Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

WILD HERITAGE NEWS

Summer 2018

Inside This Issue

Tough Nuts to Crack	1
Emerging Invasive Plant Threats	6
EYE Con Summer Camp	8
Spotted Turtle Conservation	8
State Park Vernal Pool Surveys	9
New Cooperative Weed Management Area	9
Tick Borne Disease Collaboration	10
Indian Creek Caverns	11
Rare Plant Finds at Bear Run Nature Reserve	11
Mudpuppy Project	12
Spring Insect Survey Photo Highlights	13

Photo Banner:
Netted chain fern
(*Woodwardia areolata*)

Jessica McPherson

Tough Nuts to Crack

Zeroing in on Some of Our Most Mysterious Plant Species

by

Jessica McPherson

Scientific understanding of our native biodiversity is a constant work in progress. We continue to uncover the intricacies of our native plant species habitat requirements, biological needs, and ecological interrelationships such as animal pollinators and seed dispersers. To determine the conservation needs of our native species, the Natural Heritage Program synthesizes the best available science on what we know a species needs to survive with population data and information on any threats it faces. For plants, the sheer numbers of species pose a significant challenge; there are over 2,100 native plant species in Pennsylvania, and about 800 species are of conservation concern.

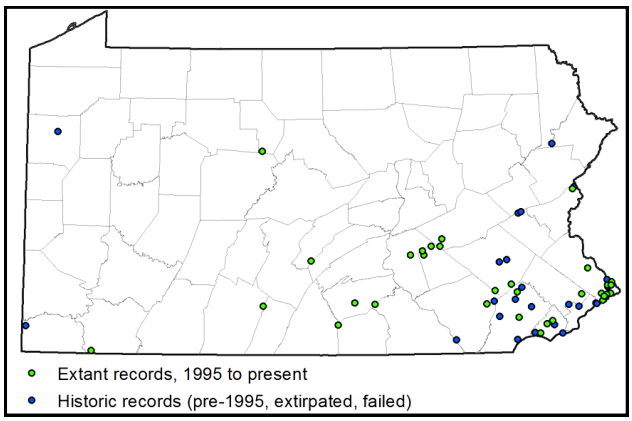
The Plant Status Update Project completed in 2016, was a focused investigation of 56 plant species that DCNR determined lacked sufficient data to evaluate the appropriate conservation status. Along with PNHP botanists, botanical experts from institutions across the state contributed to the project, including the Morris Arboretum, the Carnegie Museum of Natural History, and Cleveland Museum of Natural History. The stories of some of these species illustrate the interesting complexities of our native diversity, some trends in conservation, and some of the data gaps that often challenge our ability to assess the conservation needs of plant species.

Netted Chain Fern

The netted chain fern (*Woodwardia areolata*) was previously known almost exclusively from the coastal plain in Pennsylvania, but new field work suggests

© Arthur Haines
New England Wildflower Society

Meadow rose (*Rosa blanda*) - native or not? This plant remains a mystery.



PNHP records of netted chain fern (*Woodwardia areolata*). Historic records (blue dots) are concentrated in southeastern Pennsylvania. Extant records (green dots) may represent population expansion in the central part of the state.

it appears to be expanding west and north. Several populations have been found outside of the coastal plain, and since some of them are in places that have been fairly well surveyed in the past, our biologists believe they are newly established populations. We're not sure why it is expanding, but it could be related to changes in climate as Pennsylvania is at the northern edge of this species' range. Because new data reflect a larger number of populations and an expanding range, we updated the recommended status for this species from Pennsylvania Threatened to Pennsylvania Rare.

Red Mulberry

The red mulberry (*Morus rubra*) was first proposed as Pennsylvania Threatened in 2013, and it was a very unusual proposal, because we have over a hundred historical records of this tree spread across the southern half of the state. It came to our attention when someone investigated which species have had a decline in museum collections in recent years. For the red mulberry, there was a very striking pattern of many historical collections but almost no recent collections. Furthermore, when we inquired among expert botanists in the state, many of whom had been working in Pennsylvania for decades, only a few of them had ever seen it. However, to support assigning a legal conservation status to a species that once appeared to be relatively common, we needed to do some focused surveys to make sure it wasn't still out there, and some digging in scientific literature to understand any possible reasons for this apparent dramatic decline.

Jessica McPherson

Leaves of a red mulberry which tend to be heart-shaped and unlobed when growing in shaded conditions,

Our surveys, unfortunately, did not find much. We now know of about 16 plants in eleven locations across the state. Half of these are just a single seedling at a site. Our literature review, however, found that similar declines have been observed in many parts of its fairly wide geographic range. Studies have shown that the red mulberry and the non-native white mulberry (*Morus alba*) hybridize, and the red mulberry loses out. Not only does the red mulberry lose its distinctness as a species, its reproduction is inhibited by the hybrids, and its genes are underrepresented in these white–red crosses.

