



Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

WILD HERITAGE NEWS

Fall 2021



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Photo Banner:
Conneaut Marsh sunrise
David Yeany II

Secrets of the Marsh Crawford County Marsh Bird Surveys by David Yeany II

A recent landmark study showed that we have lost 3 billion birds across all North American bird species over the past 50 years (Rosenberg et al. 2019). Among these losses was a 22% decline in waterbirds with more than half of waterbird species in decline. On the other hand, waterfowl species (ducks, geese, and swans) have increased by 56% in the same time period, while occupying many of the same habitats as waterbirds. These contrasting trends indicate an overall need for addressing waterbird-specific wetland habitat conservation. In Pennsylvania, many of our breeding waterbird species – herons, bitterns, rails, grebes, etc. – are listed as Species of Conservation Concern and/or Endangered or Threatened due to their declining populations (11 of 16 survey target bird species have statewide declines $\geq 10\%$, Table 1).

Some of our highest priority waterbirds are known as secretive marsh birds – owed to the fact that they most often remain hidden and are difficult to detect with passive survey methods. Secretive marsh bird surveys have rigorous, standardized protocols that use target

species vocalization playback to persuade marsh bird species to respond. During spring and summer 2021, PNHP-WPC led an intensive secretive marsh bird survey in Pennsylvania's largest contiguous wetlands – Conneaut Marsh, Pymatuning, and Hartstown Marsh – all located in Crawford County as part of State Game Lands 213 and 214. This effort, funded by the Pennsylvania Game Commission (PNHP-PGC) and the DCNR Wild Resources Conservation Fund, was originally planned to complement the 2020 PNHP-PGC led statewide volunteer-based secretive marsh bird surveys, but the pandemic delayed the Crawford County surveys until 2021.



Avian Technician Eric Schill paddles through Hartstown Marsh while doing secretive marsh bird surveys.

David Yeany II

The goal of this project was to conduct the most comprehensive survey of these large wetlands by collecting abundance and occurrence data for secretive marsh bird species and their associated habitats. Ultimately, our analysis of these data will help guide management at these important wetlands and inform marsh bird conservation across Pennsylvania. For now, we will save the detailed analysis for a later date and focus here on the raw survey results, important discoveries, and the highs and lows of working in a challenging marsh ecosystem.

From May through July, we amassed a huge dataset of marsh bird and vegetation data from these wetlands. Altogether, we conducted 615 surveys at 123 point locations – including 492 secretive marsh bird surveys and vegetation assessments at every point. Our data included 27,438 bird detections of 148 species, including 27 PNHP Species of Conservation Concern. While we recorded all birds detected, our focus was on 16 target species, including 9 secretive marsh birds (Table 1) for which we used audio playback of vocalizations following the National Marsh Bird Monitoring Protocol.

Table 1. Sixteen target marsh bird species during 2021 surveys at Crawford County marshes: Conneaut Marsh, Pymatuning Marsh, and Hartstown Marsh.

Species	Target Priority	Conservation Status	PA Breeding Trend ²	Total Detections ³	Total Point Locations	Relative Frequency ⁴
American Bittern	1	PA Endangered	-42%	11	8	7%
American Coot	1	Conservation Concern	-28%	32	13	11%
Black Rail	1	--	--	--	--	--
Black Tern ¹	2	PA Endangered	-73%	4	2	2%
Black-crowned Night Heron	2	PA Endangered	-49%	--	--	--
Blue-winged Teal	2	Conservation Concern	-68%	51	25	20%
Common Gallinule	1	Conservation Concern	-37%	318	69	56%
Green-winged Teal	2	Conservation Concern	-43%	--	--	--
King Rail	1	PA Endangered Unchanged	--	--	--	--
Least Bittern	1	PA Endangered	-10%	59	33	27%
Marsh Wren	2	Conservation Concern	-32%	572	70	57%
Pied-billed Grebe	1	Conservation Concern	-26%	31	17	14%
Sedge Wren	2	PA Endangered	54%	--	--	--
Sora	1	Conservation Concern	14%	77	40	33%
Virginia Rail	1	Conservation Concern	28%	309	81	66%
Wilson's Snipe	2	Conservation Concern	-16%	37	22	18%

¹Black Tern was only detected during visit 1 in early May, likely as passage migrants.

²Total change in block occupancy from first to second PA Breeding Bird Atlas (Wilson et al. 2012).

³Detections include all 4 survey visits, May-July, plus additional observations during vegetation sampling.

⁴Frequency of occurrence across all 123 survey point locations.



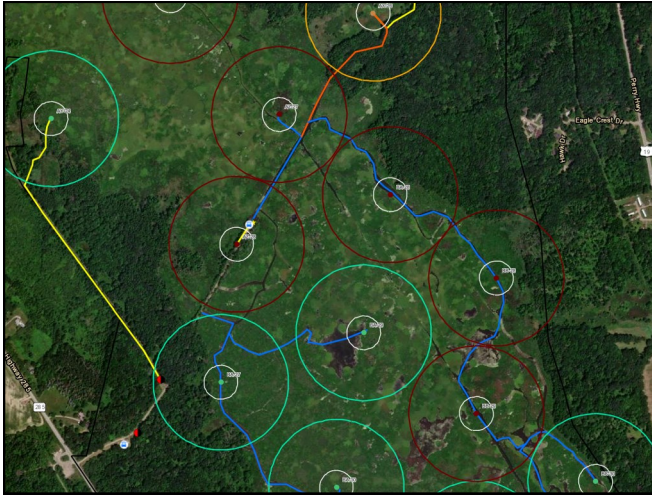
Christopher Tracey

We often paddled through long stretches of dense spatterdock to access survey locations.

The State Game Lands which hold Conneaut Marsh, Pymatuning, and Hartstown Marsh total over 15,000 acres, including more than 5,500 acres of wetlands that we surveyed. These marshes are well-known to both birders and waterfowl hunters alike as some of the best habitats for wetland birds in all of Pennsylvania. But these marshes also have a reputation for being notoriously difficult to navigate. One news article from 1931 in *The Press World of Today* (more recently *The Pittsburgh Press*) is titled “A Battle to Conquer a Bottomless Marsh.” It gives a meandering, and somewhat sensational, account of the history of the perils of Conneaut Marsh leading to the vanishing of many a pioneer, native American, or wayward traveler, and how the marsh seemingly swallowed hundreds of thousands of “cubic yards” of fill for the construction of Route 19, the Perry Highway, from Erie to Pittsburgh. Often the waterways in these Crawford County wetlands are described as being “choked” by the vegetation, consisting of dense stands of spatterdock (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), smartweed (*Persicaria* spp.), cattail (*Typha* spp.) and other robust emergent vegetation, along with substantial areas of shrub wetland and forested wetland.

There was plenty of evidence to suggest that we just might not be able to complete a comprehensive survey of these wetlands. But preparation, planning, and perseverance proved to be keys to the success of our efforts. We assembled a team of skilled and trained PNHP ecologists and field biologists, both full-time and seasonal, with ornithological and botanical expertise. We took full advantage of new spatial tools including ArcGIS Field Maps. This all-in-one application for fieldwork enabled us to combine multiple sources of high-resolution imagery, classified wetland vegetation, and survey locations to map out detailed access routes.

