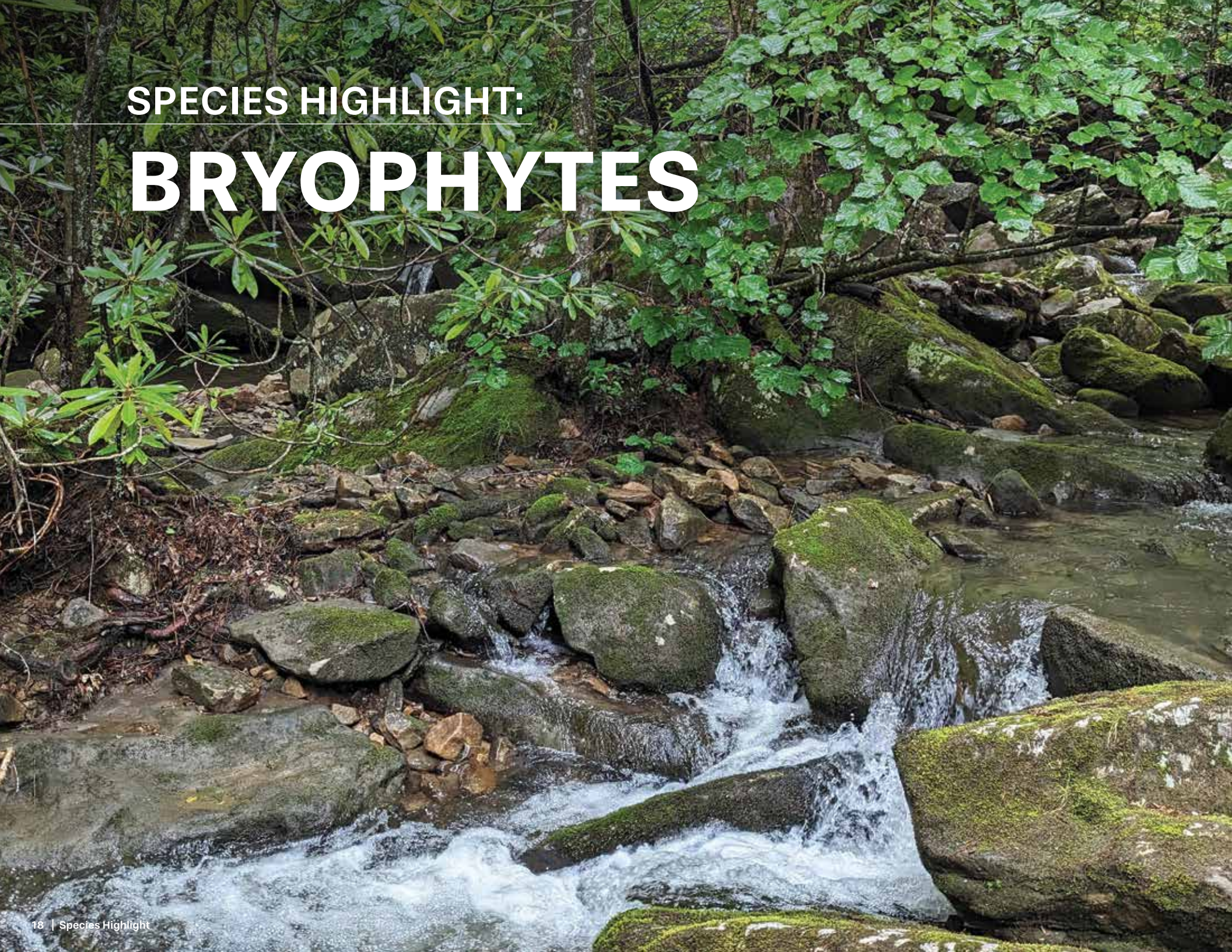
MOVING INVASIVE SPECIES EFFORTS TO A STATEWIDE LEVEL

PNHP is promoting the Partnerships for Regional Invasive Species Management (PRISM) program in many ways, including through the recent creation of an Invasive Species Legislative Dashboard. This tool was made for legislators, their staff, and constituents to learn about noxious weeds in Pennsylvania's legislative districts. Program staff also attended several events including a hearing on invasive species and a meeting on the challenges and opportunities associated with invasives in northwestern Pennsylvania.