Jessica McPherson

Leaves and trunk of a young red mulberry tree

White mulberry is widespread in eastern Pennsylvania, so hybridization could be an important reason for the decline of the red mulberry there. However, we suspect that there may be other factors at play as well, because even in remote areas where white mulberries have not escaped, our searches for the red mulberry have been largely unsuccessful. Many literature reports have referenced decline due to disease, although there is not clarity or agreement on exactly what disease agent is responsible.

The remarkable – and cautionary – element of this story is that a native tree species seems to have all but vanished from the state over several decades without anyone really noticing, and we still don't have enough data to effectively combat the threats that have caused its decline. However, we have taken the first steps in recognizing these threats and recommended a conservation status of Pennsylvania Threatened.

Robert Coxe

Tall meadow rue (*Thalictrum pubescens*) - upright stamens

R.W. Smith
Lady Bird Johnson Wildflower Center

Purple meadow rue (*Thalictrum dasycarpum*) - drooping stamens

Tall Meadow Rue

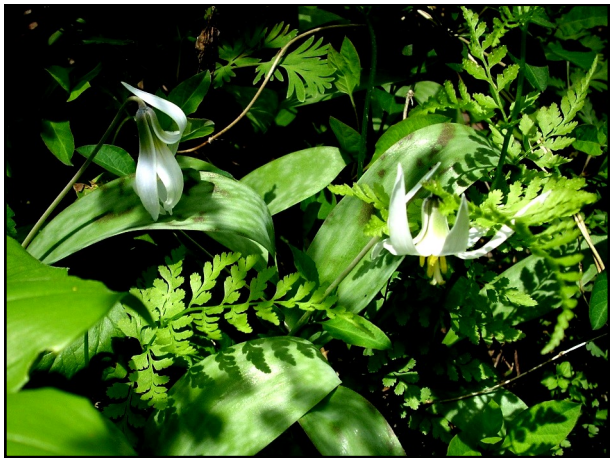
Tall meadow rue (*Thalictrum pubescens*) is a common plant of Pennsylvania wetlands and is distributed throughout the state, with a global range concentrated in northeastern North America. However, it has a cousin, the purple meadow rue (*Thalictrum dasycarpum*) with a similar geographic range, concentrated in the Midwest with a string of outlier populations in Ohio at the eastern edge of its range. Several plant specimens had been collected in northeastern Pennsylvania and labelled as the purple meadow rue, so this species had been recommended as Pennsylvania Endangered. However, as is often the case with closely related species that have adjacent geographic ranges, the shared edge of their ranges is a zone where identification can get a little bit tricky, due to past or present hybridization. Our botanists reviewed the herbarium specimens and determined that all except one of them were actually the tall meadow rue. We visited the site of the single purple meadow rue specimen but were unable to relocate the plants. Therefore, we now recommend that this species be considered Pennsylvania Historic.

White Trout Lily

The white trout lily (*Erythronium albidum*) did not have a status recommended at the start of the project. We knew it was less common than the yellow trout lily (*Erythronium americanum*), but we weren't sure how much was out there. We had a vague understanding of its habitat and little sense of what threats it might be facing. This species had long been overlooked because it blooms very early in spring, the flowering window is short, and it can't be distinguished from the yellow trout lily by leaves alone. We mapped out the dates for all past observations of the species and identified a two-week survey window, approximately April 15 to May 1.

One of our partner botanists, Loree Speedy, also found a way to extend the survey window a few weeks past flowering by distinguishing subtle characteristics of the fruit shape. With this information, several partners did fieldwork in different parts of the state and found several new populations, refining their understanding of white trout lily habitat. It likes higher pH soils, which are uncommon in Pennsylvania, and often lives on rich floodplains. With a total of 42 populations documented (a relatively high number), evaluation of the threats facing this species was important to assessing the appropriate status.

PNHP now uses a tool created by NatureServe called the Rank Calculator, which provides a systematic way to evaluate threats. In this case, there is no single major threat causing dramatic decline in white trout lily, so we were somewhat surprised to find that this species could be facing a "death from a thousand cuts" in which it could lose a significant proportion of currently known populations over the next several decades. For example, adding together a projected 3% decline from 15 different threats (i.e., residential development,



