Pennsylvania Natural Heritage Program

ANNUAL REPORT 2021

MESSAGE FROM THE PROGRAM

After necessary caution and delays in 2020 with staff having to adapt to pandemic work arrangements, this year found us fully engaged in the whole range of projects that we were continuing or starting. As usual, our staff invested a lot of time in the field, faced some challenges, and collected some incredible data with the help of new technology and great planning. Perhaps not surprisingly, virtual communication has benefited our program as we work in numerous places across the state.

We spent a lot of time in wet places this year, surveying floodplains, reintroducing freshwater mussels, monitoring the scour sections of the Youghiogheny River, managing fens in the northwest, and surveying for marsh birds in incredibly dense and extensive wetlands on State Game Lands. Thankfully, the weather cooperated and we didn't have to delay any of the work to next field season as we have had to do in years past. Also, as one might expect with having many biologists working around the state, we found some unique species and places, and worked with partners to keep long known special places healthy and able to support the rare species living there.

As data flows in from our field projects, we are also concentrating on entering datasets coming from outside the program. We are again processing a set of fish, reptile, and amphibian records from PFBC and the PARS database and expect to update our geologic features with the new classification developed by the Bureau of Geological Survey at DCNR. The information we collected from the southwest Pennsylvania 10-county inventory is now fully integrated into over 600 Natural Heritage Areas and available on the PNHP website.

Our work with partners and volunteers is always an important part of our program. We were able to contribute our expertise to the New Jersey Natural Heritage Program for cliff surveys, to Longwood Gardens for natural community mapping and classification, to Allegheny County Parks as part of their park wide master plans, and to DCNR to prepare for the newly adopted bat habitat conservation plan. We managed seasonal biologists to help with compartment surveys in the Allegheny National Forest, worked with graduate students to assess Aconitum populations on river scours, and held the third water chestnut challenge as part of our growing invasive species work.

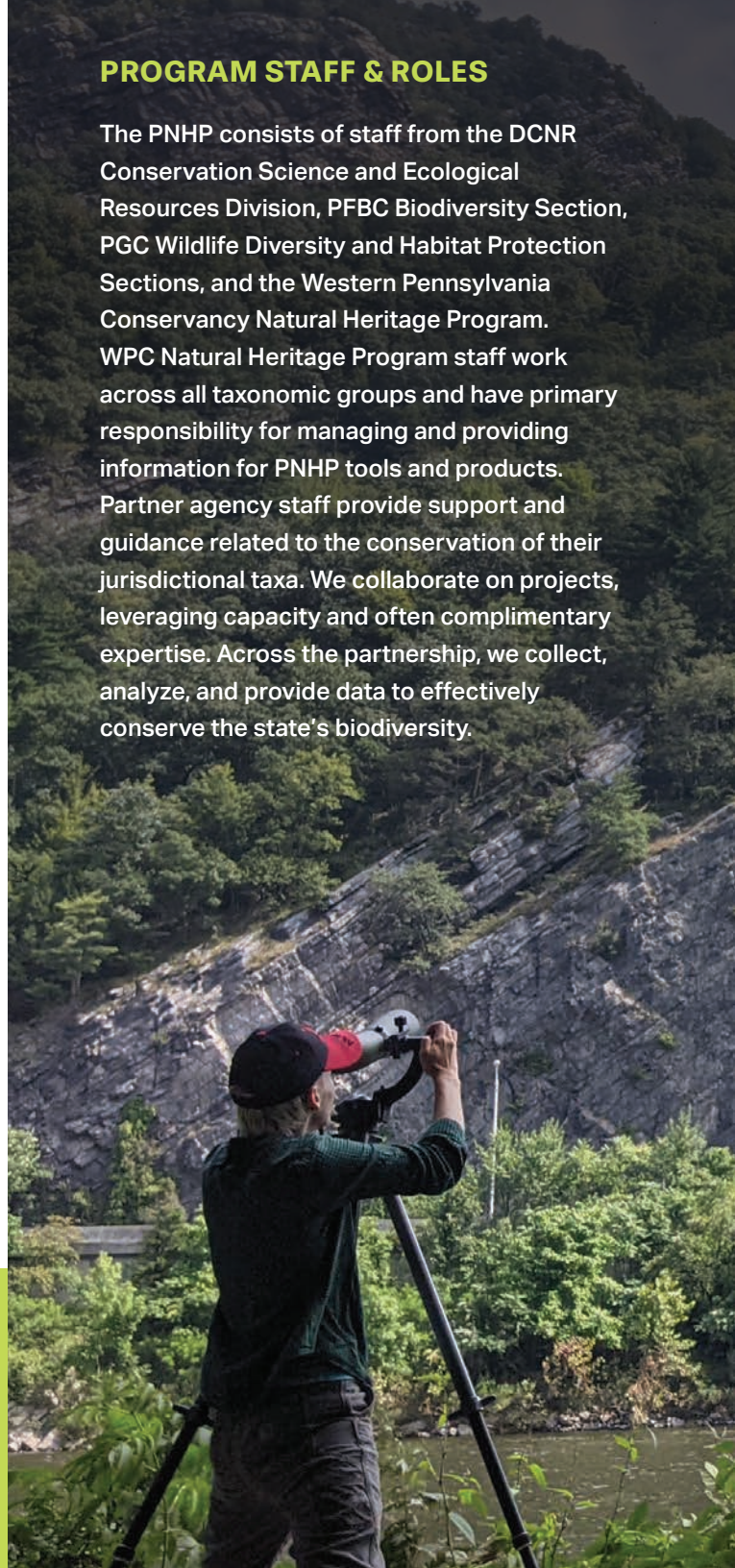
Please enjoy and share our fourth annual report. We feel fortunate to be able to carry on with our work and constantly expand and share our expertise and information.

OUR MISSION

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

PROGRAM STAFF & ROLES

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



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

This year, NatureServe President, Sean O'Brien accompanied by Director of Network Relations, Allison Gratz, visited Pennsylvania as part of an initiative to visit every program in the lower 48 states. They spend a day with each program, visiting significant places, and having conversations that only rarely have a chance to happen.

PNHP and NatureServe share a commitment to maintain a close working relationship for our benefit and that of the network as a whole. Collaboration and mutual support are the key pieces of keeping the network and NatureServe strong and adaptable. Fresh leadership and a new strategic plan position NatureServe to lead the network into the decades ahead.

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

Our Partners

DCNR

Pennsylvania Game Commission 1895

Pennsylvania Fish & Boat Commission

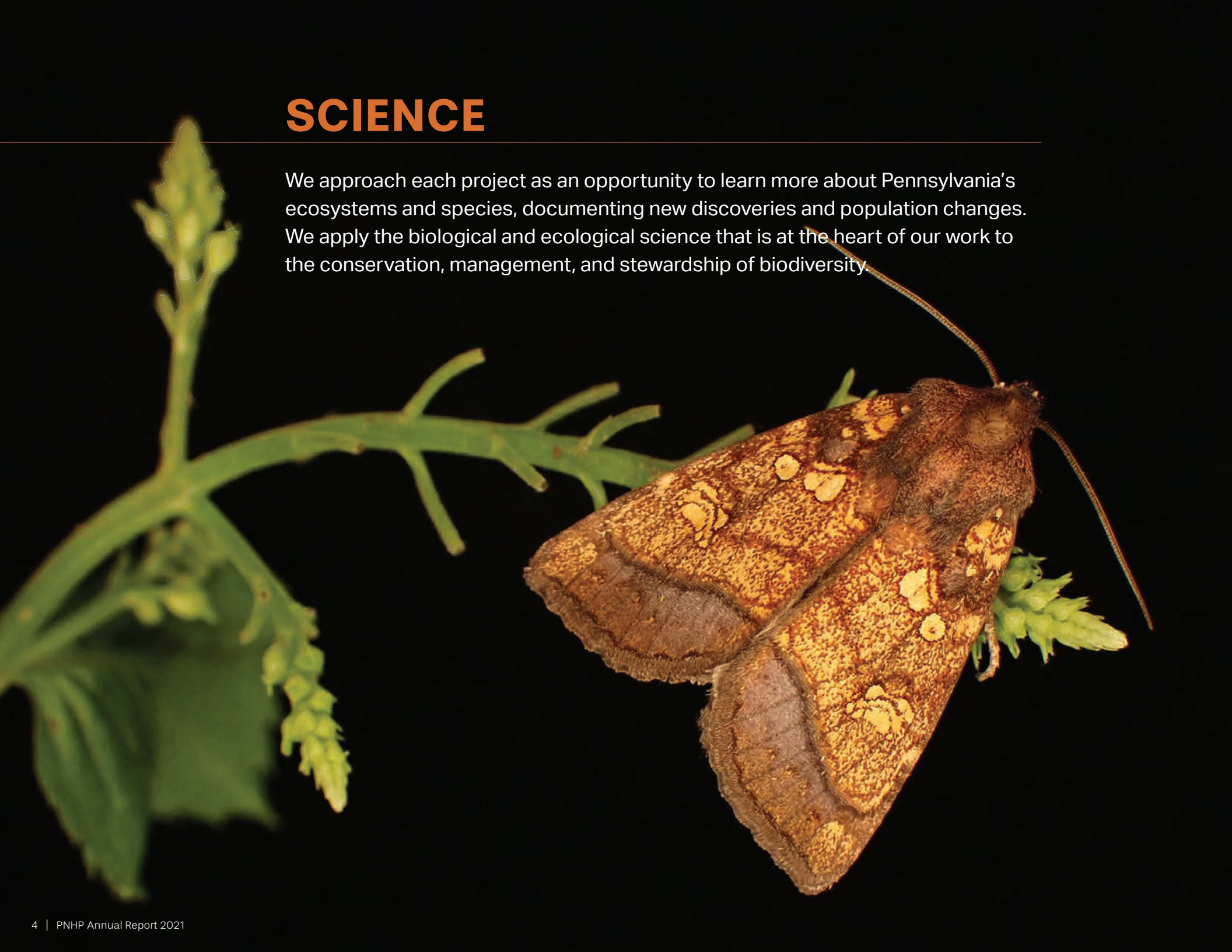
Western Pennsylvania Conservancy
water, land, life.