An article published by the Allegheny Front titled "Hunting for Invasive Snails in Lake Erie" highlighted invasive mysterysnails, one of the species on the 2023 Invasive Species Scavenger Hunt checklist, an event hosted by PNHP staff. Additionally, six presentations were hosted by program staff featuring experts speaking on topics including the connection between ticks and invasive plants, restoring a floodplain forest from invasive knotweed, and the use of goats to manage multiflora rose on a national wildlife refuge. WPC

SPECIES HIGHLIGHT:

BRYOPHYTES



BRYOPHYTES

Bryophytes are an ancient group of plants that includes hornworts, liverworts, and mosses. Recent estimates suggest that this group of plants have been on the planet for ~500 million years predating all other land-dwelling plants. That's a long time to adapt and evolve in an ever-changing world leading to a diversity of beautiful forms that are often unseen, overlooked, or dismissed as "green stuff" on a tree or rock. With nearly 20,000 species worldwide, bryophytes represent approximately 5% of the total global flora. In North America, there are about 1,900 recognized species and nearly 30% of those species are found in Pennsylvania.

These small, flowerless plants occupy a wide variety of habitats in Pennsylvania, ranging from urban/suburban landscapes to remote rocky outcrops in the forests, and from a plethora of wetland types to dry barrens and woodlands. Within these habitat types, bryophytes perform several ecosystem services. They are critical to carbon and nitrogen cycling, important for providing habitat for invertebrates, amphibians, and reptiles, and known to act as nurseries for seed plants. Bryophytes are ubiquitous in Pennsylvania, yet, until recently, there wasn't a current compiled list of all bryophyte species that PNHP could use to identify those in need of conservation actions.

Diversity and Distribution:

For the past decade PNHP has been studying bryophyte biodiversity (a.k.a. bryodiversity) in Pennsylvania. Using previously published checklists and data from over 58,000 specimens available through Symbiota Bryophyte Portal, we were able to identify data deficient counties, those having few species relative to the number of available habitats. Collections from these counties, conducted with help from the bryologist community in combination with field surveys in different plant communities, worked towards filling those data gaps. In addition to beginning to fill data gaps, we cleaned the specimen data removing duplicate records, ultimately resulting in a list of over 22,000 unique specimen records and representing the 547 species currently recognized in Pennsylvania. The bryodiversity of Pennsylvania includes 3 hornwort, 118 liverwort, and 426 moss species. Combined they represent between 10 and 15 percent of the total plant diversity in the state. Among these species approximately 260 will be tracked to gather relevant occurrence and distribution data that will further inform us about the appropriate conservation categories for these species. Most species are distributed throughout the state, with the exception of those that occupy specialized habitats such as peatlands, barrens, and mature forests.

Barrens: Dry but not Depauperate

People often associate bryophytes with moist, shaded conditions in forests with streams and waterfalls. However, many bryophytes have evolved to withstand the hot, dry habitats of different types of barrens. The ability of some mosses and liverworts to completely dry out during extended exposure to the hot sun has provided those species the opportunity to occupy harsh microhabitats. Specifically, *Rhytidium rugosum* (golden glade moss) which grows over exposed outcrops in calcareous shale and limestone barrens in Pennsylvania.

Another example of a dry-adapted bryophyte is the leafy liverwort *Frullania riparia* (river scalewort). Contrary to the species name, this liverwort is found on rocks and rarely trees in outcrop and cliff communities often associated with limestone or other calcareous geologies.

Sphagnum: Peatland Ecosystem Engineer

Whether forested or open, peatlands have one thing in common, the genus *Sphagnum* and some combination of its 43 species known to Pennsylvania. These globally important ecosystems are responsible for sequestering massive amounts of terrestrial carbon. Because of the vast coverage these ecosystems have in some parts of the planet, it is thought that *Sphagnum* likely has more carbon bound in living and dead plants than any other plant genus. Peatlands form when decomposition is slower than production, often in inundated, acidic, and nutrient poor conditions that are ideal for *Sphagnum* colonization and proliferation. Once established, Sphagnum species slowly change the ecosystem making it more conducive for this keystone moss and providing it with a competitive advantage over other plant species. Within a given peatland, *Sphagnum* species are differentiated by niche, exhibit evolutionarily conserved variability in decomposition rate, and provide refuge for animals that require relatively stable wetland habitats.