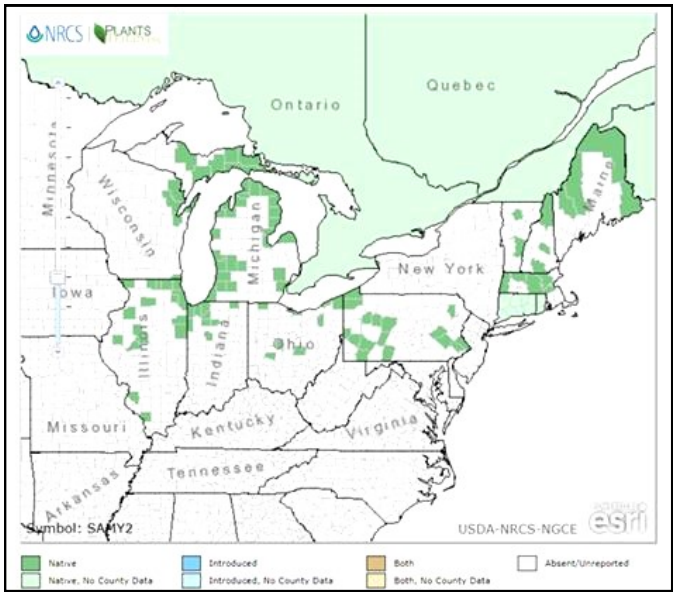
John Ambler
Shenk's Ferry Wildflower Preserve

White trout lily growing in a rich floodplain

outdoor recreation, invasive species, timbering, extreme flooding, etc.), results in a total projected decline of 45%. Without the systematic approach of the rank calculator tool, the high threat level faced by the white trout lily may not have been apparent. Considering the new information on population numbers, somewhat limited available habitat in Pennsylvania, and threat level, we now recommend a status of Pennsylvania Rare for this species.

Blue Willow

The blue willow (*Salix myricoides*) has a limited global distribution, concentrated around the edges of the Great Lakes but also scattered inland in Minnesota, Ohio, and Pennsylvania. In Pennsylvania, it was known from Presque Isle and several fen habitats in the northwestern part of the state, but herbarium specimens had also been collected from other locations where the habitat didn't seem to match. Because willow species are notoriously difficult to tell apart, we suspected that these were either misidentified, or that the species was more common than the specimen record indicated.



Counties in green on this map show the limited global distribution of the blue willow around the edges of the Great Lakes and scattered inland.

Our partner, Jim Bissell at the Cleveland Museum, investigated blue willow, reviewing the herbarium specimens and searching for it in the field. He found that the specimens actually were correctly identified, and closer examination of their habitats revealed that they were all recorded from major river shores, which provide a similar kind of habitat to the Great Lakes shores. However, Jim has also monitored populations over several years in northwestern Pennsylvania and saw them greatly diminished by deer browse. Continued fieldwork at fens has turned up very few new populations. In this case, an investigation of the species reinforced a previous recommendation: the blue willow should be considered Pennsylvania Endangered.

Jessica McPherson

The leaves of blue willow are dark green on top, with a thick white waxy layer on the underside.

Setose Blackberry

The setose blackberry (*Rubus setosus*) was a mystery when we started the project. It had not been seen in Pennsylvania since 1963. The genus *Rubus* is notorious for frequent taxonomic revisions, so we questioned whether this species was distinctive. However, the *Rubus* experts we contacted assured us it is a true species, even if none of us had ever seen it. So, we reviewed herbarium specimens collected from other places to get a sense for the plant, and then went out into the field to look for it.

A specimen of the elusive setose blackberry collected by PNHP ecologist Rocky Gleason

In this case, we found that historical specimens offered guidance about the kind of habitat to look in, but they were not useful in relocating populations of the setose blackberry. Some plants prefer more open, transient types of habitats, and naturally move around on the landscape; in these cases, historical specimens are unlikely to be relocated after more than a few years. However, their habitat and location data did indicate that the plant is found in the coldest regions of Pennsylvania in a variety of wet settings. Once our botanists focused on this species with a refined search image, they were able to discover three new populations in northeast Pennsylvania.

Jessica McPherson

The characteristic bristly (setose) stem and leaves with five leaflets of setose blackberry.

Efforts to relocate the setose blackberry in the high elevations of the Allegheny Mountains in southwest Pennsylvania, however, were not successful. To date our results suggest that the range of the species may have diminished consistent with a warming climate, but it is capable of establishing new and vigorous populations in early successional habitats that are abundant in northeast and northcentral Pennsylvania. Although we rediscovered a species that was largely missing in Pennsylvania, we were not yet able to assign a conservation status. More populations likely exist, and we will continue to search for them.

Although these stories highlight the progress that we can make with focused investigations into individual species, there are also many cases where the data just isn't there yet and some instances where it may never be adequate. The meadow rose (*Rosa blanda*), for example, appears to be native in Pennsylvania based on its nativity in adjacent states, but it is also cultivated. Its natural habitat is disturbed, open places, and the few historical collections that exist from Pennsylvania have label data like "near a bridge, Allegheny County" where it is impossible to determine whether it might have arrived naturally or is an escape from cultivation. Genetic comparisons of cultivated and wild stock could eventually shed some light on this question, but for now, it is impossible to even say conclusively if the species is naturally occurring in the state or to evaluate the number of populations and assign a conservation status.