In such a dynamic and changing marsh system where water channels could virtually vanish, having these data on smartphones and GPS units in the field was a huge part of reaching 123 survey locations five times (!) which were spaced at least 400 meters from each other. With visits to survey points at 10-14 days apart, conditions were never the same twice. Chest waders, dry bag backpacks, and solo Old Town 12-foot canoes were other vital pieces of equipment for this fieldwork.



ArcGIS Field Maps allowed us to meticulously plan survey sites and access routes and was a key to our survey success.

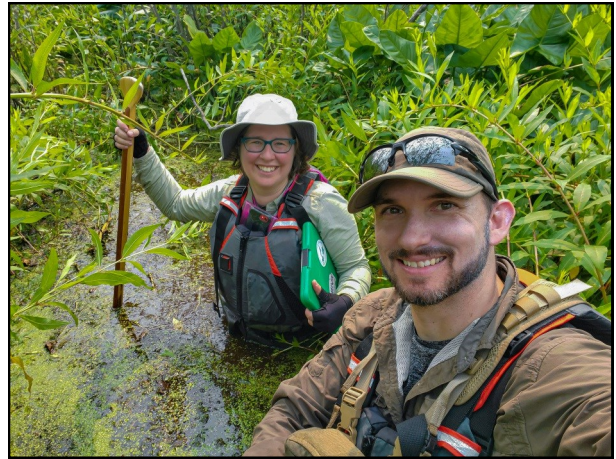
Marsh birds tend to be most available for human detection in the early morning hours just before and up to a few hours after sunrise or a few hours before and just after sunset. For consistency, all of our surveys



We often had to drag or push canoes through dense vegetation to access survey locations.

were conducted in the early morning period, but this also meant some very early starts to enable us to reach our first survey points by 30 minutes before sunrise. Wading through knee-deep to chest-deep water was a daily part of our surveys, as was push/pulling our boats through narrow channels and dense spatterdock

and pickerelweed, or portaging across stands of cattail or floating mats of smartweed. Even so, all of this hard work paid off with some exciting survey results.



The author and Conservation Planner Anna Johnson waded into a hard-to-access survey location in a mixed shrub wetland.

We detected 11 of our 16 target marsh bird species (Table 1). We were still adding new target species observations on the fourth marsh bird survey visit, as well as during vegetation surveys when we found our only least bittern (*Ixobrychus exilis*) nest and three separate families of common gallinule (*Gallinula galeata*) – one with two adults and seven juveniles! This highlights the value of additional, repeat visits for detecting secretive marsh birds. Perhaps our most surprising and significant survey result was the number of PA-Endangered least bitterns that we found across the Crawford County marshes. We detected least bittern at 33 survey locations, or about 27% of all points, with 59 total detections (Table 1). These numbers represent the highest ever recorded for least bittern in these marshes. Additionally, these detections could indicate a population of least bitterns as large as the population at Presque Isle State Park in Erie County. This further elevates the importance of the management of wetlands on these State Game Lands for conserving least bittern in the state.



In late June, we spotted this common gallinule family feeding on a dense mat of duckweed (*Lemna* spp.).

David Yeany II

David Yeany II



David Yeany II

Common gallinule shows a 37% decline in Pennsylvania. Gallinules can be loud and vocal during the breeding season giving a variety of trumpet-like calls. This species needs wetlands with half open water cover and half emergent vegetation, like spatterdock.



David Yeany II

Least bittern shows a 10% decline in Pennsylvania. Our surveys revealed a surprisingly high number of least bitterns with encounters like the one in this photo. As a thunderstorm approached, this male flushed from a cattail edge, and was followed to a dense cattail patch with a narrow water channel where it gave its soft "coo-coo-coo" call with the cadence of a bouncing ball.



David Yeany II

Prothonotary warbler, while not a marsh bird, is a Species of Conservation Concern found in abundance in the forested wetland periphery of the Crawford County marshes. We had 91 detections of this species across 30 point locations or about 24% of the survey area.



David Yeany II

American coot shows a 28% decline in Pennsylvania. Despite being a very common migrant, American coot was never a common breeder in the state, requiring large wetlands with open water bordered by dense emergent plants and open water areas interspersed within dense vegetation.



David Yeany II

Virginia rail shows a 28% increase in Pennsylvania. Virginia rail was our most frequently detected marsh bird. Sometimes bold in response to our call-broadcast, they would come "charging" into the speaker within 1-3 meters and circle it looking for the intruder.



David Yeany II

Marsh wren shows a 32% decline in Pennsylvania. Marsh wrens prefer nesting in larger wetlands with tall erect emergent vegetation such as cattails where polygynous males build 5 nests per territory on-average, but in some cases more than 20!



David Yeany II

American bittern shows a 42% decline in Pennsylvania. Solitary and extremely secretive, little is known about their basic ecology. They are area-sensitive – requiring large shallow water wetlands with dense cattails, bulrushes, and sedges.

American bittern (*Botaurus lentiginosus*) proved much more difficult to find with just 11 detections across eight survey locations. This species was more consistently located in the Hartstown Marsh complex giving it's characteristic “pumper-lunk” call, but perhaps the most noteworthy observation came at Conneaut Marsh during the fourth survey visit in late June. It was a very foggy morning when we were

conducting a survey in an area with dense cattail and spatterdock. Standing and balancing in our canoe, we spun around to see an American bittern emerge from the fog flying by at close range – it was in and out of the fog in matter of seconds, living up to its secretive reputation.

We recorded three target species across more than half of all survey locations: Virginia rail (*Rallus limicola*, 66%), marsh wren (*Cistothorus palustris*, 57%), and common gallinule (56%). Marsh wren was by far the



Christopher Tracey

Avian Ecologist David Yeany stands in his canoe to see over tall marsh vegetation – good balance was a must for collecting observations of both marsh birds and marsh plants.

most ubiquitous species with 572 detections, and likely occupying every patch of cattail. However, Virginia rail was the most widespread with detections across 81 survey locations, showing its more generalized marsh habitat preferences.

Although five target species were not detected, king rail (*Rallus elegans*) was likely the most significant missing species from our surveys. Crawford County has long been one of the more consistent locations in the state, outside of Mercer and Philadelphia counties, for this PA-Endangered species during spring and summer, even if not necessarily breeding. King rail was last confirmed here in 2017 with one well-documented individual. With such very low numbers statewide, it will be very difficult to pin-down exact causes of decline, aside from total wetland loss over time or maintenance of large wetlands with stable summer water levels.

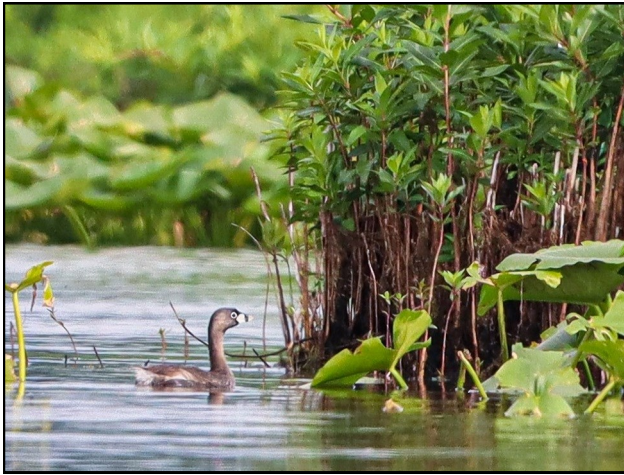


David Yeany II

Conservation Program Manager Chris Tracey collects a specimen of wild rice (*Zizania aquatica*).