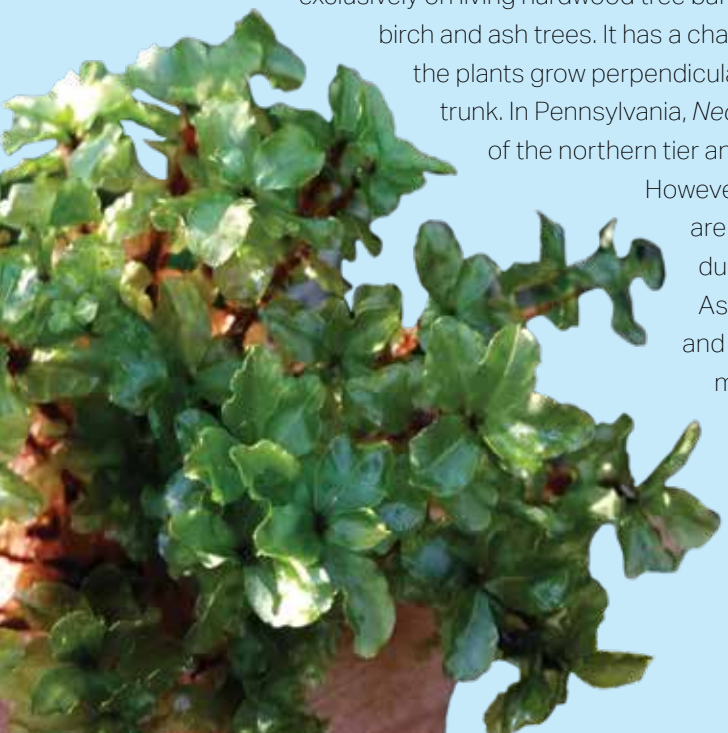
Niche Specialist Bryophytes

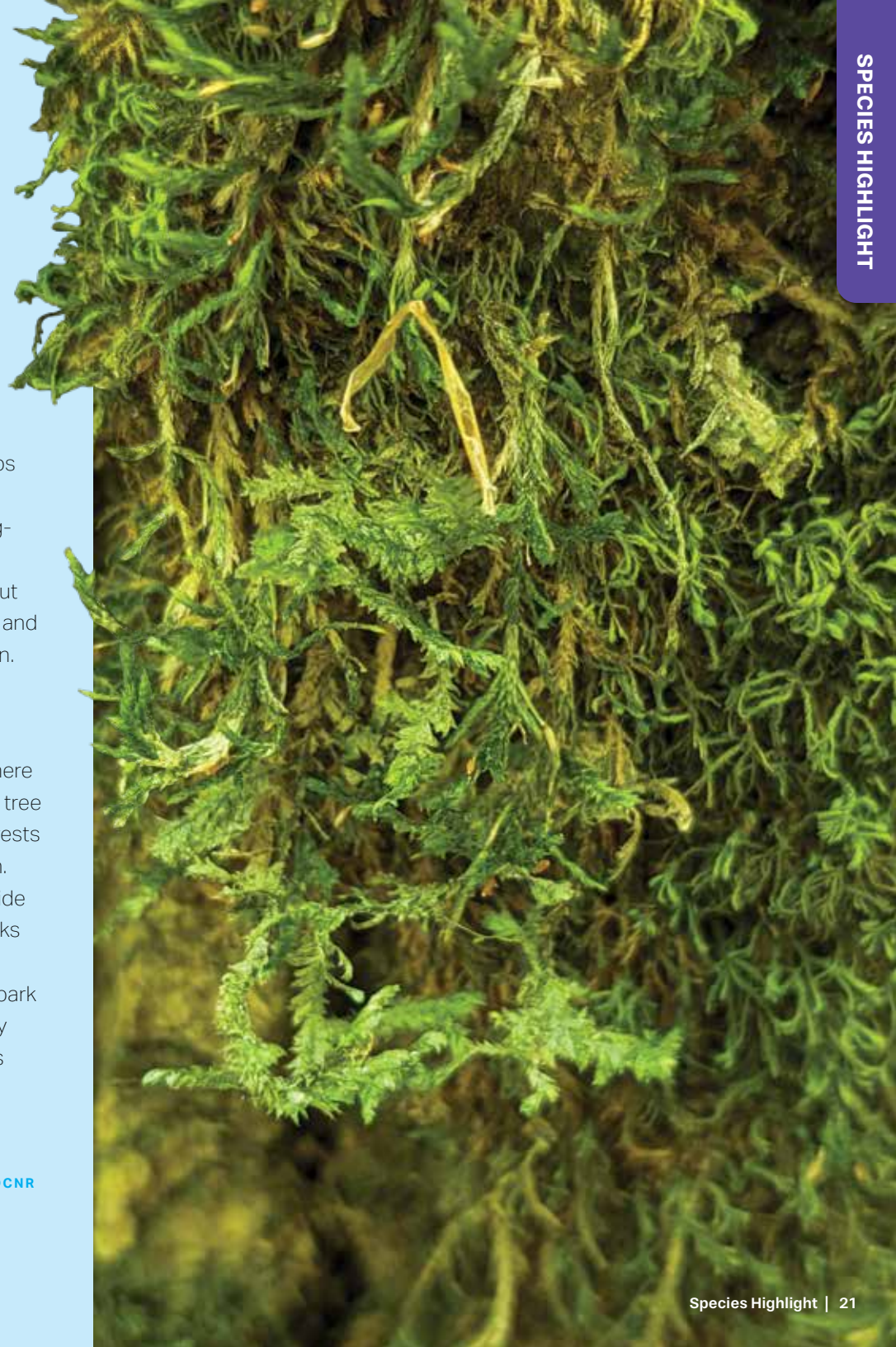
Some species, common or rare, are considered niche specialists and often considered indicative of a particular type of habitat.