In Cooperation With

U.S. Fish & Wildlife Service

SCIENCE

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



DISCOVERIES

INVERTEBRATES

Every year our lists of the invertebrate species of Pennsylvania grow longer and more complete, both through our field work and that of many others. And every year we improve our knowledge of the distribution of those species, which helps us work toward assigning conservation ranks to those species. Every ten years, we have a chance to recognize our species of conservation concern when Pennsylvania's State Wildlife Action Plan (SWAP) is revised. In the most recent revision of the plan in 2015, 450 species of invertebrates were recognized as being Species of Greatest Conservation Need (SGCN). As we work toward the 2025 SWAP revision, PNHP is anticipating adding more moths, bees, flowerflies, and other invertebrates to that list.

Five Moths and a Stonefly

- This year PNHP staff conducted a number of caterpillar surveys targeting specific species of concern, with success in many cases.
  - We found that the globally rare yellow stoneroot borer moth (*Papaipema astuta*) is more widespread in the state than previously known; we have now found it in five counties.
  - We found the globally rare dark stoneroot borer moth (*Papaipema duplicatus*) in two counties in western Pennsylvania, where we did not expect it to be.
  - The globally rare starry campion moth (*Hadena ectypa*), previously known from one record in the state, was found at three new sites, and caterpillar feeding damage strongly suspected to be from that species was found at two additional sites.
- PNHP biologists found caterpillars of the moth hoptree borer moth (*Prays atomocella*) at Presque Isle, where the state's largest population of its hostplant (hoptree, *Ptelea trifoliata*) can be found. This is the first time this species has been found in Pennsylvania. As an obligate feeder on a Pennsylvania rare plant, this moth will likewise be considered a rare species in the state. The low-down ash bark-miner moth (*Marmara basidendroca*) was also confirmed for Pennsylvania for the first time. This moth is probably not rare at this time, but it is expected to decline steeply in coming years as ash seedlings become scarce in the wake of the emerald ash-borer (*Agrilus planipennis*).
- Pennsylvania's endemic stonefly, the Powdermill forestfly (*Soyedina merritti*), was found at two new sites in the Laurel Highlands.

One Sawfly Mystery Solved, One More to Go

Last year PNHP biologists found some sawfly larvae eating the leaves of bladdernut (*Staphylea trifolia*), which was not known to be the host plant of any sawfly. Our biologists reared the larvae to adulthood and sent them to sawfly expert Dr. David Smith. Covid restrictions prevented Dr. Smith from going to his laboratory until this year, but when he got back he quickly determined that the sawflies were *Caliroa lunata*, which had never been associated with a host plant before. So now we understand one piece of the ecology of one of our less-studied invertebrates.

This year PNHP biologists found sawfly larvae eating the leaves of mountain brook lettuce (*Micranthes micranthidifolia*). No sawfly is known to eat any plant in the Saxifrage family, so we are excited to rear these to determine what species they are, or whether they might be an undescribed species. This sawfly appears to have just one generation per year, so with a little luck we will see the adults in the spring of 2022.

Big Sand Tiger Discovered in Pennsylvania Woods

It sounds exotic but Pennsylvania is home to tigers…in the beetle family! In spring of 2021, PNHP volunteers John and Becky Peplinski and Ben Coulter documented a new location of the eastern big sand tiger beetle (*Cicindela formosa generosa*). It was known historically in Pennsylvania from one site in Centre County but had not been seen since 1988 and may be gone from that site due to habitat loss or succession. The newly discovered location is a sandy opening in a large pine-oak woodland, about ten miles from the historical site. The big sand tiger beetle is a denizen of dry upland sandy habitats with little or no low vegetation. In the larval stage, big sand tiger beetles dig pits in the sand to capture small invertebrates who fall into their traps. Adult big sand tiger beetles run rapidly across the ground to catch their prey with their formidable mandibles. This species is secure globally but critically imperiled in Pennsylvania, so we are happy to know that they are still here.

BIRD SURVEYS YIELD RARE PLANT OCCURRENCES

During bird 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.

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.

SUMMER BAT CAPTURES

Over the past summer while conducting bat surveys on surveys on the Bureau of Forestry's High Conservation High Conservation Value Forest tracts throughout Pennsylvania, PNHP zoologists documented new occurrences for both the federally threatened northern long-eared bat (*Myotis septentrionalis*) and the state threatened small-footed bat (*M. leibii*), as well as updated a previous occurrence of the state endangered little brown bat (*M. lucifugus*). Northern long-eared and small-footed bats have never been common species on Pennsylvania's landscape, but due to the introduction of the non-native cold dwelling fungus *Pseudogymnascus destructans* which causes White Nose Syndrome, all native bat populations belonging to the genus *Myotis* have suffered sharp declines. Recently, the Department of Conservation and Natural Resources and the Pennsylvania Game Commission have developed a Habitat Conservation Plan which aims to promote the creation and maintenance of seasonal habitats through forest management strategies. Initiatives such as seasonal restrictions, canopy retention, and protection of hibernacula will be implemented to enhance bat habitat on Pennsylvania's landscape.

BE ON THE LOOKOUT FOR THIS NEW INVADER

JAVA WATERDROPWORT (*Oenanthe javanica*) is a perennial herb native to East Asia and Queensland, Australia, but considered exotic in Pennsylvania. Some plant enthusiasts enjoy using it in their home gardens while others appreciate its medicinal qualities and uses in salads and seasonings. However, natural resource professionals have determined java waterdropwort is an invasive species in the commonwealth because it can escape from cultivation and enter into natural areas where native plants are outcompeted and ecological processes are hindered.

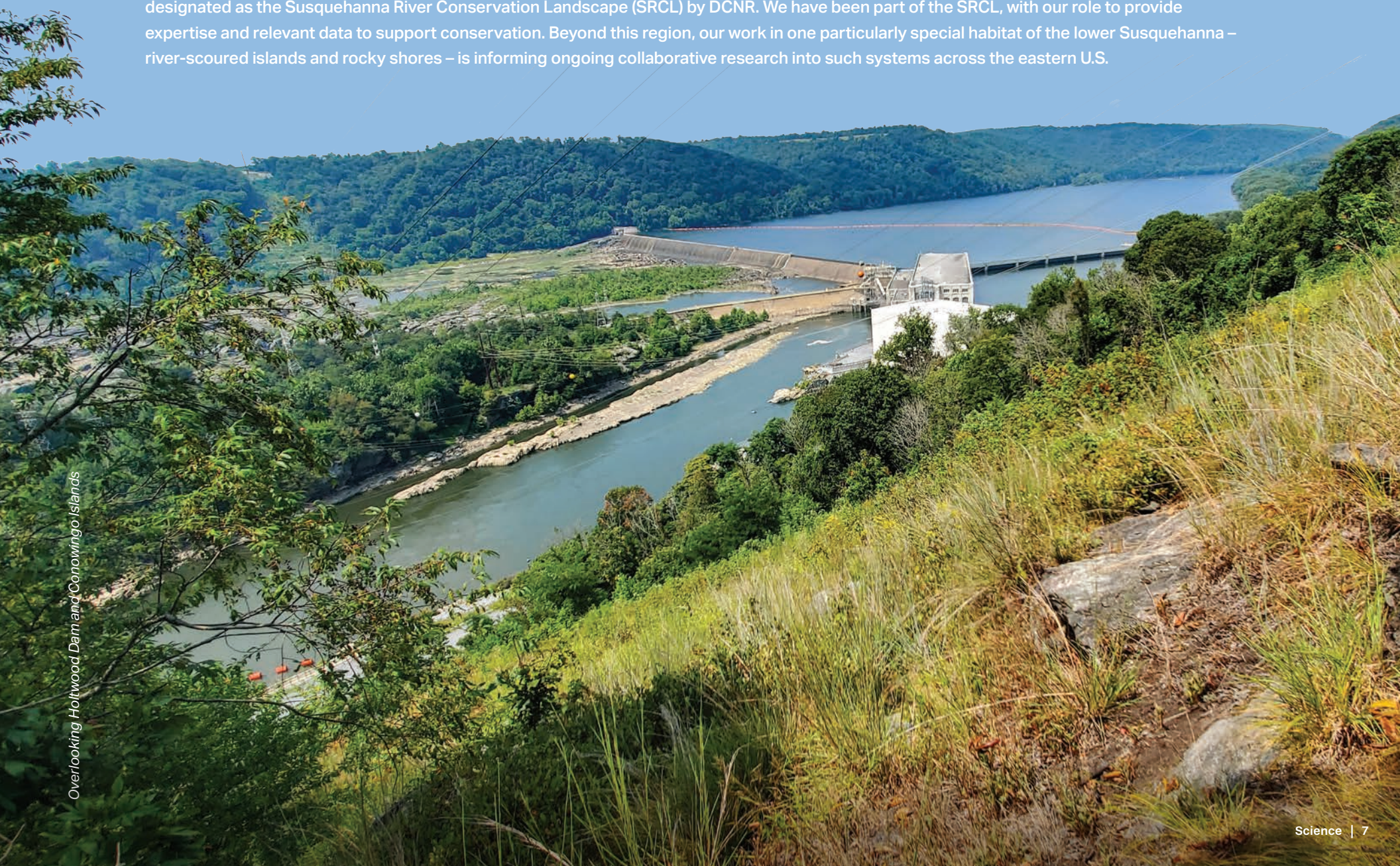
In 2020, java waterdropwort was found for the first time in Pennsylvania in Berks County, and later in 2021, in Franklin County. These reports submitted to iMapInvasives were a surprise to many and indicate this plant is one to continue watching for in our state. If you think you've found java waterdropwort anywhere in Pennsylvania, please submit your finding(s) to iMapInvasives by filling out a public report.

Java waterdropwort discovered in Franklin County in 2021.

RIVERS

LOWER SUSQUEHANNA RIVER

In 2021 PNHP conducted updates and inventory work on the lower Susquehanna River, a continuation from 2020 when we began putting our newly developed Botany Plan into practice. The lower Susquehanna River is home to many rare species and communities, and it has been designated as the Susquehanna River Conservation Landscape (SRCL) by DCNR. We have been part of the SRCL, with our role to provide expertise and relevant data to support conservation. Beyond this region, our work in one particularly special habitat of the lower Susquehanna – river-scoured islands and rocky shores – is informing ongoing collaborative research into such systems across the eastern U.S.



Overlooking Holtwood Dam and Conowingo Islands

YOUGHIOGHENY RIVERSCOUR

We continued work on the Youghiogheny Riverscour, an important habitat for rare plant species. These rare plants make their home in bedrock cracks and between rocks in the cobble bars and are subject to high flows that maintain the open habitat that they require. Using field cameras that record time lapse videos of high flow events and hydrological modeling conducted by our partners at the Army Corps of Engineers, we have begun to better understand the interacting factors such as river flow management, invasive species, and climate change that influence these rare plant populations. We are working with Ohiopyle State Park to utilize the results of this research to guide management decisions.