These stories illustrate how some of the ongoing challenges affecting our native species, including deer browse impacts, habitat loss, and disease, can impact species viability over decades. They also suggest, although certainly do not prove without much more in-depth investigation, that long-term changes in distributions might be occurring in response to climate changes. With the results of this project, DCNR has better information to use in determining the appropriate legal conservation status to assign to some of our more mysterious plant species.

About the Author

Jessica McPherson has worked with PNHP since 2001, first as a botanically-oriented Ecologist and now as an ecologically-oriented Botanist. She is interested in how environmental factors shape where and how plants grow. She is happy to work with PNHP in continuing to expand our understanding of Pennsylvania's extensive botanical diversity and its conservation needs.

Be on the Lookout for Emerging Invasive Plant Threats

by

Mary Walsh

Invasive species are one of the greatest threats to biodiversity. When species are introduced to natural areas outside their native range, they may not have the population control mechanisms (e.g., predation, disease, or competition from similar species) that limit their numbers in their native habitat. Populations of invasive species can be fast growing and very damaging to native species. One such invader to Pennsylvania's waterways, the water chestnut (*Trapa natans*), depletes dissolved oxygen in lakes and rivers and can result in anoxia, negatively impacting other aquatic life. Because of high reproductive rates, fast growth rates, or the ability to quickly colonize after disturbance, invasive plants have competitive advantages over native species.

Gretchen Schatschneider, Bucks Cty Conservation District (Insert) Jessie Kemper, Perkiomen Watershed Conservancy

A dense stand of water chestnut in a waterbody near Doylestown, Pennsylvania. Water chestnut is a rooted aquatic plant with both floating and submersed leaves; the floating leaves are arranged in large rosettes.

For rare species with limited distribution, the impacts from invasive species can be severe. More than 40% of species listed as Endangered or Candidate under the Endangered Species Act were threatened by exotic species (USFWS 2012). By outcompeting an already declining species for space or resources, invasive species could cause further population reductions. The negative effects of invasive species on native species are many and include population decline, alteration of the range, hybridization, and habitat degradation. A single invasive species can be damaging to many native species. In Europe, the invasive ice plant (*Carpobrotus* spp.) transplanted from South Africa has caused the declines of 13 native species and is very detrimental to the coastal dune ecosystems in the southern continent where it grows in dense, large monoculture mats.

Invasive species come with an expensive price tag for agencies and organizations working to mitigate the damage and control the spread. Damage from invasive species in the U.S. has been estimated at more than $120 billion a year (Pimetel et al. 2000). In the Great Lakes region, the costs to control invasive species introduced to the lakes from ballast water add up to $200 million annually (USFWS 2012). The expense of invasive species management can strain budgets. Early detection of a newly established invasive species and rapid control of the infestation can minimize adverse impacts, as well as greatly reduce the costs of removal or remediation, compared to when an invasive species becomes widespread.

Experts and agencies managing invasive species recognize the need to act on emerging threats. A rapid response plan for aquatic invasive species created by the Pennsylvania Invasive Species Council in 2014 emphasizes using proper reporting channels so that state agencies can mount a response. If land managers are aware of new threats and recently-arrived invasive species are recognized quickly, a timely and efficient response can be implemented.

With funding from the Wild Resource Conservation Program through the Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Natural Heritage Program (PNHP) staff identified invasive species likely to be emerging threats. From a broad list of invasive species not yet known from Pennsylvania, we reviewed species suggested to be potential threats to the commonwealth by a variety of regional and national sources. From regional experts in government agencies, conservation organizations, academic institutions, and environmental consulting companies we solicited information about candidate species that may be among the most significant future threats to Pennsylvania. We examined invasive species lists and reviewed seven invasive species and floristic databases to identify other species that are problematic in the region but are not yet known to occur in Pennsylvania.

Using a combination of standardized invasiveness ranking and professional judgment, PNHP staff generated a short list of species estimated to be the most likely threats that could be mitigated with early

detection efforts. We reviewed evidence of the presence and degree of invasive characteristics for each species using expert opinion from natural resource professionals, fact sheets, white papers, and scientific literature. Information from the U.S. Department of Agriculture Weed Risk Assessments and several standardized invasiveness ratings were also assembled. In addition, project staff members analyzed the native and invaded habitats of the species under consideration for similarity to habitats present in Pennsylvania, particularly natural disturbance habitats such as dunes and floodplains, and other habitats particularly vulnerable to invasion, especially wetlands and water bodies.