We also had some unexpected and significant discoveries on the botanical side during our marsh vegetation assessments. During surveys at Pymatuning Marsh, we found a population of wild rice (*Zizania aquatica*), a PA-Vulnerable (S3) plant Species of Conservation Concern. Currently found in just three southeastern counties, this was the first record of wild rice in Crawford County. Historically, this species of native wild rice was a cultivated primary grain source for northern Native American tribes. In the same area of Pymatuning Marsh where we found wild rice, we also located broad-winged sedge (*Carex alata*), a PA-Threatened (S2) plant Species of Conservation Concern. Historically, this species has primarily been recorded in northwestern counties. It grows in wetlands with limestone or non-acidic substrates.

Back to the remaining marsh birds, we found higher numbers of American coot (*Fulica americana*), pied-billed grebe (*Podilymbus podiceps*), and Wilson's snipe (*Gallinago delicata*) during the first survey visit with many migrants using the marshes as stopover habitat. However, few individuals persisted into the late spring and summer with a handful of locations where each of these species likely had breeding territories. This was also true of blue-winged teal (*Anas discors*), a steeply declining waterfowl Species of Conservation Concern (Table 1), which was found in low numbers at a few locations at Pymatuning Marsh. Sora (*Porzana carolina*) was found across one third of our survey locations, but showed some variation in detection across the survey period that will be an interesting aspect to explore in our quantitative analysis.



David Yeany II

Pied-billed grebe populations have declined by 26% in Pennsylvania. This species dives for aquatic invertebrates, fish, and amphibians, and builds a floating platform nest from marsh vegetation. These factors contribute to its sensitivity to fluctuating water levels.

Finally, PA-Endangered black tern (*Chlidonias niger*) was detected but was likely only a passage migrant using the marshes along the Upper Reservoir at Pymatuning Lake as stopover habitat in mid-May. Pennsylvania's black tern breeding population has all but disappeared, with the last known nesting in 2004 at Presque Isle in Erie County. These Crawford County marshes had historically been a breeding stronghold for the state's black terns, but changes in wetland water level, increased woody plant growth such as waterwillow (*Decodon verticillatus*) and buttonbush (*Cephalanthus occidentalis*), and human disturbance could all be factors in its looming extirpation.

We aim to combine these marsh bird data with detailed wetland maps and vegetation measurements to identify key habitat attributes influencing occupancy or abundance of high priority species like least bittern. Our

forthcoming analysis should inform current management of these Crawford County marshes and marsh bird conservation across the state. Our hope is that by learning some of these secrets of the marsh we can act now to better position our marsh birds to maintain their breeding populations into the future and avoid further declines.



David Yeany II

This female least bittern was building a stick-nest in Conneaut Marsh in mid-July. Our project aims to provide important habitat relationship information to help maintain breeding populations in these Crawford County marshes.

About the Author

David Yeany joined the PNHP in 2011 and currently serves as Avian Ecologist. His work focuses on conserving rare and declining bird species – including field surveys, monitoring, habitat relationships studies, spatial analysis, and tracking with Motus. David is passionate



about birds and their conservation, gladly sharing his enthusiasm with anyone willing to listen.

Assessing Freshwater Mussel Reintroduction Potential

by
Mary Walsh

Populations of freshwater mussels in Pennsylvania are winking out. Many stressors on water quality and habitat, such as runoff from natural resource extraction and farming, point source pollution, and damming of waterways are attributed to extirpations. Since the rivers in Pennsylvania began to flow rusty red from coal mine drainage and inky black during the height of the industrial revolution, freshwater mussel populations have been disappearing. Threats from modern day pollution are also evident in waterways. In Dunkard Creek, for example, a catastrophic bloom of toxic algae surged at the same time illegal waste dumping was polluting the stream, killing the remaining mussel populations which were already diminished from coal mine discharges.

Although waterways in Pennsylvania have experienced improvements in water quality since the peak of industrial pollution due to more stringent water pollution regulations (e.g., the Federal Water Pollution Control Act of 1948 and the 1972 Water Quality Amendments), freshwater mussels have not recovered in many streams. Populations may have been entirely eliminated in some locations or there may only be a paltry few species where there were formerly rich mussel communities.

The upper Clarion River flows through a watershed that is more than 90% forested and is protected in state and federal lands. The river's clear, warm waters are popular for boating. Historically, the aquatic life in the river was impacted from the acidified effluents flowing

from coal mines. Since remediation of the mining discharges, the water quality has rebounded and it now is home to a robust largemouth bass fishery. However, the river holds surprisingly few numbers of freshwater mussels. Could formerly polluted streams, like the Clarion River, be teaming with freshwater mussels again?



Mary Walsh

Pollution from coal mines has degraded formerly rich streams. The red iron precipitate in many western Pennsylvania streams results from mine discharges.

Mussels don't readily recolonize locations for several reasons. A source population must be nearby in a connected waterway and host fish must be present. Most freshwater mussel species have a larval stage (glochidia) during which they must attach to fish gills or fins to transform to a juvenile. Without the appropriate fish host, the life cycle cannot be completed. Impoundments complicate restoration since dams can interrupt the connectivity to host fish habitat and can fundamentally alter aquatic habitat.

Given the hurdles for mussels to return to habitats recovering from past pollution, biologists are looking to jumpstart populations. Reintroductions are one tool for helping mussel populations in impacted waterways. PNHP began an experiment to test the reintroduction potential of streams to gauge how future reintroductions may fare in places where mussels have declined for unknown reasons, in streams which may have persistent pollutants from remediated sources, or in waterways where water quality conditions are unknown.



Mary Walsh

Project scientists wanted to study how well the formerly polluted Clarion River could support juvenile freshwater mussels.



Mary Walsh

Silos were made from concrete and PVC pipe components.

The project was designed to learn how well freshwater mussels would grow in experimental containers, called silos, placed in waterways across a range of conditions in western Pennsylvania. The first step was to make concrete silos, using a design from other similar studies, to hold cages for mussels during the study. Juvenile plain pocketbook

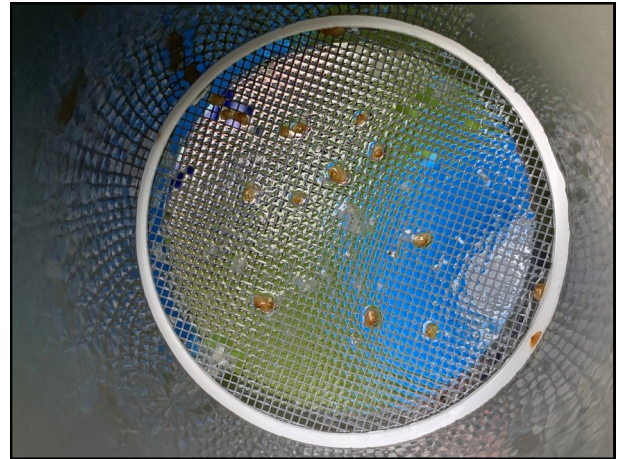
(*Lampsilis cardium*) were loaded into cylinders made from PVC pipe and screen mesh which was secured to the concrete housing. A central open chamber allowed water to pass over the mussels.