FLOODPLAIN PLANT COMMUNITIES

Over the last three years, PNHP ecologists have conducted an EPA-funded study to better understand the composition, condition, and distribution of floodplain plant communities in Pennsylvania. Previous work focused on larger rivers in the state, but until now, less effort had been directed at smaller ones.

This year, the focus was on floodplains of the upper Lehigh River. Natural factors like geology, landform, and slope, coupled with historical and present uses of the river, have helped shape the floodplain communities of today.

Generally, we found the overall floodplain extent was limited. Plant communities occurred as narrow bands in the floodplain on exposed rocky shorelines and grasslands adjacent to the river channel and floodplain shrublands and forests paralleling the upland edge. Most community types were similar to those found along other rivers in the state. One exception was a floodplain shrubland type of dense glossy buckthorn, an invasive species in Pennsylvania. This work will provide a good baseline of current conditions to help gauge future changes.

STATUS ASSESSMENTS

SECRETIVE MARSH BIRD SURVEYS

PNHP Avian Ecologist David Yeany led a team of PNHP seasonal avian technicians and full-time ecologists in an intensive survey of secretive marsh birds and their habitats in Pennsylvania's largest contiguous wetlands. With funding and assistance from the Pennsylvania Game Commission and the Wild Resources Conservation Program, our team navigated the challenging wetlands of Crawford County's Conneaut Marsh, Pymatuning, and Hartstown Marsh on State Game Lands 213 and 214 as a complementary effort to PGC's 2020 statewide volunteer marsh bird survey. We surveyed more than 5,500 acres of wetland habitat as we conducted the most comprehensive survey ever for these wetlands. We detected 11 of 16 target marsh bird species and documented 27 PNHP bird Species of Conservation Concern, including high numbers of Virginia rail (*Rallus limicola*), marsh wren (*Cistothorus palustris*), and common gallinule (*Gallinula galeata)*. Most significantly, we detected PA-Endangered least bittern (*Ixobrychus exilis*) at 33 locations (27% of all points) with 59 total detections, likely representing a population equal in size to the population at Presque Isle which is considered to be the largest in the state. Our analysis of bird and vegetation data, including extensive drone imagery and mapping, will help to estimate populations, identify critical habitat, and inform wetland management to help conserve declining marsh bird species.

BEES OF BARRENS

Barrens habitats support unique groupings of plants and wildlife, and many Species of Greatest Conservation Need. For this project, we are documenting the distribution of wild bees and their associated plant communities in barrens. We established 40 vegetation and 13 bee transects across four xeric habitats in Pennsylvania. We survey the vegetation transects once and the bee transects monthly (spring through fall) during each year of the project (2020-2022). Partner agencies are conducting vegetation management at several sites to maintain and expand early successional habitats. Resampling the transects will show how plant and bee communities change with habitat management. In the absence of management, we can study the effects of succession or the spread of invasive plants. Our data will be pooled and analyzed with data from xeric habitats in ten other states in the northeastern U.S. from Maryland to Maine. This project is supported by the Pennsylvania Department of Agriculture and a Regional Conservation Needs grant. More information on the Northeast Barrens project is available at https://www.northeastbarrens.org/.

EVENING GROSBEAK PROJECT

PNHP continued our partnership with the Carnegie Museum of Natural History's Powdermill Avian Research Center and the Finch Research Network to track the steeply declining evening grosbeak (*Coccothraustes vespertinus*) across its annual cycle using cutting edge technology. In the project's fifth year, we saw a huge winter irruption of evening grosbeaks into Pennsylvania and we deployed nanotags—tiny radio transmitters detected by automated radio telemetry stations—on 56 birds from December 2020 to April 2021. Our project represents the first tracking study of evening grosbeaks and the first to deploy new Lotek solar-powered nanotags. This gives us the potential to track these birds for their entire life. The 118 grosbeaks tagged or color-banded in our study have already shown us links between wintering sites in Pennsylvania and potential breeding areas in Quebec and Nova Scotia. Bolstered by the Road to Recovery initiative and a grant from the Knobloch Family Foundation, PNHP and its partners will expand this project in 2022 to include the use of new miniaturized satellite transmitters and additional grosbeak wintering sites across the eastern U.S. to better determine migratory connectivity and shed light on factors in the species decline.

This male evening grosbeak is outfitted with a solar-powered radio transmitter, enabling its movements to be detected by Motus receiver stations throughout the life of the bird.

GROWING OUR CRAYFISH DATA

Over the past four years, PNHP staff, partners, and contractors surveyed thousands of sites in Pennsylvania for crayfishes. We concentrated in the west, although some sites were in the southeast. These surveys resulted in the collection of the digger crayfish from Pennsylvania for the first time, the discovery of a potentially undescribed species in the Lake Erie basin, and the rediscovery of the devil crayfish, last found in Pennsylvania in the early 1900s and currently only known from one site in the state. Green spaces including parks and game lands serve as important refugia for crayfishes in anthropogenically modified landscapes. By 2021, enough data were available to calculate conservation ranks for many of Pennsylvania's crayfishes. Nine species were ranked as potentially rare, threatened, or endangered and recommended for SGCN status. The devil crayfish, digger crayfish, calico crayfish, and the potentially undescribed species were the rarest species with each found at <15 sites occupying <6 square miles, indicating a high degree of imperilment and risk of extirpation from the state.

STEWARDSHIP & MANAGEMENT

ASSESSING STREAM READINESS FOR FRESHWATER MUSSEL REINTRODUCTIONS IN WESTERN PENNSYLVANIA

To assess streams for reintroducing freshwater mussels in locations where they were wiped out due to prior pollution, we placed mussels in experimental containers, called silos. Juvenile plain pocketbook mussels lived in their temporary homes for two months, while filter feeding on particles suspended in the flowing waters passing through their silos. The juveniles are indicators of water quality conditions in the 13 streams in western Pennsylvania in which the study occurred. If juveniles survived and grew well in the silos, it would suggest that the water quality and general habitat quality in the stream is conducive to freshwater mussel reintroductions. Results will be available in 2022. The project is a collaboration between the Pennsylvania Natural Heritage Program, Pennsylvania Fish and Boat Commission, and U.S. Forest Service.

PLANT RECOVERY EFFORTS

PNHP in conjunction with DCNR identified many globally rare plant species and populations in critical need of stewardship to facilitate their recovery and prevent extirpation from Pennsylvania.

To help initiate this work, PNHP botanists performed detailed status assessments and developed recovery plans for 11 species in greatest need of focused attention. These plans serve as roadmaps for species-specific conservation research, planning, and activities that can be tracked over time. For example, pest treatment and invasive species control was performed for two populations of Canby's mountain lover (*Paxistima canbyi*) as outlined in the recovery plan.

We also are developing a plan for white monkshood (*Aconitum reclinatum*) beginning with detailed documentation of populations, habitats, and pollinators. Our work on these plans and early stages of implementation enables coordination of future activities through the Pennsylvania Plant Conservation Network of volunteer plant stewards.

POSITIVE RESULTS IN FEN MANAGEMENT

Follow-up visits in 2021 at two PGC-managed fen sites showed *Phragmites* cover was dramatically reduced by 2020 treatment efforts. Treatment was part of a cross-agency partnership to steward fens, which host some of Pennsylvania's most diverse native plant communities.

At a fen on State Game Land #196, a dense stand of *Phragmites* was almost entirely killed, preventing further displacement of the native fen vegetation growing below it. PNHP ecologists were unable to detect a negative effect on the native species from the herbicide treatment—a positive result highlighting the expertise of the PGC land management staff!

At a second fen management site on State Game Land #102, no living *Phragmites* could be found after treatment of a smaller stand. The density of native alder shrub cover was also reduced as many native fen specialists prefer more open environments. Follow-up monitoring at both sites over the next few years will be conducted to understand the response of the rare and other native species to these management activities and guide future work. Building on these early successes, we hope to expand fen management to more sites in 2022.

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

Restoration workers install large woody materials into the stream channel of Little Arnot Run.

LITTLE ARNOT RUN RESTORATION

In 2021, PNHP collaborated with an effort led by the U.S. Forest Service, the Western Pennsylvania Conservancy's Watershed Conservation Program, and faculty from Bucknell, Gannon, and Lock Haven universities to improve the aquatic habitat and ecological function of Little Arnot Run, a tributary of Tionesta Creek in Warren County. This restoration uses a number of large woody material (LWM) structures to increase the diversity and complexity of aquatic habitat and reconnect the stream to its floodplain. With funds from the EPA's Wetland Program Development Grants, PNHP and WPC's Watershed Conservation Program contributed to the pre-construction baseline 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. Restoration activities took place in August 2021. It is our hope that the results will be used to guide restoration of watersheds region-wide.

PLANTINGS FOR A RARE BUTTERFLY

PNHP staff continued to work with local land managers, volunteers, and the USFWS Pennsylvania Field Office to improve and expand habitat for the globally rare frosted elfin butterfly (*Callophrys irus*). Frosted elfin caterpillars are specialists that feed exclusively on yellow wild indigo (*Baptisia tinctoria*) in Pennsylvania. Our two known frosted elfin sites have healthy but isolated patches of wild indigo plants.

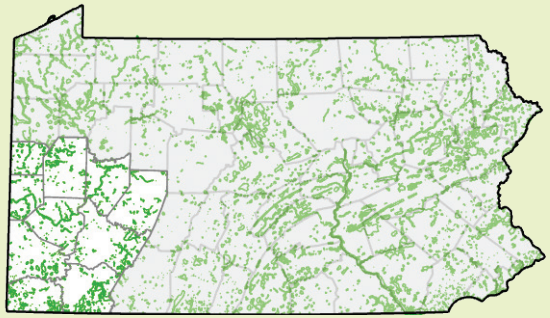
This year following habitat management that included mowing and woody shrub and tree control, we began planting wild indigo seeds and seedlings in these managed areas. USFWS is working with students in the State College Area School District to grow additional wild indigo seedlings, through the Partners for Fish and Wildlife Program. These plantings will help us expand and connect patches of wild indigo at our frosted elfin sites, with the hope of boosting populations of both host plants and butterflies.