We selected twelve species considered highly invasive, a threat to Pennsylvania habitats, and having the potential to invade Pennsylvania habitats for our Plant Invader Watchlist. Project staff used a slightly modified version of the New York State Plant Ranking System for Evaluating Non-Native Plant Species for Invasiveness to assess the invasiveness of those twelve species using standard methodology that will enable comparison with other species and/or other geographical areas.

We provide descriptions of the twelve Plant Invader Watchlist species on the PA iMapInvasives website *Be on the Lookout - Plants* page and in the brochure *Be on the Lookout for these Emerging Invasive Species in Pennsylvania*. Information in the brochure includes invasion history, habitats which may be invaded, and lookalike species.

© Sonnia Hill

Chinese privet (*Ligustrum sinense*) would damage Pennsylvania habitats, if it entered the state.

The Plant Invader Watchlist includes Chinese privet (*Ligustrum sinense*) and diffuse knapweed (*Centaurea diffusa*). Chinese privet is a scourge in the forests of the southeast United States, where it has become very dense in the understory and excludes native plants.

Matt Lavin, Montana State University

A single diffuse knapweed plant can produce up to 18,000 seeds.

Chinese privet has spread to New York, New Jersey, West Virginia, and Virginia; models from the 2012 USDA Weed Risk Assessment of its predicted invasion range include Pennsylvania. From the eastern Mediterranean region, diffuse knapweed can invade grasslands and open areas in forest uplands. The knapweed can deplete soil moisture, displace native species, and reduce biodiversity. It inhibits root growth of other species through allelopathy – the diffusion of chemicals into the soil through secretions or deposits of plant material that create unfavorable germination or growing conditions. Diffuse knapweed is not yet known to occur in Pennsylvania, but it is found in New Jersey, New York, and Ohio, and could be transported to Pennsylvania from these surrounding states.

The Plant Invader Watchlist is an additional tool for professionals who work with invasive species management. Education about plant invasive species is a first step towards early detection and rapid response.

About the Author

Mary Walsh, Aquatic Zoology Coordinator, has been studying native and invasive aquatic species in Pennsylvania for the Natural Heritage Program since 2003. She snorkels and scuba dives for freshwater mussels in small streams and large rivers across the state. She has worked on state and regional aquatic classifications; species assessments and inventory; land-owner outreach; and invasive species tracking projects.

Notes from the Field

EYE Con Summer Camp

Adam Hnatkovich

This June, WPC Heritage biologists partnered with staff at Jennings Environmental Education Center (JEEC) to host the third installment of EYE Con (Experiencing Your Environment through Conservation), a summer science camp for high school students. Camp projects this year focused on potential impacts of climate change on Big Run Creek. Student's examined water chemistry, macroinvertebrates, fish, algae, and riparian plants. Recommendations from students will inform stream management and forest management at Jennings for years to come. Algae surveys that were initiated during EYE Con are also leading to increased interest in an algae monitoring program at the park.

JoAnn Albert

EYE Con campers used nets and minnow traps to survey fish populations in Big Run Creek.

This year, the WPC and Jennings Environmental Education Center began a new collaboration with Westminster College. Students registering for EYE Con at Jennings will now have the option to utilize their EYE Con experience to earn college credits through Westminster's Early College program. Students were able to interact with Dr. Helen Boylan and Dr. Patrick Krantz, faculty from Westminster's Chemistry and Environmental Science Departments. This collaboration allowed EYE Con students to experience a new component of the camp: a visit to Westminster College, complete with chemistry laboratory experience, interaction with student laboratory assistants, and collaborative research activities in the college library. Students were also treated to a delicious meal at the College's dining hall.

EYE Con will return in 2019 with sessions at Jennings Environmental Education Center and Ohiopyle State Park, as students continue to investigate and promote conservation in a changing climate.

Spotted Turtle Conservation

Kathy Gipe

The Pennsylvania Fish and Boat Commission (PFBC) and partners in several other states are participating in a new Competitive State Wildlife Grant, this time for the conservation and management of the spotted turtle (*Clemmys guttata*) across the Atlantic states from Maine to Florida. Funding provided by this grant will enable Pennsylvania and its partners to identify the eastern region's most important remaining wetland ecosystems and to identify and implement necessary actions to maintain viable spotted turtle populations using highly quantitative population assessment protocols to establish necessary baselines for an adaptive management framework.

This project will address conservation goals and priorities recently identified in the 2015 update to the State Wildlife Action Plan (SWAP). The conservation goal for the spotted turtle as stated in this plan is to "improve knowledge of distribution and population parameters in order to establish conservation and management actions that will prevent further decline." The most pressing research need identified in the SWAP is to implement a thorough status assessment and monitoring program for the species.