Nowellia curvifolia (pouncewort) although common and widespread, this species occupies a very specialized microhabitat in the forests of Pennsylvania. This attractive, small leafy liverwort grows exclusively on logs that are in advanced stages of decomposition where the bark is no longer present. The wood of these logs is soft and spongy to the touch. You can see "*Nowellia* logs" using the characteristic rusty, orange-brown color as a search image. These logs are found in forests that have intact canopies and relatively high humidity and suggest mid to late stages of succession.

Rhizomnium appalachianum is a charismatic mega-moss found in our forested seeps and palustrine forests where there is notable microtopography that leads to the formation of pools or otherwise saturated to inundated soil conditions. This is a long-lived species that indicates wetland hydrology in relatively stable forested wetlands. These beautiful plants are large and surprisingly vascular plant-like in appearance, but close inspection with a hand lens will reveal the leaves are but 1 to 2 cell layers thick and the stems are covered with reddish "fuzz" that is specialized for asexual reproduction.

Neckera pennata, is tabbed as an old growth forest indicator. This species grows exclusively on living hardwood tree bark with a tendency towards birch and ash trees. It has a characteristic wefting habit where the plants grow perpendicular to the vertical axis of the tree trunk. In Pennsylvania, *Neckera* is known from the forests of the northern tier and near the Poconos region. However, mature ash trees statewide are experiencing large die backs due to the emerald ash borer. As those trees die, lose their bark and fall to the ground, a primary microhabitat for this moss is no longer available. This greatly increases the conservation need for *Neckera pennata*. WPC DCNR



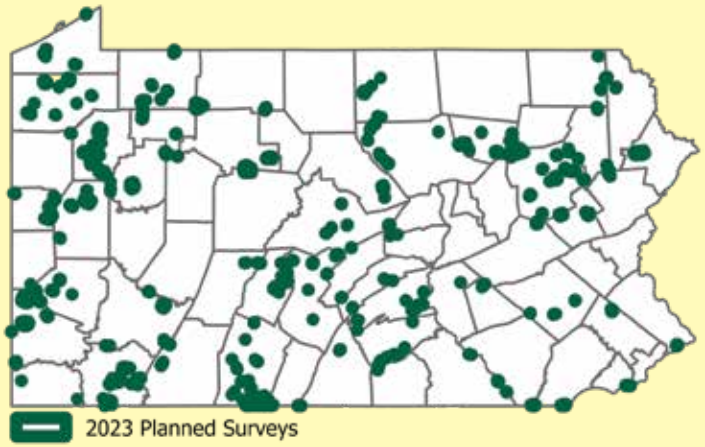


INFORMATION

PNHP information is far from static. Each year brings new records and new ways of distributing our information. Additionally, this information is critical in planning our field work. 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.

"The Pennsylvania Natural Heritage Program has been at the leading edge of results-oriented conservation in Pennsylvania since its establishment in 1982. By offering tools like Conservation Explorer that are populated with biological diversity information, the PNHP provides the framework for data-driven conservation planning to proactively keep common species common and move vulnerable species toward recovery."

– TIMOTHY SCHAEFFER, Executive Director
Pennsylvania Fish and Boat Commission



In 2023, seventeen biologists entered nearly 350 planned survey sites into the FIND Planning App that span across 57 of the 67 Pennsylvania counties.

NEW TOOLS FOR FIELD SEASON PLANNING

Before any of our field biologists step outside, a lot of work goes into planning for a successful field season. Released in early 2023, the FIND Planning App (FIND PA), a web-based GIS application, provided a powerful tool for efficient and collaborative field season planning. This innovative platform provides a centralized location to enter and store PNHP planned survey site data making it simple to view field work planned for the 2023 season. FIND PA helps identify overlapping survey interests and glean program-wide statistics for the upcoming field season. Last spring, FIND PA was used to drive the first ever PNHP-wide field season planning session where biologists shared 2023 field season plans and identified opportunities for collaboration. Moving forward, FIND PA will play an integral role in the process to improve the efficiency of the PNHP workflow from field season planning to conservation planning products.