APPLICATION

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

UPDATING THE SOUTHWEST: 643 NEW NATURAL HERITAGE AREAS RELEASED TO THE PUBLIC

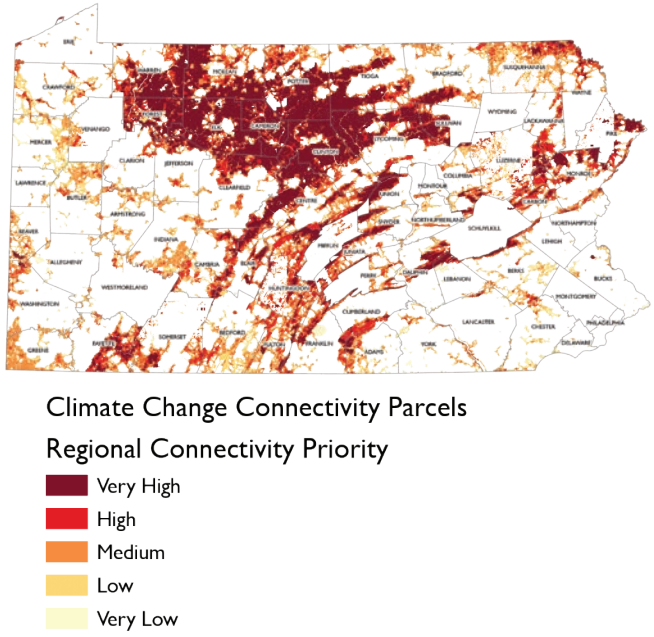
In 2018, PNHP began work—in partnership with the Southwest Pennsylvania Commission and with funding from DCNR—on an update of the County Natural Heritage Inventories (CNHIs) for ten counties: Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington, and Westmoreland. This is PNHP's most ambitious CNHI update project to date.



PNHP has defined 3,968 NHAs across Pennsylvania: 643 of these are now newly updated and found in the southwestern region.

The results, released in April 2021, showcase a region where natural areas are recovering in many places. For example, rare freshwater mussels have returned to the Ohio River as water quality has improved. Unfortunately, we also see the impact of continued development of rural and suburban areas. Many of our forests have again become fragmented by urbanization and energy infrastructure.

The 643 new NHAs support conservation planning for the region. They serve as a guide to the diversity of our landscape for local stakeholders and landowners, and suggest conservation actions that can be taken to protect these areas into the future.

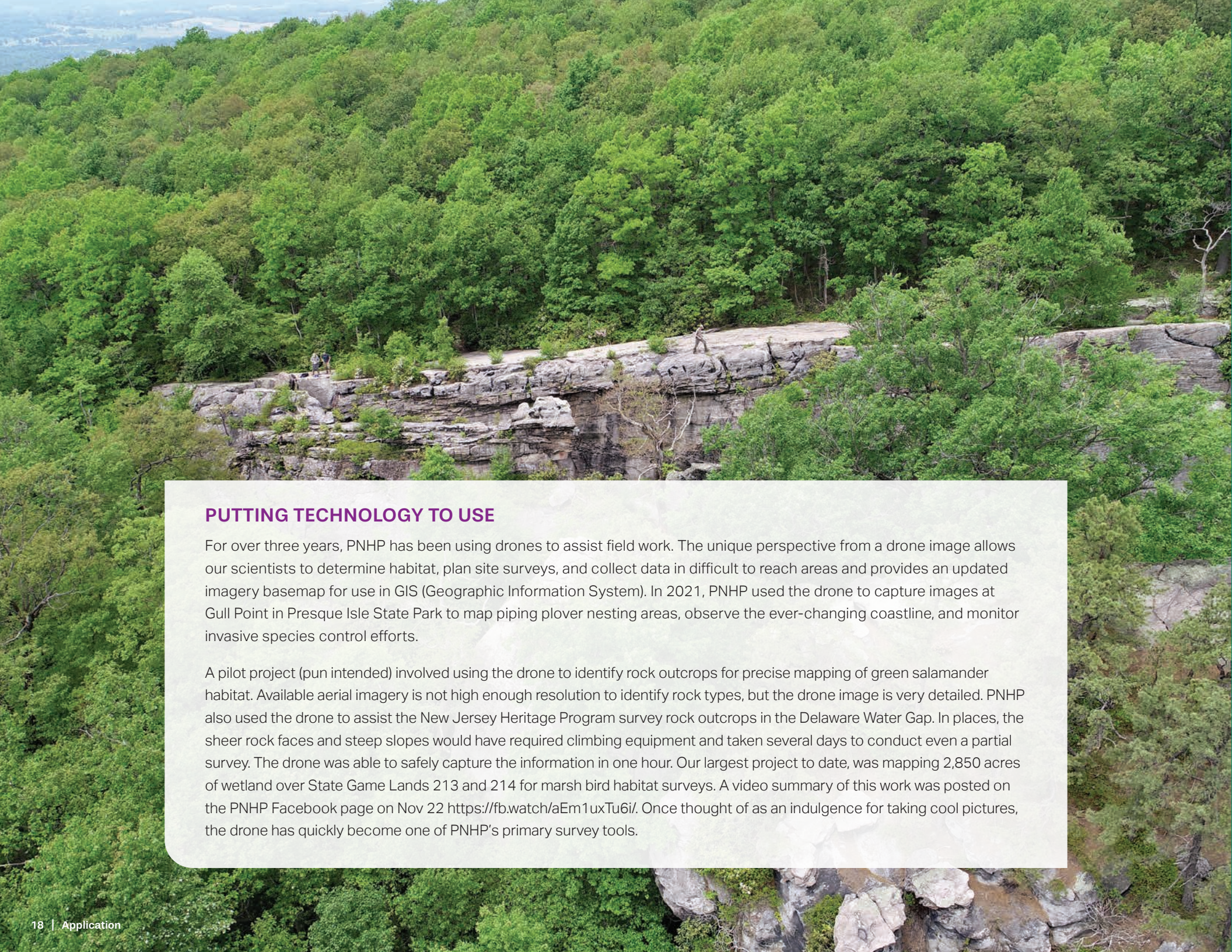


CLIMATE CHANGE CONNECTIVITY

In 2020, PNHP scientists produced a map of climate change connectivity corridors in Pennsylvania for the Department of Conservation and Natural Resources.

This year, we refined the mapping with a parcel-level analysis for the entire state: 390,000 individual parcels which overlapped our identified corridors were assigned a connectivity priority score. Additional attributes within this rich dataset provide guidance to stakeholders on management, restoration, or land protection priorities and support on-the-ground conservation actions.

This work will hopefully be a key step towards supporting the resiliency of our natural systems in the face of climate change and will allow for movement of plants and animals between patches. We are now looking to share the information and analysis via the PNHP website and determining if it can be a part of Conservation Explorer.



PUTTING TECHNOLOGY TO USE

For over three years, PNHP has been using drones to assist field work. The unique perspective from a drone image allows our scientists to determine habitat, plan site surveys, and collect data in difficult to reach areas and provides an updated imagery basemap for use in GIS (Geographic Information System). In 2021, PNHP used the drone to capture images at Gull Point in Presque Isle State Park to map piping plover nesting areas, observe the ever-changing coastline, and monitor invasive species control efforts.

A pilot project (pun intended) involved using the drone to identify rock outcrops for precise mapping of green salamander habitat. Available aerial imagery is not high enough resolution to identify rock types, but the drone image is very detailed. PNHP also used the drone to assist the New Jersey Heritage Program survey rock outcrops in the Delaware Water Gap. In places, the sheer rock faces and steep slopes would have required climbing equipment and taken several days to conduct even a partial survey. The drone was able to safely capture the information in one hour. Our largest project to date, was mapping 2,850 acres of wetland over State Game Lands 213 and 214 for marsh bird habitat surveys. A video summary of this work was posted on the PNHP Facebook page on Nov 22 https://fb.watch/aEm1uxTu6i/. Once thought of as an indulgence for taking cool pictures, the drone has quickly become one of PNHP's primary survey tools.

*Northern snakehead (*Channa argus*) held by Matthew Shank of the Susquehanna River Basin Commission.*

INVASIVE SPECIES DATA CLEARINGHOUSE SELECTED FOR PENNSYLVANIA

Since its inception in 2004, the Governor's Invasive Species Council has addressed invasive species issues that threaten the environment, the state's economic vitality, and the health and well-being of Pennsylvania citizens.

Seven state agencies and 14 non-governmental organizations comprise the council, with two staff from the Western Pennsylvania Conservancy providing their time and expertise as members.

In September 2021, the Council recommended that iMapInvasives be designated as the central clearinghouse for invasive species data in Pennsylvania, noting the need for sustainable funding to support database maintenance and development. This action by the Council was a critical step forward to ensuring invasive species occurrences and management information will one day be housed in a single, agreed-upon location for use by all. Future plans by the Council to implement Partnerships for Regional Invasive Species Management should guarantee sustainable funding for the program.

CONSERVATION EXPLORER MEETS HIGH DEMAND FOR SPECIES INFORMATION

Since 2016, PNHP and NatureServe have worked together to develop, manage, and host PA Conservation Explorer. This award-winning web mapping application was used by more than 3,500 registered users in 2021, primarily to prevent or avoid adverse impacts to Pennsylvania's rare species and habitats while expediting responsible development.

Explorer is backed by more than 40 years of scientific data and information technology. Its project review analysis overlays project footprints with natural heritage data layers and generates a report specific to the user-defined geography. This analysis provides valuable information for avoiding impacts and carrying out responsible development and management of land and water resources.

In 2021 PA Conservation Explorer users recorded approximately 20,500 finalized project searches: 8,300 projects had a response other than no-impact, and 3,700 projects had potential conflicts that required an environmental review by state and federal agencies. Commercial and residential development, agriculture, transportation, and energy development accounted for a majority of all project types. In addition, more than 2,500 conservation planning reports were generated. Clearly, the Explorer played an important role in protecting our most imperiled natural resources from the impacts of land development.