Charlie Eichelberger

Spotted turtle

The project got underway this spring with consideration of potential sites. Trap and visual surveys began in the summer of 2018, led by PNHP staff and the Mid-Atlantic Center for Herpetology and Conservation (MACHAC), in cooperation with DCNR Bureau of Forestry, private landowners, and enthusiastic volunteers. Additional wetland surveys will be conducted in spring 2019 at a series of sites across the eastern half of the state.

State Park Vernal Pool Surveys

Betsy Leppo

This spring Heritage staff continued to work on a Wild Resource Conservation Program grant project in partnership with Clarion University to map and survey vernal pools in ten state parks: Pine Grove, Swatara, Nescopeck, Promised Land, Laurel Hill, Clear Creek, Cook Forest, M.K. Goddard, Chapman, and Bendigo. The data will be used to develop maps and descriptions of vernal pool survey sites in these ten parks, characterize the amphibian and invertebrate communities of documented vernal pools, and provide conservation ranks and management recommendations for confirmed vernal pools sites.

JoAnn Albert

A vernal pool at M.K. Goddard State Park that may be influenced by salt runoff from a nearby road.

Water chemistry measurements in seasonal wetlands at two state parks revealed an interesting trend. Winter stayed late this year in Pennsylvania bringing snow on the first day of spring and additional squalls through the first two weeks of April. In late April, Heritage staff explored a series of seasonal wetlands at Pine Grove Furnace in Cumberland County and M.K. Goddard in Mercer County. We found unusually high readings for conductivity and total dissolved solids (TDS) at wetlands located close to paved roads. As we moved away from the roads but stayed within the same wetland systems, we found the water chemistry readings dropped to more typical levels. Dissolved salts are a common source of high conductivity/TDS readings. A likely explanation for our results is that snowmelt carried dissolved salts from road treatments into the adjacent wetlands.

Betsy Leppo

The long white strand in the photo above is a horsehair worm.

At Pine Grove Furnace State Park we also stumbled upon a strange and elusive creature, the horsehair worm, swimming in a vernal pool. These long writhing pale worms may have a certain 'yuck' factor, but humans have nothing to fear from them and control measures are not necessary. Adult horsehair worms mate in temporary bodies of water after which the females lay strings of eggs that can contain up to a staggering 10 million eggs! The eggs sink to the bottom of the water body and develop a protective covering.

As the water source dries up the eggs can be inadvertently consumed by insects such as grasshoppers, crickets, cockroaches and beetles. Once inside the gut of a suitable insect, the protective egg coating dissolves. The liberated worm larvae bore through the gut wall of the insect host and absorb nutrients directly from the hosts' body fluids. When a full grown worm is ready to escape the host, it employs a mysterious strategy that likely involves a chemical assault on the host's brain. The host is suddenly and inexplicably driven to throw itself into a body of water, an action it would typically avoid! When the host falls in water the adult worm emerges and immediately begins searching for a mate. The adults die after mating and laying eggs, once they ensure the cycle of life for their species continues.

New Cooperative Weed Management Area

Amy Jewitt

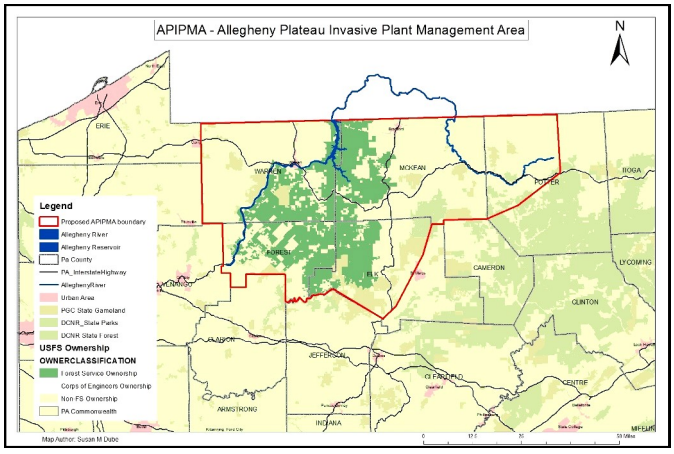
A new invasive species cooperative, called the Allegheny Plateau Invasive Plant Management Area (APIPMA) was recently formed at the beginning of 2018 to tackle invasive plants in northcentral Pennsylvania. APIPMA originated after co-founders Kimberly Bohn,

Educator with Penn State Extension, and Jody Groshek, Communications Outreach Director for the McKean County Conservation District, saw a need for such a group in the McKean County area after attending a meeting of neighboring Sinnemahoning Invasive Plant Management Area (SIPMA). An initial meeting with local stakeholders including federal, state, and local agencies, private natural resource companies, and community groups widened the scope of the cooperative region to cover both the watershed of the Upper Allegheny River and the entirety of the Allegheny National Forest. The mission of APIPMA is to work toward invasive plant awareness, inventory, prevention, early detection, and control.