Mary Walsh

The juvenile mussels were reared offspring from gravid plain pocketbook mussels collected from a Pennsylvania stream.

In June, project staff deployed the silos in 13 waterways – some were locations where mussels are known to thrive, like French Creek (Mercer County), and others were locations where mussels have been extirpated, like the Mahoning River (Lawrence County), where former industrial pollution decimated populations. Twenty tiny mussels, slightly larger than a sesame seed, were placed into each silo and four silos were put in each of the waterways. The juvenile mussels lived in their temporary homes for two months, while filter feeding on particles suspended in the flowing waters passing through their silos. Water temperature monitors were deployed and water quality data were collected at each silo location. How well the mussels survived and grew during the study is an indicator of the water quality and food sources in the waterway. If conditions were adequate for the sensitive juveniles to grow, the waterway may be a good candidate for reintroduction.



Mary Walsh

Small juvenile mussels were placed in silos in June.

The project dovetails with an initiative at the Pennsylvania Fish and Boat Commission (PFBC) to rear freshwater mussels at a specially designed hatchery; eventually the hatchery-raised mussels will be used in Pennsylvania mussel conservation and reintroduction projects. While the PFBC hatchery is building capacity for raising mussels, project partners at the Kentucky Department of Fish and Wildlife Resources assisted by rearing the juvenile mussels used in this project. Gravid female plain pocketbook mussels from Pennsylvania were shipped to a Kentucky hatchery, where glochidial mussels were extracted and raised to the juvenile stage.

PNHP and WPC staff collaborated with a broad-scale project run by U.S. Forest Service researcher, Wendell Haag, to assess mussel juvenile growth across streams in several states, including Indiana, Virginia, North Carolina, and Pennsylvania. We assisted in measuring other site-specific parameters for the USFS study, like



Mary Walsh

Silos collected algae and sediment over the course of the study disguising them on the stream bottom.



Mary Walsh

Silos are designed so that stream water flows through the center chamber with the juvenile mussels.

the density of the non-native Asian clam, substrate permeability, and the characteristics of sediments, which may relate to patterns in mussel growth at the silo locations.

One key to success for growing freshwater mussels in this study was placing the silos in a spot, which would not dry out at low flows and would not be disturbed by curious recreationists. Over the course of the summer the concrete silos became camouflaged with a patina of algae and silt, making them harder to detect under water by anyone fishing in the vicinity. When the silos were retrieved, the project team was delighted to find that they were remarkably undisturbed by the high waters that occurred in the 2021 summer season; the mussels collected from the silos were frozen and will be measured in a laboratory.

The next steps for the project are to analyze and apply the information gained about mussel survival and growth to stocking Pennsylvania streams and rivers.



Mary Walsh

Silos were removed from the study streams in September.

Preliminary results indicate that mussels in all waterways grew, but growth was quite variable between silos and among streams. The data from the study will be integrated into a systematic assessment of the condition of the waterways and their potential for reintroductions of mussels.

The stocking of freshwater mussels is gaining momentum as a conservation tool among states in the region. The goals of stocking projects may include augmenting small populations, reintroducing species that were extirpated, and restoring the ecosystem services (e.g., filtering capacity) of the freshwater mussels. Planning reintroduction initiatives and stocking reared mussels from the new PFBC mussel hatchery is ongoing in Pennsylvania. As projects take shape, additional studies by the PNHP and PFBC are anticipated to evaluate streams and juvenile growth patterns.

Project staff include Mary Walsh, Eric Chapman, and Nevin Welte. Thanks to Ryan Miller and John Berger for field assistance.

About the Author

Mary Walsh coordinates the aquatic zoology program at the Pennsylvania Natural Heritage Program. She's been studying aquatic fauna with PNHP since 2003. Mary works on inventories of aquatic invertebrates and communities, assesses conservation statuses, models species distributions, and tracks invasive species. When she's not managing projects, Mary watches thriller series, reads books, and hangs out with her family.



Mary Walsh

Plain pocketbook mussels were removed from the silos.



Notes from the Field

Plant Recovery Plans: White Monkshood

Anna Johnson

PNHP botanists and ecologists are developing recovery plans that highlight the current state of some of our rarest plants in Pennsylvania. By utilizing years of field data and a comprehensive literature review our goal is to identify the major conservation threats unique to each species in Pennsylvania and to recommend actions that support population recovery. They serve as roadmaps for species-specific conservation research, planning, and action, and are meant to track species status over time, as components of the plan are implemented.



Anna Johnson

The delicate, white blooms of white monkshood are held on long, winding racemes that often climb up neighboring plants or sprawl along the ground.

This summer with funding from a DCNR WRCP grant, PNHP

Conservation Planner Anna Johnson and PNHP intern Bailey Bower, a University of Pittsburgh student, focused on developing the recovery plan for the rare plant, white monkshood (*Aconitum reclinatum*).

White monkshood is a Pennsylvania Endangered species found in forested, moist areas along streams

or seeps. Only a handful of extant populations are known in the state, all in the Laurel Highlands. It requires pollen from another individual to set seeds and is only visited by bumblebees. One of the conservation issues we set out to address was whether white monkshood is being effectively pollinated.

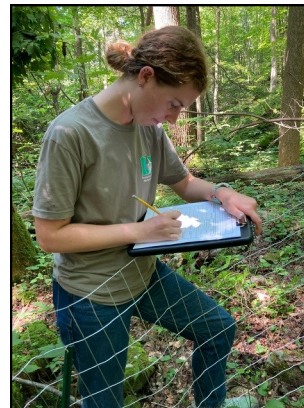
Over the course of the summer, we collected demographic data in each population, assessed the community that co-occurs with white monkshood, measured canopy cover, looked for signs of deer browse, and sampled bumblebees that visited the flowers to identify which species are supporting white monkshood. So far, we have identified at least four different species of bumblebee that provide pollination services to this rare wildflower. Currently, Bailey is working with a partnering research group at the University of Pittsburgh to assess pollination quality by

measuring the proportion of pollen grains deposited on stigmas of the plants that were able to germinate. In plants, like *Aconitum*, that require pollen from other genetically-different individuals to sexually reproduce, chemical signals from the stigma often will halt the germination of pollen grains that are too closely related to the individual plant receiving the pollen. This can tell us something about the level of inbreeding in these small, somewhat isolated plant populations.



Anna Johnson

A hemispherical photo taken to estimate the amount of canopy cover; a potential threat to white monkshood is canopy closure and lack of light.



Anna Johnson

PNHP intern, Bailey Bower, takes notes in the field.

In addition to being a great opportunity to focus on the ecology and conservation needs of a single species, this project also provided Bailey with her first field and research experience. Small, single-season projects can be great learning experiences for PNHP interns, as they have the opportunity to track a study from beginning to end. They get

a taste of all the phases of a conservation science project, from planning, to field and lab work, to data entry, analysis, and reporting.