INFORMATION

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

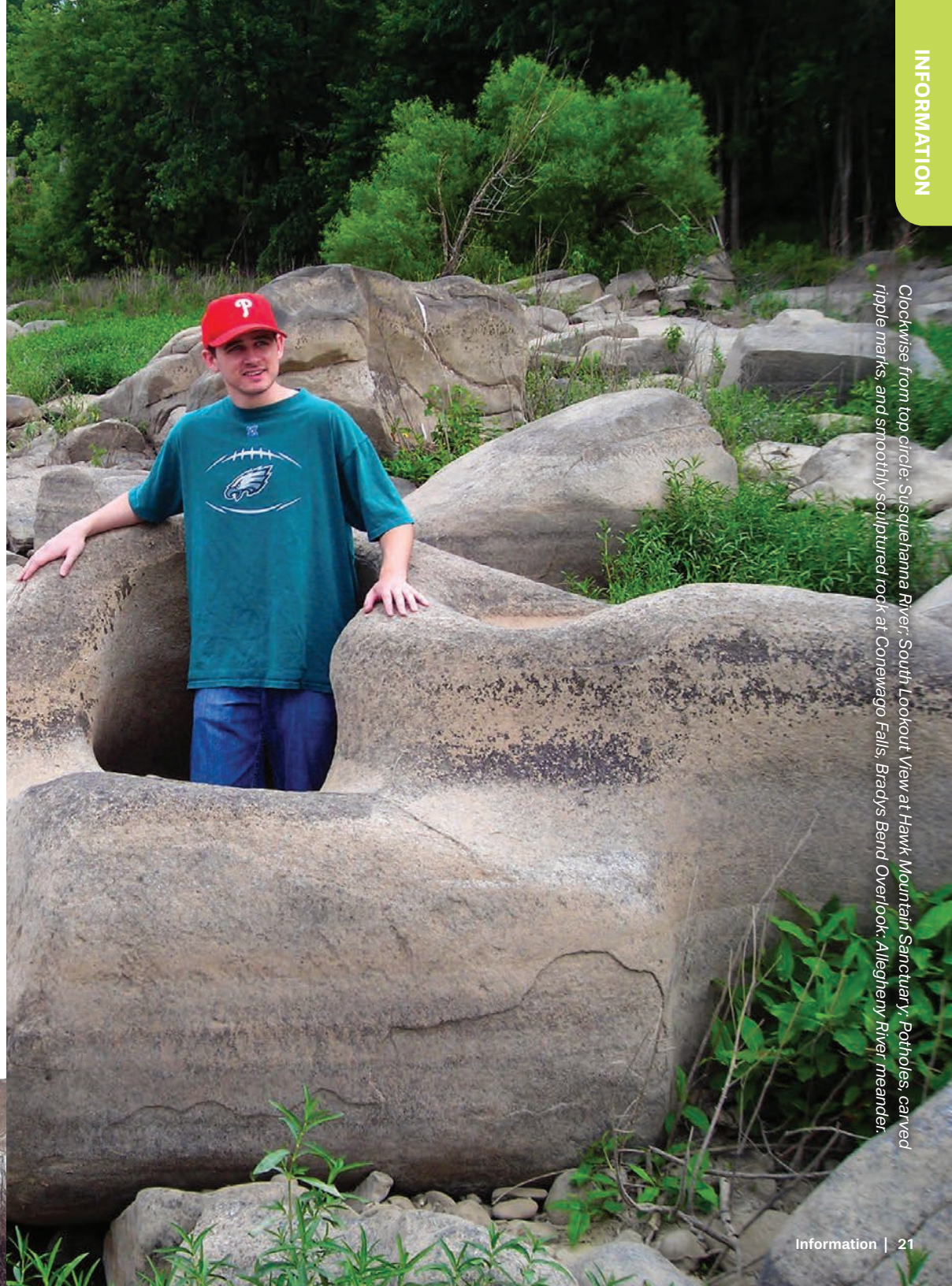
CLASSIFYING GEOHERITAGE FEATURES

The Geoheritage Committee of the Pennsylvania Geological Survey (PaGS) recently revised the classification of sites. The new classification scheme comprises six different categories:

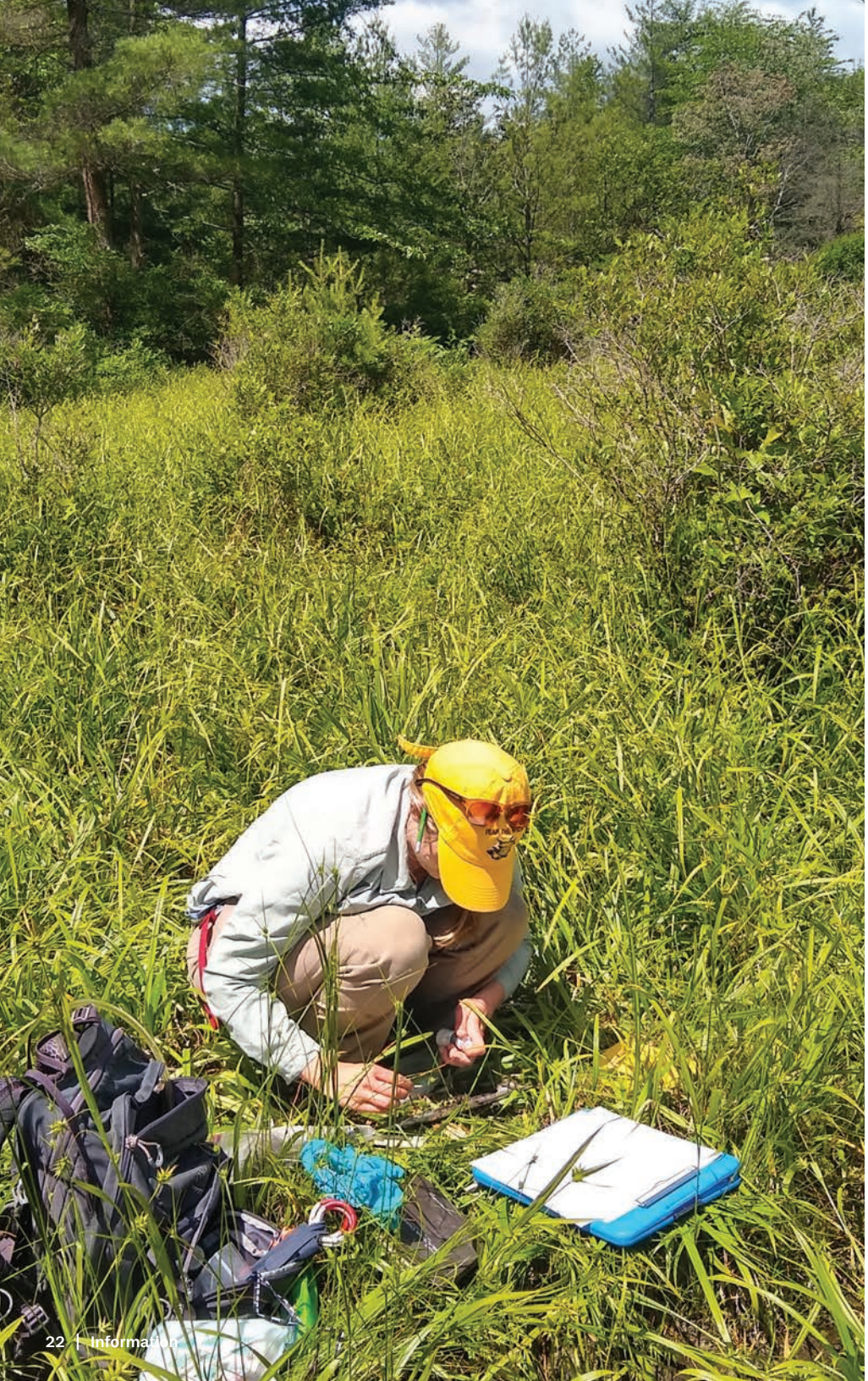
- **Hydrodynamic** - sites related to the flow of fluids
- **Geomorphic** - sites related to the Earth's landforms and the geologic processes that shape them
- **Compositional** - site features that are notable because of lithology, mineralogy, or paleontology
- **Tectonic** - site features that display some structural characteristic, such as folds, faults, jointing, or foliation
- **Earth History** - sites that exhibit some geologic event or era in a clear way
- **Cultural and Historic** - sites that have a human connection, such as a geologically famous quarry or mine

Classification gives the Geoheritage Committee a way to compare sites and provides a means to promote geologic education while highlighting important geoheritage features in the state. The new classification scheme will be incorporated into PNHP and Biotics to better categorize geoheritage sites. Although current law does not provide geoheritage features any special protection, numerous notifications through the PNDI process have led to action to conserve sites or reduce potential impacts.

Members of the Geoheritage Committee are Jim Shaulis, Kristen Hand, Craig Ebersole, Katie Schmid, and Stuart Reese.



Clockwise from top circle: Susquehanna River; South Lookout View at Hawk Mountain Sanctuary; Potholes, carved ripple marks, and smoothly sculptured rock at Conewago Falls; Bradys Bend Overlook; Allegheny River meander.



INFORMATION MANAGEMENT

PNHP Information Management staff maintain Biotics, the Heritage information database developed by NatureServe to provide a standardized platform used across the Heritage network for mapping biodiversity data.

We also manage the field survey information database (FIND), and provide support for iMapInvasives and Conservation Planning products based on the Biotics information, including the Natural Heritage Areas (NHAs), the Pennsylvania Conservation Explorer (PACE) tool, and the Pennsylvania Conservation Opportunity Areas (COA) tool.

The records in our Biotics database are compiled from field surveys by PNHP partner biologists, researchers, and community scientists, and represent a wide range of taxa including vascular and non-vascular plants, vertebrate and invertebrate animals, natural communities, and geologic features.

Records Added to Biotics in 2021

TAXONOMIC GROUP	COUNT
Birds	5
Mammals	8
Reptiles & Amphibians	408
Fish	5
Mussels	6
Butterflies & Moths	13
Other Invertebrates	1
Communities	1
Non-vascular Plants	1
Vascular Plants	144
Total	**592**

Total Number of Records in Biotics

TAXONOMIC GROUP	COUNT
Birds	2,668
Butterflies & Moths	1,162
Communities	970
Fish	858
Geological & Hydrological Features	499
Mammals	1,425
Mussels	1,290
Non-vascular Plants	59
Other Invertebrates	1,819
Reptiles & Amphibians	3,796
Vascular Plants	16,093
Total	**30,639**

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

In July, WPC was awarded a State Wildlife Grant to process fish, amphibian, and reptile Species of Greatest Conservation Need records into the Pennsylvania Natural Heritage Program databases and the Pennsylvania Conservation Explorer. Data for amphibians and reptiles are primarily from the Pennsylvania Amphibian and Reptile Survey (PARS), a project of the Pennsylvania Fish and Boat Commission and the Mid-Atlantic Center for Herpetology and Conservation. PARS is a community science website where users enter their observations. The records are verified by reviewers and forwarded to us for processing. The fish records are from the data that were compiled for the 2016 book *Fishes of Pennsylvania*, by Jay R. Stauffer, Douglas P. Fischer, and Robert W. Criswell. Since July, we have processed over 900 PARS records and over 300 fish records. Adding this information to our Heritage databases promotes better conservation planning to help protect Species of Greatest Conservation Need in Pennsylvania.