PROCESSING BAT DATA FROM PGC DATABASES

Pennsylvania's bat species are of increasing conservation concern due to White Nose Syndrome and other threats. The Pennsylvania Game Commission (PGC) has been working to create new and improved databases to manage their bat survey data. PNHP Information Management worked with PGC biologists and database managers to help design exports from the new databases that will improve the transfer of data for processing and improve tracking of the records that have been submitted, processed, and added to Environmental Review. As a result, we were able to streamline PNHP bat data processing with partial automation. Using the new system, this year we completed two successful data loads into Biotics totaling 634 individual observations. More complete and up-to-date information will mean better protection for bat species across the commonwealth. **PGC WPC**

Big Brown Bat (*Eptesicus fuscus*) captured in Bedford County

PLANT REGULATIONS UPDATE

In 2023, DCNR updated the legal classifications of 82 plants through a rulemaking process in PA Code Chapter 45. DCNR is responsible for maintaining the list of classified plants in Pennsylvania which has only been updated twice since the mid-1990s. This update added 24 plants in need of conservation, reclassified 28 listed plants, and removed 30 plants no longer conservation concerns. Botanists from PNHP and DCNR combed through herbarium specimens, plant taxonomy and nomenclature sources, and peer-reviewed journals, consulted experts, and conducted field work to answer questions about the plants' statuses in Pennsylvania. Wild Resource Conservation Program grants helped facilitate work needed for many species. As a result, we have a clearer picture of many species' statuses in Pennsylvania. DCNR and PNHP are working together in preparation for another plant status update in the future. **DCNR WPC**

Total Number of Element Occurence Records in Biotics

TAXONOMIC GROUP	COUNT
Vascular Plants	16,280
Reptiles & Amphibians	4,334
Other Invertebrates	1,832
Non-vascular Plants	73
Mussels	1,358
Mammals	1,699
Fish	1,025
Communities	1,480
Butterflies & Moths	1,168
Birds	2,685
Total	**31,934**

Element Occurrence Records Added to Biotics in 2023

TAXONOMIC GROUP	COUNT
Vascular Plants	73
Reptiles & Amphibians	3
Other Invertebrates	3
Non-vascular Plants	1
Mussels	25
Mammals	273
Fish	17
Birds	20
Total	**415**

In 2023 the Heritage Program added over 400 new records to the Biotics database. These new records represent over 1,600 individually mapped locations of plants, animals, communities, and natural features. In addition to mapping new locations, we updated over 2,000 existing features with newer survey information.

APPLICATION

Our work is conservation focused, and we look to address issues that stand in the way of efforts to conserve species and biodiversity. Better understanding species, the complexities of their genetics and distribution, and their communities are necessary for effective conservation.

"The Pennsylvania Natural Heritage Program provides critical information that influences DCNR's management of more than 2.4 million acres of state park and forest lands, helping to ensure biodiversity is conserved for future generations. The Pennsylvania Natural Heritage Program also provides private landowners, county and regional planners, and consultants with the tools to responsibly plan and develop, while minimizing impacts to our natural resources."

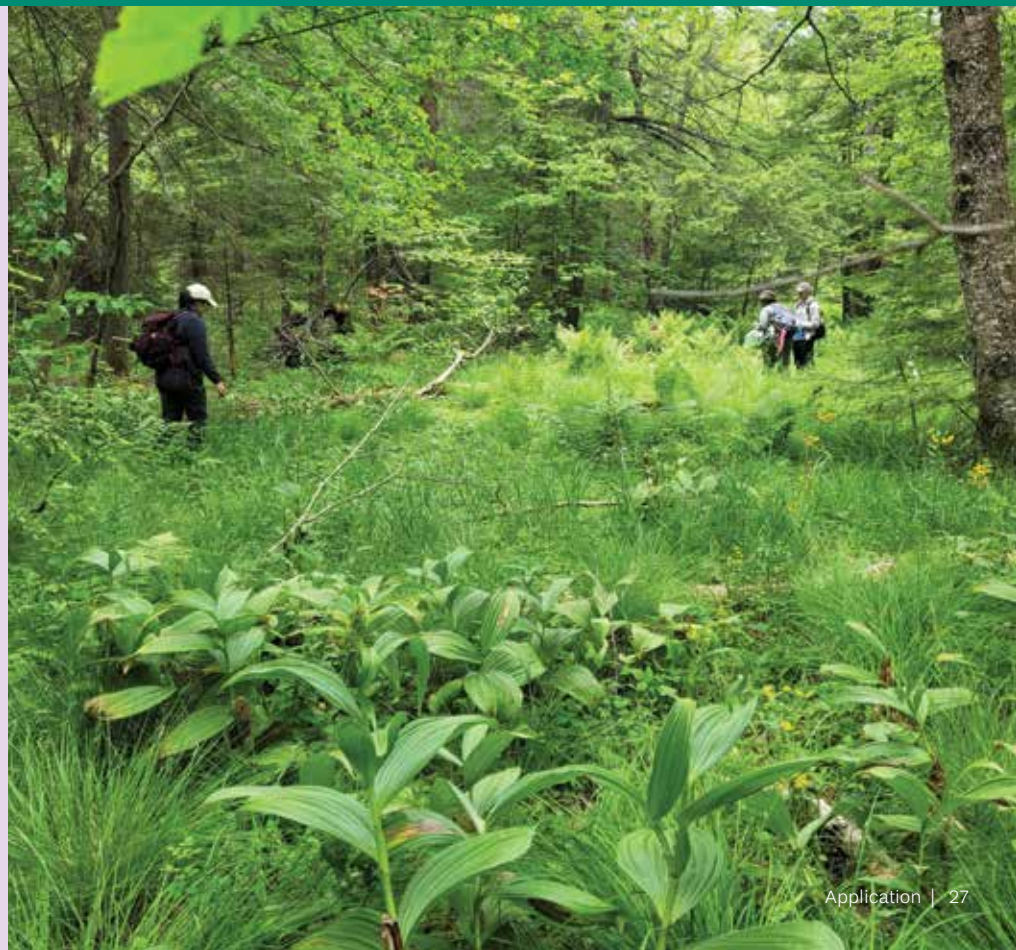
– CINDY ADAMS DUNN, Secretary
Pennsylvania Department of Conservation and Natural Resources