Bioblitz Revisit

Pete Woods

Most species on a bioblitz are identified as they are found, but sometimes the most interesting finds are the ones that don't get named right away, and which yield surprises years later.

In 2017 several PNHP staff took part in a bioblitz along Chartiers Creek in Allegheny County that was hosted by the Allegheny Land Trust and took place partly on the Wingfield Pines property that they own. The blitz occurred on four different dates spread throughout the

growing season to maximize the number of species we could detect. Among the 724 species that were documented were several of conservation interest, including white trout lily, broad-banded forest snail, and a sensitive species that we cannot disclose.



Liriomyza mine in a leafcup leaf; undescribed when this photo was taken.

Pete Woods

We also found some things we couldn't put a name on, such as a leafminer on the leaves of leaf-cup (*Polymnia canadensis*). A leafminer is an insect whose larvae live inside a leaf, eating the inner leaf tissue while leaving the outer layer of the leaf intact. No leafminer had ever been reported from leaf-cup, so we suspected this was an undescribed species, but unfortunately the larvae had already finished their development and left the plants. We returned several times over the next few

years, hoping to collect live larvae, and to rear them into adults so they could be described, but we never saw the leaf mines until they were already empty. Fortunately, John van der Linden, an entomologist in Iowa, had found the same species the month before we did, and had successfully raised the larvae into adult agromyzid flies. He and his colleagues published a description of the species this year and named it *Liriomyza hypopolymnia*.

Another mystery from the bioblitz was a gall on the midribs and stems of bitternut hickory leaves. This summer we consulted Dr. Ray Gagne, emeritus scientist at the Smithsonian Museum of Natural History and the foremost expert on hickory galls, who said the galls appear to be an undescribed species. We missed the emergence of the larvae this summer, but we will return next year to try to obtain specimens of this new species.



Undescribed hickory petiole gall

Pete Woods

A third mystery insect was the caterpillar of a borer moth (*Papaipema* sp.) in the stem of horsebalm (*Collinsonia canadensis*). That caterpillar was parasitized and could not be identified, but this year, our third

attempt to rear a caterpillar from this site was successful, and it turned out to be the rare yellow stoneroot borer moth (*Papaipema astuta*). The rediscovery of this species in Pennsylvania was discussed in the fall 2020 PNHP newsletter.

Status of a Rare, Undescribed Pennsylvania Crayfish

David Lieb

In 2000, an undescribed species of crayfish belonging to the *Cambarus acuminatus* species complex was discovered in Valley Creek, a tributary to the Schuylkill River in southeastern Pennsylvania. This was a significant discovery, as it represented a substantial northward geographic extension of the known range of the species complex. Subsequent surveys throughout eastern Pennsylvania showed that the undescribed species, hereafter referred to as *Cambarus* (*Puncticambarus*) sp., has a very limited distribution in Pennsylvania, with reproducing populations restricted to five small drainages, all of which occur in a rapidly urbanizing area within approximately 30 km of one of North America's largest cities (Philadelphia).



David Lieb

Rare, undescribed crayfish specimen collected from a small headwater stream in the lower Delaware River drainage.

In recent years, exotic crayfishes have been introduced to four of those drainages, resulting in substantial reductions or extirpation of *Cambarus* (*Puncticambarus*) sp. from invaded sites. In some cases, the replacement of *Cambarus* (*Puncticambarus*) sp. by exotic crayfish has been rapid, occurring in less than nine years. Based on its limited distribution and the considerable threats it faces from exotic crayfishes and urban development, *Cambarus* (*Puncticambarus*) sp. may be one of the most endangered aquatic species in Pennsylvania, and possibly in eastern North America. However, uncertainty in its taxonomic status presents a substantial barrier to effective management. Without management action, this species faces an uncertain future.



David Lieb

Crayfish collected during a stream survey in the lower Delaware drainage, southeastern Pennsylvania. The right bucket contains the rare undescribed crayfish; the left bucket contains the nonnative virile crayfish, which recently invaded the stream and is rapidly increasing in numbers eliminating the rare, undescribed crayfish.

In 2017, PNHP ecologists and colleagues from the North Carolina Museum of Natural Sciences and West Liberty University received funding from the State Wildlife Grants Program to utilize genetic analyses in combination with traditional taxonomy to formally describe *Cambarus (Puncticambarus)* sp. and determine its status in Pennsylvania (native or introduced). Members of the *Cambarus acuminatus* species complex were collected from at least one site in each HUC 10 (10-digit Hydrologic Unit Code) watershed within which it occurs, from southeastern Pennsylvania southward to Columbia, South Carolina. Between 2017 and 2020, over 2,000 crayfish specimens from 1,000+ sites were collected, and genetic and taxonomic analyses were completed with those specimens.

Those analyses revealed distinct genetic structure throughout the range of the *Cambarus acuminatus* species complex, indicating the potential for numerous undescribed species (possibly 30+). We confirmed that the member of the complex that occurs in Pennsylvania, *Cambarus (Puncticambarus)* sp., is in fact an undescribed species. Additional taxonomic and genetic analyses are currently being conducted, ultimately resulting in the formal description and status determination of the undescribed Pennsylvania species. This will allow for management and conservation actions targeting extant populations in the commonwealth.

Fen Management Update

Christopher Tracey

Past glaciation has created several fen habitats across northwestern Pennsylvania. Last year, in cooperation with Pennsylvania Game Commission land management

staff, PNHP worked to restore two of these calcareous groundwater-fed wetlands on State Game Lands. This was previously highlighted in the 2020 fall newsletter. PNHP and PGC staff revisited this site in early August 2021 to assess the results of last year's treatment activities.

Walking into the site in 2021, we were anxious— did our *Phragmites* treatments work? As we emerged from a small hemlock swamp, we were greeted by thousands of brown stems—the remains of last year's *Phragmites*. Success! It was somewhat unusual to see the stems from last year still standing, but this region of the state saw significantly less snowfall than the typical winter, allowing them to persist in the upright position. We found occasional living *Phragmites* stems that escaped application, but there was significantly less than before treatment. We also noticed that the rare native plants that we had covered with buckets and paper cups to protect them during the treatment were still present and looking healthy.



Christopher Tracey

Standing dead *Phragmites* stems as the results of our herbicide treatment, with living *Phragmites* in the ARGO tracks. The living stems were treated this fall.

Back in 2020, to treat the densest areas of *Phragmites* infestation we used an ARGO, an eight wheeled amphibious utility vehicle, to access the area and sprayed the *Phragmites* from above, which reduced the amount of herbicide that reached the ground, protecting the native species below. However, we did not spray the *Phragmites* in the area the ARGO was driven through, as not to track herbicide across the fen via the tires. During our follow-up visit to the fen, the ARGO paths were clearly visible due to the lack of standing dead stems and some living stems that were not treated. PGC staff returned to the site in early September to conduct a follow-up hand treatment of the remaining living *Phragmites* stems.

The real measure of success for these restorations is not just the elimination of the invasive exotic *Phragmites*, but maintaining, if not increasing the native



Shayne Hoachlander (PGC retired) and PNHP Invasive Species Ecologist Brian Daggs assess a fen monitoring plot.