Amy Jewitt

Kimberly Bohn and Jody Groshek, co-founders of the APIPMA, speak on best management practices related to invasive species prevention at a workshop held near Emporium.

One of the first goals of APIPMA is to better inform the public and develop a citizen science volunteer network that can help the cooperative to monitor and map invasive plants in critical habitats throughout the region. Ultimately, APIPMA would like to prioritize the most critical areas in the region to target invasive plant control and work with agencies, industry, and private individuals to treat these target areas simultaneously.



Map showing proposed APIPMA boundary in red

Species of special interest in the region include glossy buckthorn (*Frangula alnus),* Japanese stiltgrass (*Microstegium viminium*), bush honeysuckles (*Lonicera morrowii* and *L. tatarica*), tree-of-heaven (*Ailanthus altissima*), mile-a-minute vine (*Persicaria perfoliata*), Japanese barberry (*Berberis thunbergii*), and oriental bittersweet (*Celastrus orbiculatus*).

Amy Jewitt

Japanese stiltgrass

To that end, the cooperative will be using iMapInvasives to build a database of invasive plants within the region. Several trainings will be provided this summer to the community and volunteers interested in identifying, monitoring, and mapping invasive plants, including a tutorial on how to use the iMapInvasives mobile app and how to upload data through the website. With iMapInvasives, APIPMA members will be able to combine existing datasets provided by agency and industry partners with new datasets collected by volunteers in the area. In addition to mapping their favorite recreational areas, APIPMA coordinators are asking partners to identify crucial areas where volunteers can be sent in order to fill gaps in the iMapInvasives database.

For more information on the APIPMA, please contact Kimberly Bohn at kkb29@psu.edu or (814) 887-5613.

Tick Borne Disease Collaboration

Joe Wisgo

Human illness from tick-borne disease has been increasing rapidly throughout parts of the United States. In particular, states in the northeast have seen an upsurge in cases of Lyme disease, Anaplasmosis, and Babesiosis. These diseases are caused by bacteria that can be transmitted when a tick attaches to a host for a blood meal. If infected, a host can become a source of bacteria facilitating future transmission of disease. Small mammals, such as rodents and shrews, can act as natural reservoirs for these pathogens. The deer tick is a common vector for these diseases in Pennsylvania.

Recently, PNHP staff have been collaborating with researchers from Indiana University of Pennsylvania who are investigating the presence and extent of tick-

borne pathogens in Pennsylvania. We have been providing small mammal specimens collected throughout central Pennsylvania to be analyzed for the presence of the bacteria *Borrelia burgdorferi* (Lyme disease), *Anaplasma phagocytophilum* (Anaplasmosis), and *Babesia microti* (Babesiosis).

Blood samples of 106 small mammals including the northern short tailed-shrew (*Blarina brevicauda*), white-footed mouse (*Peromyscus leucopus*), and southern red-backed vole (*Myodes gapperi*) were analyzed. Initial results from IUP were startling as they found that over half of the specimens tested positive for at least one pathogen. Even more staggering is that greater than 50% proved to be co-infected with a combination of two or even all three of the bacteria with some counties showing greater than 90% co-infection rate.

Though ticks are the vector of transmission, identifying the prevalence and extent of these small mammal reservoirs is important to better understanding the link to human illnesses. Given that these three common mammal species can occupy a multitude of habitats, locating hotspots of disease could lead to more public awareness and hopefully disease prevention. Research at IUP is currently ongoing, and PNHP will continue to provide samples from different regions throughout the state as we continue our small mammal surveys.

Indian Creek Caverns, It's Not Just for Bats!

Steve Grund

Indian Creek Caverns, formerly run as a commercial tourist cave, has been acquired by the Western Pennsylvania Conservancy with a plan to work with the Pennsylvania Game Commission to mitigate the effects of past cultural use and improve the cave as bat habitat, and also to work with the Pennsylvania Fish and Boat Commission (PFBC) to provide public access to Spruce Creek. PFBC will be the state partner to eventually assume ownership. After the acquisition, PNHP botanists were eager to explore the limestone habitat adjacent to and above the cave entrance. Botanists John Kunsman, Jessica McPherson, Rachael Goad, and Steve Grund, as well as Seasonal Ecologist Gabryel Malone and Intern Melanie Fetsko, found several rare plants, including a native species not previously documented from Pennsylvania. We found six species of conservation concern and another eight species on the PNHP Watch List, a remarkable number for an area less than 15 acres.