COLLABORATION AND COMMUNITY

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

ECOLOGICALLY-INFORMED PARK MANAGEMENT

We have continued our partnership with Allegheny County Parks and Allegheny County Parks Foundation to complete ecological assessments of two more parks: White Oak Park and Round Hill Park. The assessments identify the parks' best ecological features and guide park managers in stewarding them.

Allegheny County's parks have high forest cover and each includes some mature, high-quality native communities and plant species found only in these relatively intact natural habitats, but they also are challenged by deer overbrowsing and the spread of invasive species. White Oak Park has a large amount of mature native forest cover but is quite impacted by deer browsing. Round Hill Park has an exemplary ecologically-managed demonstration farm and several diverse mixed mesophytic forest ravines, but is challenged by large areas of post-agricultural forest with high invasive species cover. Through this partnership we provided ecologically-based recommendations to support Allegheny County Parks in reducing mowed areas by planting meadows, restoring native forests, and managing invasive species.

I-80 ROCKFALL SURVEY – COLLABORATION WITH NEW JERSEY NATURAL HERITAGE PROGRAM

The New Jersey Natural Heritage Program (NJNHP) knew of the work we had done on Shikellamy Cliffs a few years ago and asked us for help in surveying a section of the I-80 right of way in the Delaware Water Gap, just across the river from Pennsylvania. A number of rare plants are known from these cliffs, outcrops, and scree slopes but the entire area is difficult to access. We supplied drone expertise, rappelling skill, and capacity to help NJNHP in looking for any plants that might be impacted by the scheduled New Jersey Department of Transportation stabilization work.

LONGWOOD GARDENS PARTNERSHIP

In 2021, Longwood Gardens partnered with PNHP to map and describe the plant communities within the 700 acres of natural land on their property located in Chester County, PA. PHNP ecologists collaborated with Longwood Land Stewardship staff to design a sampling methodology so the resulting data would be beneficial to both programs. PNHP ecologist Claire Ciafre worked closely with Longwood interns and staff, as well as local botanist Janet Ebert, to map forests, meadows, and wetlands and establish and sample 58 permanently marked plots.

The collected data, which encompasses over 500 species of plants, will be used to describe plant communities and their locations on the property. The data will serve as a baseline for long-term ecological monitoring and guide management activities at Longwood. The project will also improve PNHP's data coverage of under-sampled plant communities and has resulted in the development of a digital field form using ESRI's Survey 123 which was used to collect and manage the data for the project.

This work will be part of what we hope is a close collaboration with Longwood Gardens whose expertise in plant propagation will be valuable in achieving some of the goals of the Pennsylvania Plant Conservation Network (PPCN).

CONSERVATION PLANT GENETICS COLLABORATION IN PENNSYLVANIA

Conservation of rare plants relies on understanding their natural history, biology and ecology, and population threats to inform state regulations that serve to protect species from extirpation. This involves extensive field surveys over many years to determine whether those populations are seeing reductions in the number of individuals needed to maintain genetic diversity in and between populations.

PNHP and Dr. Chris Martine and his students at Bucknell University investigated genetic diversity of three rare plant species: blue false indigo (*Baptisia australis*), river oats (*Chasmanthium latifolium*), and harbinger of spring (*Erigenia bulbosa*). The project introduced students to natural heritage methodologies and employed innovative population genetic methods to determine the diversity of these rare species. This approach utilized PNHP rare species data in conjunction with genetic diversity data for leveraging actionable plant conservation. In addition, student presentations at regional and national conferences resulted in 13 research awards and prizes for their outstanding work. Their work is captured in four peer-reviewed manuscripts and a professional video production.

PNHP COOPERATION TO PROTECT BATS

Indiana and northern long-eared bats have been impacted by white-nose syndrome. Forestry practices on state lands may both impact and improve habitat for federally listed bats. DCNR and PGC jointly obtained an incidental take permit from the U.S. Fish and Wildlife Service in December 2020 and just recently completed a Habitat Conservation Plan for these two species. Instrumental in the writing of the plan was the species survey, hibernacula monitoring, and data quality control information that PNHP staff at WPC provided to the agencies. PNHP partners, DCNR and PGC, have committed to following the State Land Habitat Conservation Plan to minimize, mitigate, and monitor impacts to bats on state lands. They submitted an annual report for the first reporting period of implementation to USFWS. The permit uses acres of forest activities (timber sales, prescribed burns, and others) in mapped bat habitat areas as a proxy for take of bats. USFWS caps allowable annual take at 19,770 acre of Indiana bat habitat and 130,386 acre of northern long-eared bat habitat. DCNR and PGC's combined acreage impact was well below the cap: 3,173 acre Indiana bat habitat and 3,511 acre northern long-eared bat habitat for the first reporting period.

WE HEAR YOU!

In 2021, the Pennsylvania Wildlife Action Plan Conservation Opportunity Area (COA) Tool received a notable enhancement to enable drawing an Area of Interest (AOI) greater than 5,500 acres. We heard from several users that allowing larger landscape assessments would be very useful so, working with NatureServe, this functionality was recently made available. The intent for the user-defined Area of Interest is to guide on-the-ground conservation actions for Species of Greatest Conservation Need (SGCN); the initial acreage restriction was to support this approach and the tool remains most useful at finer scales. User's applying this functionality to larger areas should be aware of lengthy AOI reports.

PENNSYLVANIA WILDLIFE ACTION PLAN

Developed through a PNHP partner collaborative effort, the Conservation Opportunity Area (COA) Tool was launched in August 2019 and is a user-driven, web-based, "go to" resource for Pennsylvania Wildlife Action Plan SGCN information. From its early development through present day, the Pennsylvania Game Commission and Pennsylvania Fish and Boat Commission, administrators of the Wildlife Action Plan, encourage input for improvements to make the tool more amenable to user needs. These suggestions are evaluated for their feasibility to implement and Wildlife Action Plan relevance. The COA Tool is freely available at https://wildlifeactionmap.pa.gov

SPECIES HIGHLIGHT:

TURTLES

THREATS

Turtles are unusual among vertebrates in that the removal of just a few adults from unnatural causes can lead to population decline. Loss of habitat to development or land use changes, fragmentation by roads, water pollution, and collection as pets are the primary threats to most of our turtles.

Road mortality is one of the more gruesome and immediate threats to wood turtles and box turtles especially. Every year thousands of turtles are killed on roads as they try to find nest sites or look for mates. Other threats include an overabundance of certain predators like raccoons, opossums, and skunks that dig up eggs and prey on hatchlings.

How to Help

- Do not take turtles home.
- If you live next to a stream, wetland, or pond, provide as much natural buffer as possible.
- If you see a turtle in the road and can safely pull over, help the turtle across in the direction that it was going.
- Report suspected poaching to your Fish and Boat regional office.
- Submit turtle observations to the Pennsylvania Reptile and Amphibian Survey (paherpsurvey.org). The photos are reviewed by experts to confirm the species identification, and information is added to the Natural Heritage Program databases to help assess the status of rare species in the commonwealth.

CONSERVATION EFFORTS BOLSTER PENNSYLVANIA'S IMPERILED TURTLES

The unmistakable rigid shell of a turtle provides a level of protection completely unique among vertebrates and has enabled them to thrive on earth for 220 million years. Despite this sophisticated armor, turtles have been faced with a suite of new threats which have led to turtles becoming one of the most imperiled taxa in the world.

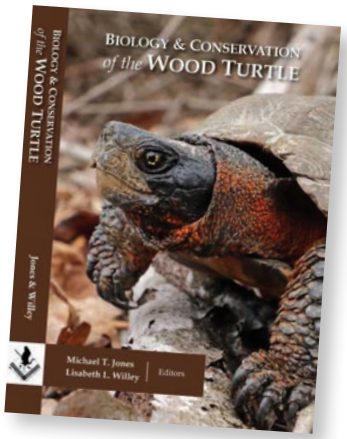
Pennsylvania's turtles are not immune to these threats and over half (seven out of thirteen) of our extant native turtle species are considered Species of Greatest Conservation Need (SGCN). The compounding threats of habitat loss and fragmentation, predation by subsidized predators, disease, road mortality, climate change, and illegal collection, are of concern to all of Pennsylvania's turtle species.

A number of these species with the most worrisome trends have been of heightened focus for the PNHP Partnership. The Pennsylvania Fish and Boat Commission and our Heritage Program zoologists are involved in several regional initiatives aimed at addressing statewide data gaps and site-specific needs concentrated on population assessments and habitat improvements. With some careful study and a helping hand, PNHP's turtle efforts should help address key needs for some of our turtles in trouble.

WOOD TURTLES

PNHP and the Fish and Boat Commission, along with many conservation partners, are in the midst of a second round of monitoring wood turtle populations in Pennsylvania. We are revisiting populations to compare survey numbers and age and gender distribution to the data collected five years ago. We are also expanding our survey reach to additional streams across the state to better understand how wood turtles are doing throughout their range. This effort is happening across the Northeast and will help the U.S. Fish and Wildlife Service determine if the wood turtle warrants federal protection.

Comprehensive Book on the Wood Turtle

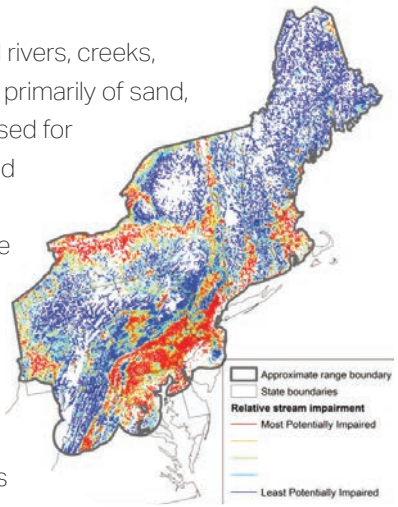


The regional wood turtle assessment and conservation efforts have culminated in several peer-reviewed publications, as well as a recently published comprehensive book on wood turtle biology and conservation. Supported in part through regional state wildlife grants, this semi-technical and richly illustrated 235-page publication will be of interest to natural resource professionals and land managers.