Christopher Tracey

species cover at the site. Before the initial treatment, PNHP ecologists set up a vegetation monitoring plot, to serve as a baseline to measure the success of management activities. We reassessed this plot in August. No significant change in native species composition and abundance was detected, but there was a significant

decline in *Phragmites* as a result of the treatment operations!

In summary, our initial treatment was more successful than we imagined, with the *Phragmites* abundance greatly reduced and no long term damage to the native plant community. We will continue to monitor *Phragmites* growth and native species at these fens and conduct follow-up treatments as required. This experience is providing the foundation for managing these important fen habitats across Pennsylvania Game Commission and other protected lands across northwestern Pennsylvania.

A Floodplain Field Day

Mary Ann Furedi

Many of the past and current ecology projects focusing on wetlands and riparian areas have been funded through EPA Wetland Program Development Grants. These projects not only help PNHP ecologists expand their understanding of wetland and riparian systems in Pennsylvania but also provide the opportunity to work with partners to help address the knowledge gaps outlined in PA DEP's Aquatic Resource Protection and Management Plan.

Field visits are one way that PNHP ecologists engage project partners. Instead of just reading about a project in a progress report, partners are invited to meet in the field to experience the project firsthand. This summer, PNHP ecologists were working on a project to characterize floodplain plant communities associated with the Lehigh River and invited staff from U.S. EPA

Region 3, DEP, and DCNR to join them for a field day. During this visit, the partners were introduced to the rich history of the river and its floodplain communities, helped with the data collection used to characterize plant communities, and learned to identify some of the common plants and mosses found in this area.



Mary Ann Furedi

Greg Podniesinski (DCNR) describes how flooding impacts floodplain plant communities.

The field visit was not only a great time to introduce the project to the partners but also an excellent learning opportunity for all. Given that the group was comprised of individuals with diverse biological backgrounds, it was interesting to hear the group's thoughts on what we were seeing. We had an interdisciplinary discussion about how geology, landforms, fluvial processes, and land uses have all contributed to the current floodplains and plant communities present today. Overall, it was great day to learn about and experience the Lehigh River.



Mary Ann Furedi

Big Bluestem - Indian-grass Floodplain Grassland is one of the common plant communities found along the banks and in-stream islands of the Lehigh River.

High Conservation Value Forest Bat Surveys: Summer Mist Net Captures

Joe Wisgo

Given the massive declines in hibernating bats due to White-Nose Syndrome (WNS), PNHP has been working with agency partners to document resilient survivors throughout the state. Part of this survey effort is focused on tracts of DCNR Bureau of Forestry Lands selected as High Conservation Value Forest (HCVF). These tracts of land are designated as such because they contain globally, regionally, or nationally significant concentrations of biodiversity and/or rare, threatened, and endangered species.



Charlie Eichelberger

The northern long-eared bat, a federally threatened species, is a denizen of Pennsylvania's expansive forests.

Recently while conducting bat surveys on HCVF forest tracts throughout the state, PNHP zoologists documented new occurrences for both the federally threatened northern long-eared bat (*Myotis septentrionalis*) and the state threatened small-footed bat (*Myotis leibii*), as well as updated a previous occurrence of the state endangered little brown bat (*Myotis lucifugus*). Northern long-eared and small-footed bats



Charlie Eichelberger

Once the most common bat in the state, the little brown bat is now listed as state endangered.

have never been very common species on Pennsylvania's landscape; however, before the introduction of WNS, little brown bats were extremely common, and unfortunately, WNS has caused a near 99% loss to Pennsylvania's little brown bat population.

While it's apparent that the damage caused by WNS isn't likely to be reversed anytime soon, it is encouraging to see some bats are showing signs of resiliency to the disease. PNHP along with agency partners will continue surveillance for bat species of concern as well as identify and attempt to conserve important habitats.

In Process-based Restoration, Collaboration is Key

Ephraim Zimmerman

This summer, PNHP collaborated with an effort led by the U.S. Forest Service, the Western Pennsylvania Conservancy's Watershed Conservation Program, and hydrologists from Bucknell University to improve habitat in streams throughout the Allegheny National Forest (ANF) through a process-based ecological restoration technique that uses additions of large woody material (LWM) to restore riparian ecosystems severely altered by recent human activities. The most prominent restoration project using LWM in the ANF is along Little Arnot Run, a tributary of Tionesta Creek in Warren County.



Luke Bobnar

In what may look like a pristine high-gradient cold water stream in the Allegheny National Forest, oil and gas development and logging activities have degraded Little Arnot Run and its floodplain. Restoration using the large wood materials (LWM) methods will reconnect the channel to the floodplain, restoring floodplain wetlands and ecological function like erosion and sedimentation control.

Like many watersheds in Pennsylvania, Little Arnot Run was subjected to industrial timber harvesting and rampant oil and gas development and the legacy effects of such exploitations remain as altered stream channels and riparian communities. While there are abandoned

channel scars, low-lying areas, and seepages on the floodplain, the low terraces of Little Arnot Run support dry upland communities, primarily an upland Hemlock – Northern Hardwood Forest. It is our hope that restoration activities will return headwater riparian wetlands to the Little Arnot Run floodplain by exposing the area to periodic flooding, and raising the water table, which will support native wetland species and benefit fish and wildlife as well.

There are a variety of process-based restoration techniques that exist and they range in scope from very active interventions, such as removing dams and barriers of accumulated sediment, to more passive approaches such as the LWM methods, which involve strategically cutting and felling trees across the stream or placing rootwads directly in the stream channel. LWM methods are considered the most natural, least invasive restoration options and ideal for small forested watersheds like Little Arnot Run.

In 2019, researchers from Bucknell, Gannon, and Lockhaven universities began pre-restoration baseline data collection in Little Arnot Run focused on hydrology, fluvial processes, water chemistry, and inventories of fish, amphibians, benthic invertebrates, and algal associations. With an Environmental Protection Agency Wetland Program Development Grant, PNHP and the WPC's Watershed Conservation Program contributed to the pre-construction baseline in the summer of 2021 by delineating the extent of the floodplain wetlands and determining the composition of the riparian vegetation along transects established across the Little Arnot Run valley. Watershed Conservation Program researchers also conducted trout habitat surveys.



PNHP Heritage ecologists Scott Schuette and Brian Daggs, Cheyenne Moore (UPitt), and Grace Tillotson (ANF) record baseline vegetation of the Little Arnot Run channel prior to restoration.

Ephraim Zimmerman

The active restoration phase took place in August 2021 and staff assisted with the placement of 20 LWM structures in the stream channel. Due to the entrenched nature of the stream from the presence of an old railroad bed used to haul timber, workers removed a few small sediment dams ("gates") impeding the natural flow of water to the floodplain and raised the elevation of the stream bed behind some of the structures to reconnect additional low-lying areas on the floodplain. Following construction, Watershed staff recorded the position of the LWM installed in the channel to document its movement over time. The team will monitor the conditions within the Little Arnot Run valley over the next few years to provide a comprehensive review of this stream restoration project. The Pennsylvania Department of Conservation and Natural Resources (PADCNR) and Pennsylvania Department of Environmental Protection (PADEP) both of whom are involved in stream restoration projects throughout the state, have identified the Little Arnot Run as a possible "demonstration" watershed, where baseline data can be gathered prior to, during, and after restoration activities take place to monitor change and assess success. It is our hope that the results will be used to guide restoration of headwater riparian wetlands region-wide.