OLD GROWTH FOREST PROJECT UPDATE

Old growth forest surveys continued this year to refine a rapid condition assessment methodology and inventory new stands. PNHP conducted ecological surveys in 18 forests and implemented bryophyte, terrestrial invertebrate, and avian sampling in old growth forests to determine if Pennsylvania has any obligate old growth species. We hope the inventories will highlight what aspects of old growth forest the species need, so we can identify management actions that would increase and replicate those features in younger forests. PNHP also collaborated on old growth forests with several partners, such as the Pennsylvania Game Commission (PGC) and other Heritage programs in the northeast. Collaboration with the PGC included working on an old growth management plan and performing surveys to understand if a rare species' habitat could be considered old growth. A highlight of 2023 was investigating old growth Dry Oak – Heath Forests, since the majority of old growth forests in the state are dominated by eastern hemlock. **WPC DCNR**

PNHP PARTNERING WITH THE PENNSYLVANIA PLANT CONSERVATION ALLIANCE (PPCA)

PNHP worked with the PPCA to advance conservation of the rarest plants in Pennsylvania using both time-tested and new techniques. We help to maintain the condition of some sites with globally rare plants through ecological stewardship. When exotic species begin to dominate or alter the chemical and/or physical nature of these sites, we work together to prioritize careful removal that supports both site and population health. We have also begun to strategically collect seed and plant cuttings for maintenance in off-site conservation collections at regional seed banks and botanic gardens. This approach amounts to keeping our (rare plant) "eggs" in multiple baskets.
At the same time, we are working to understand the genetic basis of our populations in numerous ongoing, often range-wide studies in collaboration with academic partners. By extending our focus beyond Pennsylvania, we aim to learn about the regional importance of our populations, and how we might work with our neighbors to effectively conserve these species. **DCNR WPC**



COLLABORATION AND COMMUNITY

Collaboration helps PNHP expand our knowledge and capacity while helping our partners manage ecological resources through our expertise and unique datasets.

CONTINUED RESTORATION OF LITTLE ARNOT RUN

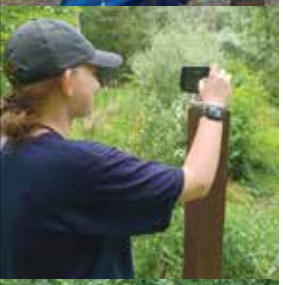
PNHP staff continued to participate in the process-based restoration activities in the Little Arnot Run watershed where Allegheny National Forest managers are using large woody materials to restore and reconnect the stream channel and floodplain wetlands that were modified during logging and development activities. Together, with Western Pennsylvania Conservancy's Watershed Conservation Program, U.S. Forest Service - Allegheny National Forest, Pennsylvania Department of Environmental Protection, and researchers from Bucknell, Lockhaven (Commonwealth), and Gannon universities, we are learning more about how these ecological restoration activities will impact all aspects of the floodplain ecosystem and ecological processes in the area. **WPC DCNR**

INVERTEBRATE CONSERVATION RANKING FOR THE PENNSYLVANIA WILDLIFE ACTION PLAN

Assessing species' conservation statuses is part of the process to update Pennsylvania's Wildlife Action Plan (PA-WAP), which prioritizes animals for conservation actions for state agencies and partners. With partners at Penn State University and the Academy of Natural Sciences of Drexel University, PNHP staff are determining the conservation statuses of approximately 1,400 invertebrates for the 2025-2035 PA-WAP. This includes compiling information from museums, databases, and other sources for groups like pollinators, beetles, and spiders, which have been traditionally underrepresented in conservation assessments. Lists of Pennsylvania invertebrate species and their habitats will be updated, and distributions, conservation ranks, and threats will be assessed to determine if each species can be classified as a Species of Greatest Conservation Need for its inclusion as a PA-WAP priority. **WPC PGC PFBC**

SPREADING THE WORD

In addition to social media and our quarterly newsletter, we also share information and expertise through education and outreach. From taxonomy workshops to helping landowners understand the resources on their property, we look at these opportunities as extremely valuable in mobilizing other scientists and the public in conserving biodiversity.