Hard copies are limited but may be available by contacting the Pennsylvania Fish and Boat Commission Division of Environmental Services. Digital copies can be downloaded at Biology and Conservation of the Wood Turtle (northeastturtles.org)

Wood Turtle Habitat

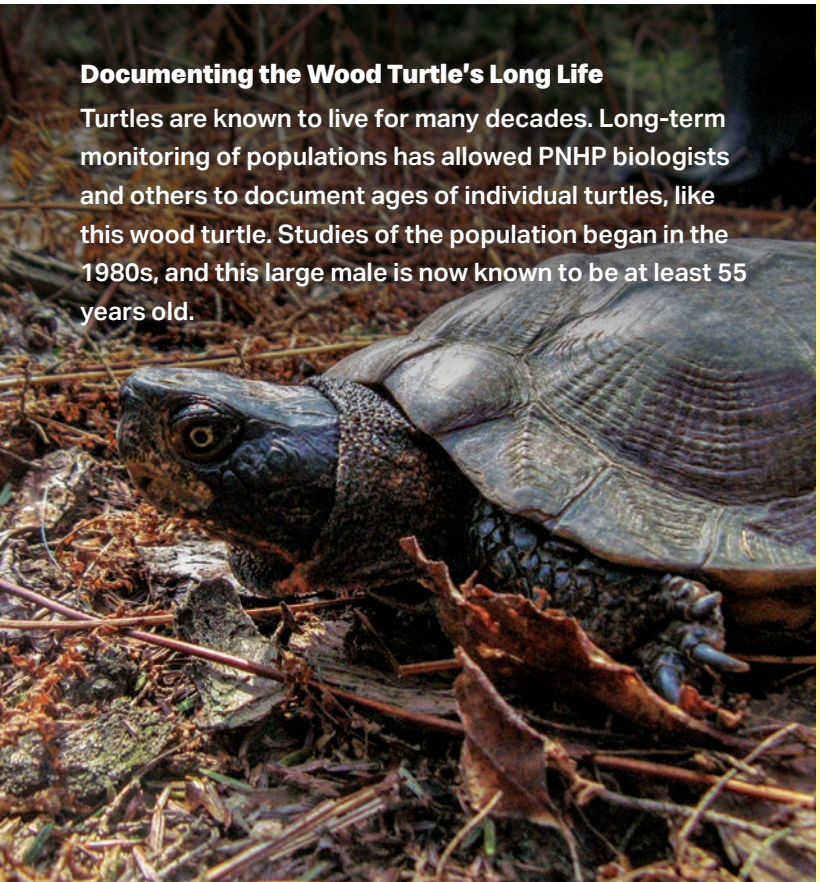
Wood Turtles occupy a variety of clear, cold, wooded rivers, creeks, and streams, with substrates consisting primarily of sand, gravel, or cobble. The waterways are used for overwintering, foraging, and mating, and adjacent terrestrial riparian zones—typically within about 300 meters of the waterway—are utilized by turtles for spring, summer, and fall foraging, basking, and nesting. During the course of the regional wood turtle monitoring efforts, PNHP biologists have surveyed over 30 stream reaches



and observed more than 145 individual wood turtles. Even though the wood turtle occurs in nearly every county of the state, we are finding that many populations are too small to persist in the long term. Fortunately, there are still thriving populations within streams that are isolated from roads and development.

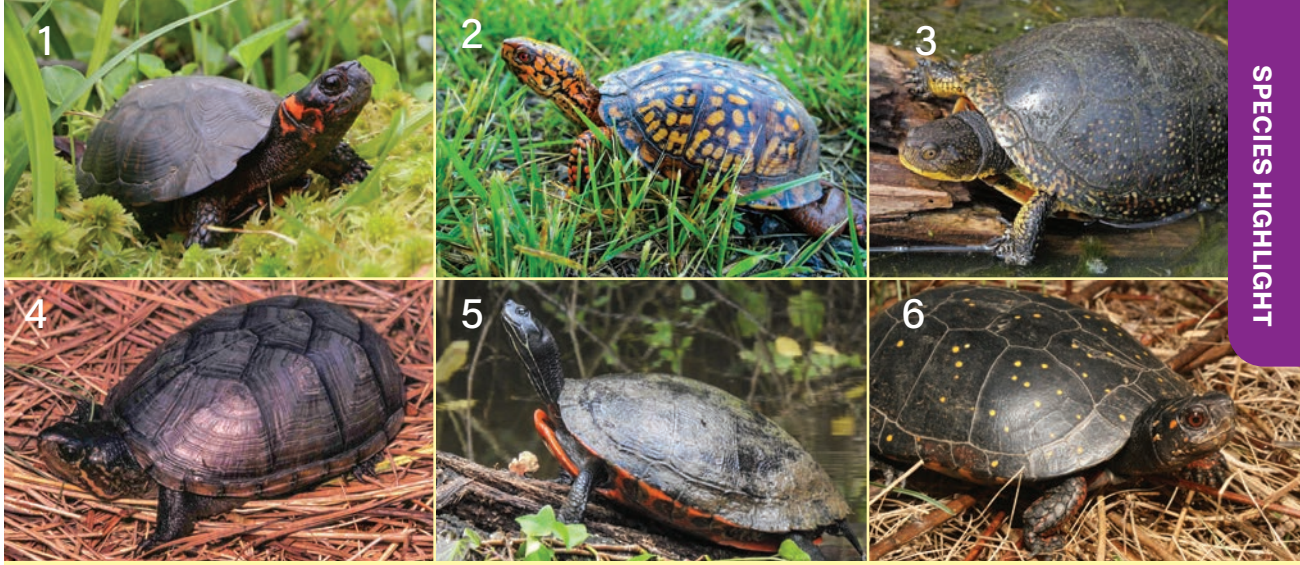
Nesting Habitat & Breeding

This small beach was covered with tracks from the resident wood turtles, and while superficially unimpressive, streamside habitat like this is very important for nesting turtles. This beach contained multiple turtle nests. Wood turtles don't become reproductive until roughly age 15 and then breed anytime during the active months.



Documenting the Wood Turtle's Long Life

Turtles are known to live for many decades. Long-term monitoring of populations has allowed PNHP biologists and others to document ages of individual turtles, like this wood turtle. Studies of the population began in the 1980s, and this large male is now known to be at least 55 years old.



1 Bog Turtle: The bog turtle is North America's smallest turtle and as its name suggests, lives in boggy wetland habitats. It is state endangered and federal threatened. PNHP and PFBC are involved in a regional recovery effort emphasizing monitoring populations with annual surveys and managing habitats to promote nesting success.

2 Box Turtle: The common name of the box turtle refers to their shell's spectacular ability to close up as tight as a box. While once considered a common species, it has been in a troubling downward trend and accordingly PNHP has been keeping tabs on these turtles for 15 years.

3 Blanding's Turtle: The Blanding's turtle, recognizable by its bright yellow chin, is a northern turtle species considered rare across its range in the northeastern and northcentral U.S. PNHP and PFBC are working to conserve the only known population of Blanding's turtles in the state through partnerships both in the state and in the region.

4 Southeastern Mud Turtle: The southeastern mud turtle is one of the rarest species in Pennsylvania. It occupies remnants of Coastal Plain habitat in the vicinity of Philadelphia.

5 Northern Red-bellied Cooter: The northern red-bellied cooter is one of Pennsylvania's largest native aquatic turtles and is restricted to the southcentral and southeastern regions of the state. Red-bellied cooters are known to inhabit relatively large, deep streams, rivers, ponds, lakes, and marshes with permanent water and ample basking sites. Females are larger than males.

6 Spotted Turtle : The handsome spotted turtle can be found in a wide range of habitats, as long as there is some shallow water present. Spotted turtles can be found from Ontario to Florida, and despite this wide distribution, it is considered of concern throughout much of its range because of predation, habitat loss, and illegal collection.

SPREADING THE WORD

PNHP maintains an excellent website, stays engaged in social media, and produces numerous publications, including this annual report. But perhaps the single most effective way for sharing our biodiversity expertise is to work directly with people. Our work with volunteers and interns gives us additional capacity, allows us to collaborate with other organizations, and provides an opportunity to guide those just beginning their conservation careers.

FIELD SEASON: HELP NEEDED!

In 2021, PNHP welcomed a number of interns and seasonal staff members to our team. Two avian technicians—Alejandra (Alie) Lewandowski and Eric Schill—joined us to assist with the Crawford County secretive marsh bird project. They conducted call-broadcast surveys for rare and endangered marsh birds, traveled through difficult marsh terrain, and helped enter data for thousands of bird observations.

Summer intern Bailey Bower, from the University of Pittsburgh, documented the status and pollination ecology of a rare plant, white monkshood, that is a target for recovery efforts in Pennsylvania. She collected and learned to identify bumblebees, took field environmental measurements, and entered data.

We also hosted two interns from Chatham University, Nicholas Leo and Ian Hart. They worked on a hydrological study of the Youghiogheny and other streams and rivers in the Allegheny Mountains looking at changes in flow due to climate change and potential impacts on rare plant species.

In service of a "good neighbor" agreement between DCNR and the Allegheny National Forest (ANF), we hired four seasonal staff—Leigh Fehlman, Luke Gray, Matthew O'Brien, and Kate Tillotson. They worked as a team to conduct inventories of management compartments in the Allegheny National Forest, noting numerous features including wetlands, unusual and rare plants, raptor nests and other specifics that the Forest Service is interested in avoiding during management and timbering.

Brian Daggs worked as an invasive plant technician during the field season, honing his skills in botany, plant identification, GIS, and habitat management. He stayed on, and has now joined us as a new full-time staff member!

COMMUNITY SCIENTISTS AID IN SEARCH FOR HIGH PRIORITY INVADERS

Water chestnut infestation discovered in Montgomery County.

The PA iMapInvasives program strives to encourage community scientists and natural resource professionals to search for invasive species and document their discoveries in the online database, iMapInvasives. This year, the program hosted its 5th annual Water Chestnut Chasers Challenge (WCCC) and its 2nd annual Invasive Species Scavenger Hunt (ISSH). These events were open for public participation and asked volunteer surveyors to search for specific plants, animals, and/or insects, some of which are considered high priority or early detection species in the commonwealth. Notable highlights from the WCCC included a new discovery of water chestnut (*Trapa natans*) in a Montgomery County waterbody. From the ISSH, over 200 new presence and not-detected records were added to iMapInvasives for a variety of invasive species. These data provide critical insight into the known distribution of each species in the state and help inform treatment decisions by regional land managers.