Luke Bobnar

Little Arnot Run during a high flow event post construction. An intense storm dumped nearly 4 inches of water in the region over the course of a day shortly after restoration activities on the LAR floodplain. Removing artificial levees and other earthen barriers to natural flow and installing large logs and wood material to the stream allowed flood-waters to enter and flow across the floodplain.

Shortly after construction, a severe storm dumped four inches of rain in the Little Arnot Run area over the course of a 24 hour period – resulting in flooding over the banks of the creek. Eyewitness accounts suggest the structures not only held, but functioned to restore the flow of water to the floodplain. It is not clear how effective the LWM structures will be in restoring the floodplain, but it certainly looks like a few of the right pieces (of LWM) are in place.

NatureServe comes to Pennsylvania

Jeff Wagner



Jeff Wagner

NatureServe President, Sean O'Brien and Director of Network Relations, Allison Gratz learning about the scour habitat and challenges in managing recreationists while visiting the Meadow Run scour along the Youghiogheny River.

NatureServe has set a goal to visit all of the state programs in the network to talk with program staff and tour places of note. Sean O'Brien, President and CEO, along with Allison Gratz, Director of Network Relations, drove the famous Van Humboldt van, outfitted for all seasons, to the Laurel Highlands the third week in July. In the morning, along with Bureau of State Parks (BOSP) staff, a group of PNHP staff met with Sean and Allison, toured the river scour of the Youghiogheny River at Meadow Run and visited the site of the vernal pool restoration that we partnered with BOSP to complete last year. In the afternoon, we stopped by Bear Run Nature Reserve to hike Peninsula Trail and get a broad view of the Youghiogheny valley.

At all stops, our botanists pointed out rare plants and we described many of our projects in the Laurel Highlands and throughout the state. We chose Ohiopyle not only because we have had several recent projects in the area but because it represents a unique and iconic section of the state where biodiversity overlaps so strongly with recreational interests. Even though this apparent conflict presents challenges, it offers opportunities to make the public aware of the resources that have drawn people to this place over the decades.

We ended the day with a meal at a local pub in Ohiopyle and talked about PNHP, the Heritage network, NatureServe, and of course, the natural world that we all care so much about. The artisanal cider that Sean brought for the occasion helped to make the day all the more memorable!

Conservation Plant Genetics Collaboration in Pennsylvania

Scott Schuette

Rare plant conservation relies on an understanding of the natural history, biology and ecology, and current and potential threats to their populations to inform state regulations that serve to protect the species from extirpation. This work often involves extensive field surveys over several years to determine population sizes and whether those populations are seeing reductions in the number of individuals and consequently, the ability to maintain the genetic diversity within and between those populations. Species and populations with high genetic diversity are better equipped to withstand sudden changes to their habitats from land use changes and changing climate.

Understanding the current state of genetic diversity of rare plant populations is an important step in developing strategies and recommendations for plant conservation in Pennsylvania.

A WRCP-funded project began in 2018 in collaboration with Dr. Chris Martine and his students at Bucknell

University focusing on three plant species of concern: blue false indigo (*Baptisia australis*), river oats (*Chasmanthium latifolium*), and harbinger of spring (*Erigenia bulbosa*). These species are at, or nearly at, the edge of their native ranges and have disjunct distributions in Pennsylvania. Two main goals of the project were to introduce undergraduate and graduate students to natural heritage methodology and investigate the genetic diversity of rare plants using innovative population genetics methods. This approach allowed us to utilize PNHP rare species data in conjunction with the genetic diversity data to perform conservation



Scott Schuette

River oats (*Chasmanthium latifolium*)



Scott Schuette

Blue false indigo (*Baptisia australis*)

status and climate change vulnerability analyses to inform DCNR with a more complete picture for listing decisions.



Harbinger of spring (*Erigenia bulbosa*)

Scott Schuette

As a result, the work at Bucknell revealed that *Baptisia* and *Erigenia* populations are genetically isolated with low genetic diversity and moderate to high levels of inbreeding, while *Chasmanthium* appears to have good diversity and no detectable inbreeding. Using this information, updates to the conservation statuses were completed; *Baptisia* remains Pennsylvania Threatened,

Chasmanthium will be proposed Pennsylvania Rare (currently tentatively undetermined), and *Erigenia* was successfully changed to Pennsylvania Rare and all populations now have conservation protections. Of these species, the work on *Erigenia* was published in the International Journal of Plant Sciences and a side project involving *Baptisia* fruits in Natural Areas Journal.

In addition, we developed a model for integrating the applied botanical research with academic botanical research to maximize the available information for leveraging actionable plant conservation. The students associated with the project presented their work at numerous regional and national conferences, many of which resulted in research awards and prizes for their outstanding work. In total, 8 podium presentations, 12 poster presentations, 4 peer-reviewed manuscripts (2 published, 2 in prep), a video production highlighting some of the research (<https://www.youtube.com/watch?v=b-XhtTw7VIY&t=7s>), and 13 student research awards.

Overall, this very successful collaboration has grown into a long-term partnership between Bucknell University and PNHP. Building from this success and to continue assessing the conservation genetics of rare, threatened, and endangered plants in Pennsylvania, Bucknell University submitted another grant this year for funding consideration that has PNHP responsible for the field botany and training workshops for students interested in learning heritage methodologies such as conservation rank status and climate change vulnerability analyses.

Rich Shockey Retires (Again!)

Greg Podniesinski

Rich Shockey, a long-time environmental review specialist in the DCNR Natural Heritage Section, retired in October. This was Rich's second retirement, as he came to the program after a long career with the Natural Resource Conservation Service (NRCS). Rich originally started as a short term, part-time reviewer and meant to stay for only 3 years, that was back in 2007. Fourteen years later, Rich is ready to retire again and we will greatly miss him!



Rich using a radio telemetry antenna to track wildlife with PNHP biologists.

Aura Stauffer

Rich has been an invaluable resource to the program, especially working with farmers, local conservation districts, and NRCS, helping them navigate the environmental review and PNDI process. Rich has also been a tireless advocate for

improving soil health, keeping the program and DCNR staff informed with the latest information (and prodding us to do more). Rich has worked closely with the Stroud Water Research Center and served as an informal liaison, organizing DCNR, DEP, and other agency staff to attend educational tours and trainings at the Center to learn about riparian buffers, soil health, and watershed management.

Above all, Rich was always positive and willing to help out where he could. He organized an annual sock, mitten, and hat "Donation Christmas Tree" every year for pre-school children. Rich plans to work on his home in Cumberland County and cabin in West Virginia and spend time with his grand-kids in retirement. Working with Rich for the past 14 years has been, in his often used exclamation, "Fantastic!"