Rachel Goad

PNHP staff surveying for rare plants at Indian Creek Caverns

Charles Bier

Walter's violet (*Viola walteri*)

The biggest find was a state record for Walter's violet (*Viola walteri*), a blue-flowered species with variegated leaves that forms mats with extensive stolons (stems that creep along the surface of the ground). The site represents a significant disjuncture of about 150 miles to the NNE from the nearest previously known site (which is in West Virginia).

The site is threatened by encroaching invasive plants, a problem that is especially common in limestone areas. The continued health of the rare plant populations will depend in part on good management of the site.

Rare Plant Finds at Bear Run Nature Reserve

Steve Grund

Western Pennsylvania Conservancy's Bear Run Nature Reserve (BRNR) is most famous for being the location of Frank Lloyd Wright's Fallingwater, but BRNR is located in the Youghiogheny Gorge, the area with the highest concentration of globally rare plant species in Pennsylvania. True to its location, BRNR has significant biodiversity value. Two new plant species of conservation concern have been discovered at BRNR this summer: forked rush (*Juncus dichotomus*), State

Jason Ryndock

Roan Mountain sedge (*Carex roanensis*)

Critically Imperiled (S1); and Roan Mountain sedge (*Carex roanensis*), State Imperiled (S1) and Globally Vulnerable (G3G4). This brings to three the number of Globally Vulnerable plant species known from BRNR; the others are large-flowered marshallia, or Barbara's buttons (*Marshallia grandiflora*), G3; and sand grape (*Vitis rupestris*), also G3.

Carex roanensis, until the mid-1980s, was known only from Roan Mountain in Tennessee. In the ensuing decades, it has been discovered further north, and the plants at BRNR along with nearby stations in Ohiopyle State Park represent the northern limit of the known distribution of the species, with the exception of a perplexing old specimen from Potter County. The species is easily confused with a few close relatives, and the expansion of the known range is mostly a result of correcting the identifications of old specimens and does not represent an actual expansion of the species to the north. Roan Mountain sedge is a forest species, found usually at interior edges such as trails and cliffs where light levels are higher than in the closed canopy forest.

Steve Grund

Copperhead

Forked rush at BRNR grows in the scour habitat at the mouth of Bear Run (aka Dimple Rock Rapids), which is where most of the rare plants on the reserve are found, including large-flowered marshallia and sand grape. They are guarded by another species that is rare in Pennsylvania, the copperhead (*Agkistrodon contortrix*), state vulnerable, (S3S4).

Mudpuppy Project

Ryan Miller

In April, Zoologist Ryan Miller and Malacologist Nevin Welte conducted mudpuppy surveys in Pools 5 and 6 on the Allegheny River as a part of the salamander mussel and mudpuppy project funded by the Wild Resource Conservation Program. The status and distribution of the salamander mussel and its mudpuppy host in the Ohio River and Allegheny River navigational pools are unclear. Mudpuppy presence could be a factor limiting the dispersal and recovery of the state endangered salamander mussel.

Ryan Miller

Mudpuppy with external gills displayed

We trapped six known salamander mussel locations in the Allegheny River with 140 modified crayfish live traps. We captured a total of 21 individual mudpuppies in four locations. Mudpuppies captured were counted, measured for length, weighed, sexed, examined for their overall health, checked for salamander mussel glochidia, and released. Mudpuppies were not detected at two locations. SCUBA surveys for salamander mussels are scheduled for August and September of 2018. We will conduct additional mudpuppy trapping on the Allegheny and Ohio rivers in the fall of 2018 and spring of 2019. Data from this study will inform Pennsylvania Fish and Boat Commission managers by identifying and prioritizing potential river conservation and salamander mussel restoration areas.

Nevin Welte

Zoologist Ryan Miller weighing a mudpuppy.

Spring Insect Surveys—Photo Highlights

Photos by Betsy Leppo

A male lilypad clubtail (*Arigomphus furcifer*) was found foraging for insects in a small forest clearing near Black Bear Swamp in Monroe County

Flowering shrubs like blueberries and huckleberries provide a critical and abundant food resource to a variety of nectar and pollen feeding butterflies, bees, flies, wasps, and beetles in the spring.

A male river jewelwing (*Calopteryx aequabilis*) at Big Bear Swamp

This male harlequin darner (*Gomphaeschna furcillata*) caught a large cranefly and apparently needed all six legs to manage it. He crash-landed in a patch of sphagnum, upside down, where he contentedly remained until he consumed every last bite of his dinner.

Flowers are a perfect place for predators to lie in wait for insects seeking nourishment. Crab spiders are beautifully camouflaged with the delicate colors and patterns of the flowers they hide in. Can you find the spider?

This robber fly's eyes must be larger than its stomach, it captured an azure butterfly as large as it is!