VERNAL POOL MONITORING USING CITIZEN SCIENCE

We continue to work with volunteers and partners to monitor vernal pools. This year we expanded a citizen science program at two state parks in southeastern Pennsylvania. We installed 30 water level staff gauges and 15 photo stations, and enrolled one wetland in the regional Vernal Pool Phenology Project. Additional monitoring techniques include acoustic monitoring and game cameras. Trained volunteers and park visitors use the stations to gather data on these dynamic wetland habitats including hydrology, phenology, and wildlife usage. Learn more:

- Chronolog stations at Gifford Pinchot State Park and Kings Gap Environmental Education Center: **https://www.chronolog.io/project/WPC**.
- CrowdHydrology stations: **http://www.crowdhydrology.com/**
- Videos on wetland restoration and citizen science monitoring on the PNHP YouTube channel **http://tinyurl.com/3f4pppjb**
- Pennsylvania Vernal Pool Pocket Guide: Available on the PNHP website under Ecological Communities > Vernal Pool Communities > Resources

WPC DCNR

DICHANTHELIUM WORKSHOP

In October PNHP Ecologist Claire Ciafré taught a workshop on witch grasses (*Dichanthelium* spp.) at the PA Botany Symposium in State College. The workshop drew botanists from five states and a wide variety of backgrounds, including PNHP staff and partners. Participants learned the identification and ecology of over 30 species and varieties, about a third of which are tracked in Pennsylvania. Increased documentation in and around the state would greatly improve the conservation of this overlooked genus of grasses, and we're happy that there will be a lot more eyes on the ground looking for them in 2024! **WPC DCNR**

PRESERVING THE PHOTOGRAPHS OF A TALENTED PENNSYLVANIA ODONATOLOGIST

Mr. Clark Nelson Shiffer worked as a biologist for the Pennsylvania Fish and Boat Commission for 26 years. He was an excellent naturalist with an affinity for damselflies and dragonflies (odonates). Clark was well known for his photography, meticulous record keeping, and long-term studies, including a remarkable 56-year inventory of the odonates of Ten Acre Pond in central Pennsylvania. We digitized over 2,500 images from Clark's 35mm slide collection using funds from a Wild Resource Conservation Program grant and volunteer effort. These photos feature most Pennsylvania species and captured unique behaviors and characteristics. The digitized images were shared with Odonata Central (https://www.odonatacentral.org/#/), an online repository for photos and data. These images will soon be made publicly available under the username "Clark Shiffer Archives." Our thanks to the Shiffer family for sharing Clark's slides with us. **WPC DCNR**

STAFF CHANGES

ETHAN DAVIS joined the DCNR Conservation Services team in January 2024 as the Chief, Ecological Services Section. Prior to joining, he worked at a number of organizations doing work with forests and other systems across a range of issues. He has a B.S. from Cornell University, an M.S. from Aalborg University (Denmark), and a PhD from The Pennsylvania State University.

HANNAH HUBER started her position in October 2023 as the first Conservation Mycologist with the Heritage program. She has a B.S. in Integrative Studies in Biology and Environmental Science from Paul Smith's College and an M.P.S in Applied Ecology from State University of New York.

MEGAN KRESSE joined the Heritage team in December of 2022 as a GIS Technician. She graduated with a bachelor's degree in Environmental Science and Sustainability from Allegheny College in the spring of 2022.

ADAM HNATKOVICH returned to the Heritage Program in April 2023. He has a B.S in Environmental Science from California University and an M.S. in Applied Ecology and Conservation Biology.

MITCH MEUSER started his work as a seasonal ecologist with PNHP in June. He graduated from Penn State University and recently worked as a forestry technician and a field research crew leader.

HELENA YU joined Heritage Data Management as a Data Science Intern in May of 2023 and worked with us through the end of the summer. She is currently a junior at Carnegie Mellon University where she is double majoring in Statistics & Machine Learning and Artificial Intelligence.

NOAH YAWN joined the Heritage program in June 2023 as an ecologist. He is a recent graduate of Auburn University where he completed a double major in Integrative Biology and Geology.