Shockey Family

Erie National Wildlife Refuge Turtle Surveys

Ryan Miller

Late in the winter of 2020, we were contracted to conduct targeted springtime surveys for wood turtles (*Glyptemys insculpta*) and spotted turtles (*Clemmys guttata*) at the Erie National Wildlife Refuge (ENWR). Both turtle species are considered priority conservation species in the northeastern United States and Species of Greatest Conservation Need by the Pennsylvania Wildlife Action Plan. The abundance of either turtle was unknown on the refuge, but it provides ideal habitat for both species. Currently, little is known about wood turtle and spotted turtle populations on ENWR and other wildlife refuge lands.



Zoologist Ryan Miller prepares to take morphometric data on a newly captured wood turtle.

JoAnn Albert

Zoologist, Ryan Miller led the project and conducted eight visual encounter surveys in April and May on ENWR in high quality wetland habitats to maximize the opportunity to observe the turtles if they were present. These timed surveys had staff and dedicated volunteers trudging through waist deep vegetation, muck, and water, searching likely basking spots for sunning turtles. We

encountered 122 painted turtles, 12 snapping turtles, two spiny softshell turtles, and seven wood turtles.

We also conducted live trapping in numerous wetlands around the refuge. Thirty-five traps were baited with sardines and set for four nights in early May. The trapping effort captured 46 painted turtles and two snapping turtles.

Although no spotted turtles were encountered during this effort, it is still plausible that they may reside within ENWR's boundaries. These limited surveys only allowed us to investigate a small percentage of the available habitat on the refuge.

The wood turtle surveys collected data that can be used to inform estimates of occupancy, abundance, and reproductive potential, and also allow refuges to contribute to the Northeast Wood Turtle Working Group's assessment of regional trends. Wood turtles



Wood turtle (*Glyptemys insculpta*)

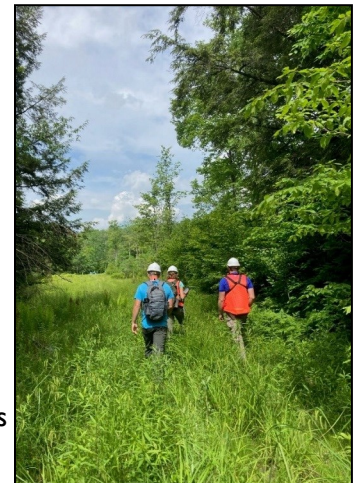
JoAnn Albert

within the refuge will continue to be monitored to assess population and habitat use trends to guide management decisions within the refuge.

Ecological Surveys in the Allegheny National Forest

Leigh Fehlman

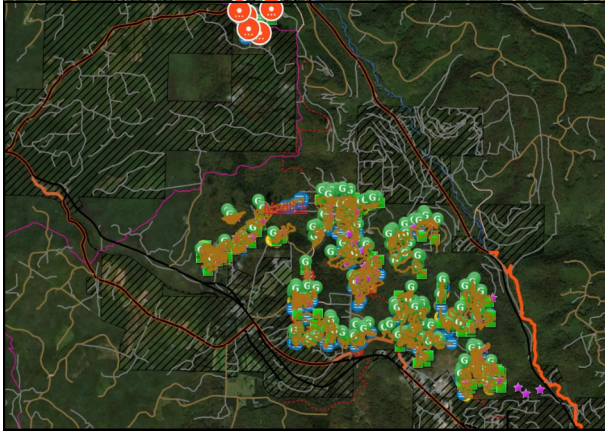
In designated areas of the Allegheny National Forest (ANF), preparation for silvicultural management is underway. To set a proper foundation, ecological surveys were conducted by the Pennsylvania Natural Heritage Program. The Western Pennsylvania Conservancy and Department of Conservation and Natural Resources (DCNR) staff hired four Seasonal Natural Resource Biologists to perform the surveys through the summer of 2021. The seasonal biologists were able to work alongside DCNR and U.S. Forest Service staff through the Good Neighbor Agreement, which is designed to promote collaboration between both agencies. The data collected will help the U.S. Forest Service decide what areas of land should be left undisturbed in order to conserve special plants, wildlife, and habitat.



Seasonal biologists heading into the field.

Kate Tillotson

Our four seasonal staff – Kate Tillotson, Luke Gray, Matt O'Brien, and Leigh Fehlman - were enthusiastic, had relevant experience, and offered some unique skills and experience from their particular backgrounds. To conduct the surveys, the biologists walked transects in



Map of survey area showing transects and Survey 123 points.

certain areas within the Madlick Management Unit, a section of land in the ANF near Kane, Pennsylvania. These areas have been marked by the U.S. Forest Service for silviculture management - activities such as reforestation or timber harvest. The transects were recorded by GPS through the Field Maps app on state-issued iPads. The biologists identified plants, wildlife, and special habitats along with invasive species, raptor nests, wetlands, disturbances, and location. Data was recorded through the Survey 123 app and reviewed by U.S. Forest Service. The Marienville Ranger District Botanist, Lauren Segarra, and Wildlife Biologist, Daniel Tollini, provided guidance on survey protocols and assisted with field work planning and plant identification. District Forester Cecile Stelter and the Cornplanter State Forest District provided the team with logistical support and a home base out of the Warren district office.

Once the surveys are completed, the U.S. Forest Service will determine which areas to dedicate as reserve for plants and wildlife within the Allegheny National Forest and will be able to conserve species diversity in the region.

Processing Fish, Amphibian, and Reptile Records

Susan Klugman and Kierstin Carlson

The Heritage Information Management team has received a grant from the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission (PFBC). This project, which began on July 1, 2021, is a continuation of our work on fish, amphibian and reptile data under a previous grant that ran from September 2015 through December 2017. The goal is to organize, process, and convert Species of Greatest Conservation Need (SGCN) information into the Pennsylvania Natural Heritage Program (PNHP) Biotics database format and

develop Conservation Planning and Environmental Review datasets for the Pennsylvania Conservation Explorer (PACE) Environmental Review Program.

The data for amphibians and reptiles comes primarily from the Pennsylvania Amphibian and Reptile Survey (PARS), a joint venture between PFBC and the Mid-Atlantic Center for Herpetology and Conservation. It is an online database (<https://paherpsurvey.org>) with members who enter their finds, from skilled professionals to amateur naturalists or “community scientists” who like to look for reptiles and amphibians. PARS reviewers verify the records for correct species identification, and records for SGCN are forwarded to us for processing. Under our previous grant, we processed over 4,600 amphibian and reptile records of 39 species from PARS. Since that grant ended in 2017, over 5,000 additional field observations and historical museum specimen records for SGCN have been submitted to Heritage Information Management.



Jack Ray

Observations of species like the eastern spadefoot are being reported by community scientists. These reports are combined with information from other sources in our databases to further understanding of Species of Greatest Conservation Need.

The data for fish come from the work that culminated in the *Fishes of Pennsylvania*, by Jay R. Stauffer, Douglas P. Fischer, and Robert W. Criswell, published in 2016. The book contains over 35,000 records for fish SGCN. We have focused on processing those that are state-listed and included in Environmental Review.

The PARS project continues to increase our knowledge of amphibian and reptile species in Pennsylvania. PFBC is sending us new PARS records as the database continues to grow. We are also continuing to process the thousands of fish records we’ve received, which will increase their representation in our databases and products. Getting these records processed into our Heritage databases promotes more effective conservation planning and environmental review, and better protection of these species in Pennsylvania.