THE TIMBER RATTLESNAKE: LIFE HISTORY, DISTRIBUTION, STATUS, AND CONSERVATION ACTION PLAN

In 2021, Partners in Amphibian and Reptile Conservation (PARC) developed *The Timber Rattlesnake: Life History, Distribution, Status, and Conservation Action Plan*. This plan was developed by a team of more than 75 concerned rattlesnake biologists from federal and state agencies, universities, and private institutions, as well as environmental consultants and private citizens.

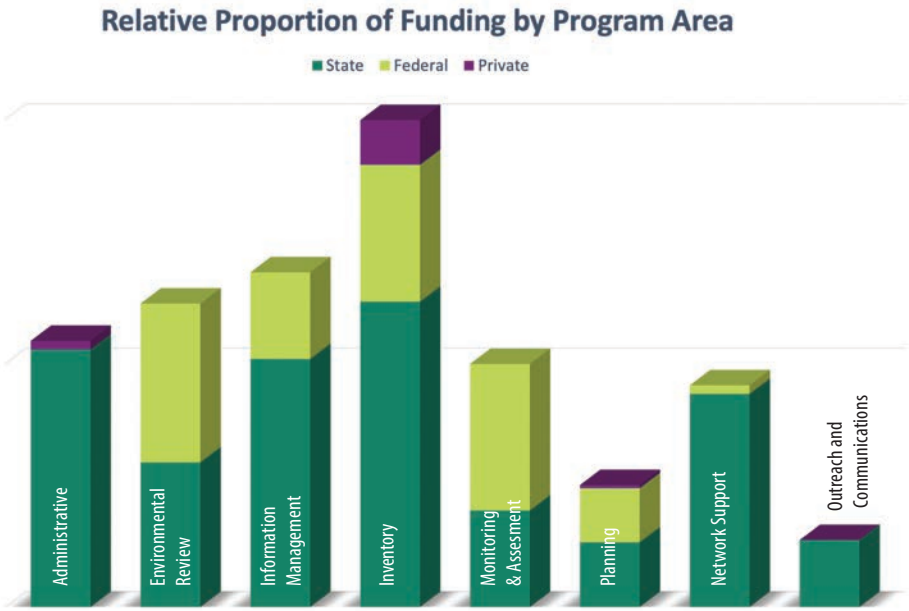
PNHP partnership staff contributed to this book through years of timber rattlesnake surveys and site assessments as well as review and development of the species action plans for Pennsylvania. The book is divided into two parts and contains more than 300 images and over 40 maps. Part I presents an overview of the life history, genetics, ecology, distribution, status, and threats to the continued existence of timber rattlesnakes from a range-wide perspective along with recommendations for conducting population assessments. Part II presents the legal status, distribution, population status, habitat needs, active period, threats, and management actions for timber rattlesnakes on a state-by-state (or province by-province) basis. To purchase a copy of the book, go to https://trcap.portalpro.com/Catalog

FINANCIALS & STAFF

PROGRAM FUNDING

Our funding reflects the large amount of work we do with state and federal agencies. In 2021, we received additional federal funds from the Payroll Protection Program. Local sources of funding include counties, municipalities, and NGOs. We also raise funds from private sources including businesses and private foundations. Together, Inventory and Monitoring & Assessment work comprise a majority of our total funding; these are the areas that supply new and updated on-the-ground information to the program.

The other parts of the program primarily are concerned with disseminating the information that we collect and manage. The ways that we provide biodiversity information have become increasingly sophisticated and the demands on Information Management and Planning have grown. The need to work with NatureServe and the Heritage network to provide a number of our online services has also grown.



WE RECOGNIZE THE MANY ENTITIES AND PROGRAMS THAT SUPPORTED OUR WORK IN 2021:

Department of Conservation and Natural Resources

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

Department of Environmental Protection

- U.S. Environmental Protection Agency, Wetlands Program Development Grants
- Clean Water Fund

Pennsylvania Game Commission

- State Wildlife Grants
- Pittman-Robertson Fund

Pennsylvania Fish and Boat Commission

- State Wildlife Grants

Pennsylvania Department of Agriculture

- Research Grants

U.S. Forest Service

- Allegheny National Forest
- Great Lake Restoration Initiative Funds (Cooperative Weed Management Program)

U.S. Fish and Wildlife Service

- Great Lake Restoration Initiative Funds
- Science Application Funds

U.S. National Park Service

Pennsylvania State University, Pennsylvania Sea Grant

- Great Lake Restoration Initiative Funds

Pennsylvania Department of Transportation

Gertrud Gerlach

The Charles Kaufman Fund

NatureServe

Allegheny County Parks Foundation

The Nature Conservancy

Allegheny Land Trust

Nuttall Ornithological Club

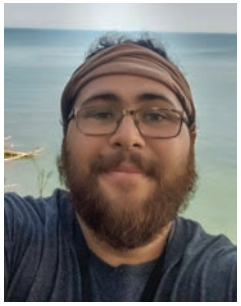
The Knobloch Family Foundation

MEET OUR NEWEST STAFF

Our staff tend to have long tenures, so the addition of new staff is a notable event. This year, we were fortunate to have three people join our ranks. Welcome to our new staff!

Claire Ciafre, *Ecologist*

Claire joined us in early 2021 as a new Ecologist working across numerous projects that involve community classification as well as rare plant and community inventories. Claire has her master's degree from Austin Peay State University in Tennessee and has lots of experience in botanical and natural community work, especially from her work in Tennessee and Missouri.



Brian Daggs, *Invasive Species Ecologist*

Brian joined us after finishing his bachelor's degree at the University of Pittsburgh. He was hired as a seasonal ecologist to help with invasive species surveys in northwest Pennsylvania. Having done an excellent job and with us having a substantial amount of invasive species work, especially in northwest Pennsylvania, we invited Brian to join us a full-time Invasive Species Ecologist.

Stephanie Seymour, *Ecological Information Specialist*

Stephanie joined us as a new Ecological Information Specialist in DCNR. This is the second time around for Stephanie who was one of our Community Ecologists in the program a few years back. She took time off to begin raising a family and we are happy to have someone with her depth of experience back in the program.

RICH SHOCKEY RETIRES (AGAIN!)

Rich Shockey, a long-time environmental review specialist in the DCNR Natural Heritage Section, retired in October.

Rich has been an invaluable resource to the program, especially working with farmers, local conservation districts, and the Natural Resource Conservation Service (NRCS), helping them navigate the environmental review and PNDI process. Rich has also been a tireless advocate for improving soil and water health, keeping staff up to date with the latest information and working closely with the Stroud Water Research Center, serving as an informal liaison by organizing educational tours and trainings at the Center.

This was Rich's second retirement, as he came to the program after a long career with the NRCS. Rich originally started as a short term, part-time reviewer and meant to stay for only three years, that was back in 2007. Fourteen years later, Rich is ready to retire again and we will greatly miss him!

Pennsylvania Natural Heritage Program

Department of Conservation and Natural Resources
Rachel Carson State Office Building
PO Box 8552
Harrisburg, PA 17105

Western Pennsylvania Conservancy
800 Waterfront Drive
Pittsburgh, PA 15222

Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg, PA 17110

Pennsylvania Fish and Boat Commission
1601 Elmerton Avenue
PO Box 67000
Harrisburg, PA 17106

www.naturalheritage.state.pa.us

/NHPPA

CONTRIBUTORS

Photos Contributors

JoAnn Albert, WPC (Back Cover)
Kierstin Carlson, WPC (Back Cover)
Terry Christopher, (Page 15)
Claire Ciafre, WPC (Pages 2 & 26)
Marlin Corn (Pages 28 & 31)
Ben Coulter (Page 15)
Brian Daggs, WPC (Page 35)
Nick Daghir (Page 14)
Amidea Daniels, PFBC (Page 30)
Kaine Diehl, West Liberty University (Page 11)
Charlie Eichelberger, WPC (Cover, 6, 20, 22, 23, 27, 31 & 32)
USFWS (Page 14)
Mary Ann Furedi, WPC (Page 8 & Back Cover)
Brad Georgic, WPC (Pages 16, 18 & 19)
Kathy Gipe, PFBC (Page 31)
Rachel Goad, WPC (Page 7, 13 & Back Cover)
Anna Johnson, WPC (Pages 17 & 33)
Tyson Johnston, WPC (Back Cover)
Andy Kubis, Allegheny Front (Page 13)
Betsy Leppo, WPC (Pages 10, 15 & Back Cover)
Nicholas Macelko (Page 33)
Chris Martine, Bucknell University (Page 26)
Jessica McPherson, WPC (Pages 24 & 25)
Ryan Miller, WPC (Pages 29, 30, 31 & Back Cover)
Anabelle Morales (Back Cover)
Rob Naczi (Page 35)
Sally Ray, WPC (Page 31)
Stuart Reese, DCNR (Page 21)
Andrew Rohrbaugh, DCNR (Page 22)
John Schwartzer, DCNR (Page 6)
Meredith Seltzer, DCNR (Page 29)
Stephanie Seymour, WPC (Page 35)
Kelly Sitch, DCNR (Page 35 & Back Cover)
Aura Stauffer, WPC (Back Cover)

Photos Contributors (cont.)

Lindsay Steis (Page 14)
Christopher Tracey, WPC (Pages 6, 8 & 13)
Jeff Wagner, WPC (Pages 3 & 35)
Mary Walsh, WPC (Page 12)
Pete Woods, WPC (Pages 4, 5, 8, 29 & Back Cover)
David Yeany, WPC (Pages 9, 10, 33, 34 & Back Cover)
Susquehanna River Basin Commission (Page 19)

Text Contributors

Jeff Wagner, WPC
Joe Wisgo, WPC
Pete Woods, WPC
Betsy Leppo, WPC
David Yeany, WPC
Amy Jewitt, WPC
Mary Ann Furedi, WPC
Christopher Tracey, WPC
Rachel Goad, WPC
Dave Lieb, PFBC
Mary Walsh, WPC
Scott Schuette, WPC
Jessica McPherson, WPC
Ephraim Zimmerman, WPC
Brad Georgic, WPC
Anna Johnson, WPC
Kent Taylor, DCNR
Greg Podniesinski, DCNR
Stuart Reese, DCNR
Susan Klugman, WPC
Kierstin Carlson, WPC
Cathy Haffner, PGC
Diana Day, PFBC
Rebecca Bowen, DCNR
Scott Bearer, PGC
Charlie Eichelberger, WPC
Kathy Gipe, PFBC
JoAnn Albert, WPC