Four seasonal biologists joined our staff to conduct ecological surveys in the Allegheny National Forest over the summer of 2023 as part of the Bureau of Forestry's Good Neighbor Agreement with the U.S. Forest Service (USFS).

DELANA KIRWAN earned her B.S. from Pennsylvania Western University, California Campus in May 2023.

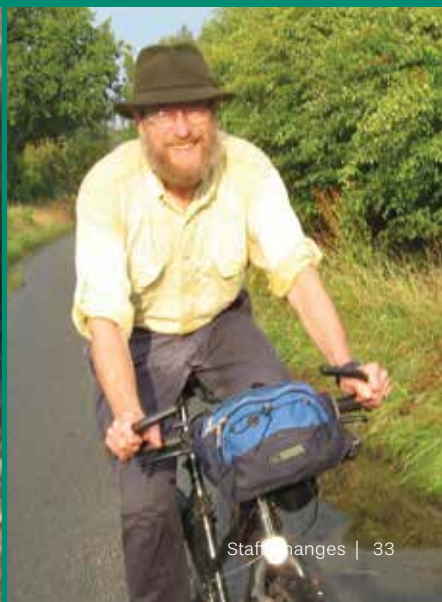
EMILY WOJTYNA has a Master of Science in Ecology, Evolution, and Systematics from the Ludwig Maximilian University (LMU) of Munich, Germany and a certificate in Environmental Studies from the Rachel Carson Center for Environment and Society at LMU.

CAITLIN O'HARA graduated from Clarion University of Pennsylvania with a bachelor's degree in Environmental Biology.

AUSTIN SWANSON graduated from Penn State University in 2017 with a degree in Wildlife and Fisheries Science.

A FOUNDER RETIRES

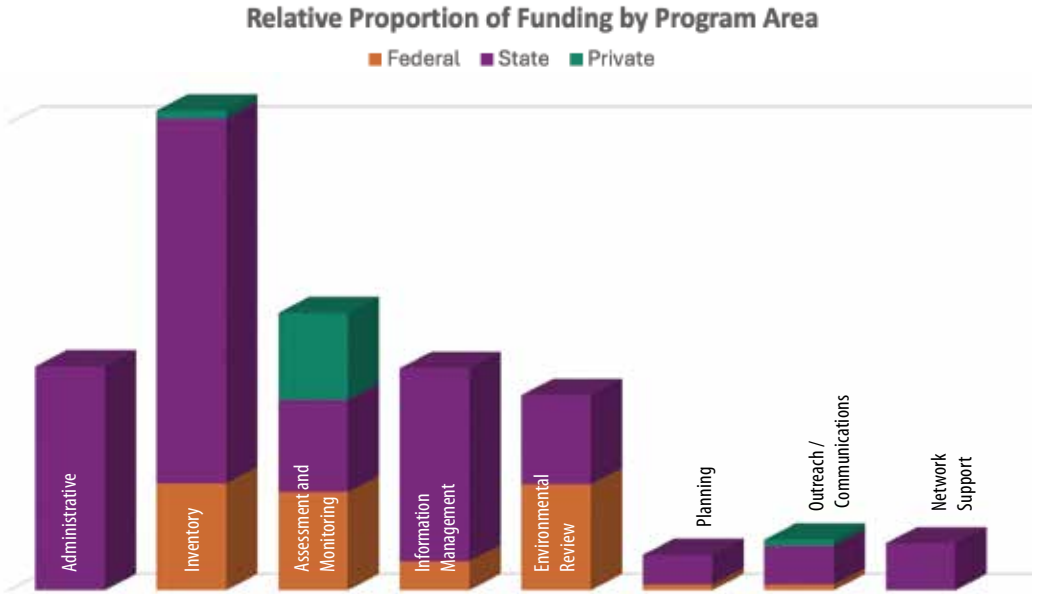
After over 40 years with WPC, Charles Bier, Senior Director of Conservation Science and former Director of the Natural Heritage Program at WPC, retired at the end of 2023. In 1982 Charles and Paul Wiegman began collecting records of rare species from museums, biologists, and anywhere that high quality records could be found. During his tenure, Charles conducted more than 1,000 field surveys and documented over 1,500 element occurrence records. The records he collected are still foundational to the over 30,000 records in our database. Fortunately, Charles will continue to volunteer at the Conservancy where our staff can continue to learn from his experience. Thank you, Charles, for all your dedication and years of service!



FINANCIALS

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.



Percentage of total funding: 70% state, 23% federal, 7% private

WE WOULD LIKE TO RECOGNIZE THE MANY ENTITIES AND PROGRAMS THAT SUPPORTED OUR WORK IN 2023:

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

The Richard King Mellon Foundation

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