



Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

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Photo Banner:

Male piping plover at Gull Point

Catherine Haffner
Pennsylvania Game
Commission

Piping Plovers Return to Pennsylvania!

by

Ephraim Zimmerman

Observation of a male piping plover (*Charadrius melodus*) strutting around the Gull Point Natural Area in 2005 triggered a multiagency effort to improve the habitat for the birds on the tiny spit of sand and cobble that juts into Lake Erie. The bird's territorial behavior indicated that the species was looking to return to this historical nesting area, last occupied in the early 1950s. PNHP has long been a part of biological inventory work on Presque Isle and an integral part of the team involved in efforts to make Gull Point more habitable for the plovers and other shorebirds. Over the last twelve years, PNHP has contributed by assessing and mapping shoreline habitat, conducting vegetation surveys, describing plant communities, quantifying the cover of invasive vegetation along transects, and ultimately clearing invasive plant, shrub, and tree species.

This year was a little different. Two piping plover pairs nested within the treatment area. "We built it... they came!" was an often used subject line of e-mails among the partners which were led by the Pennsylvania Game Commission (PGC)

and included Presque Isle State Park, Pennsylvania Audubon, U.S. Fish and Wildlife Service, and PNHP science staff from the Western Pennsylvania Conservancy. We gladly put our vegetation control work on hold so we did not disrupt the plover's nesting efforts and watched as they performed their courtship displays, defended their territories, scratched their nests in the sand, and incubated their eggs. It was not smooth sailing for the birds though. Notoriously sensitive, these tiny shorebirds were under constant threat from predators like raccoons, coyotes, peregrine falcons, and gulls. PGC set up enclosures to protect



Female piping plover

Vince Cavallieri, USFWS

the eggs and field cameras to catch anything, or anyone, in the act of disturbing the nests. The U.S. Coast Guard and Presque Isle State Park rangers patrolled the waters off Gull Point to keep recreational boaters from mooring too near the nests, and the park temporarily closed the trail from the parking lot at Bundy Beach.

Three eggs from the first nest hatched at the end of June, with two chicks surviving. Human assistance, which is often required to manage endangered species populations (think black-footed ferret, California condor, whooping crane, etc.), continued with a harrowing rescue of the second nest as strong winds and high water levels flooded the nesting area. Following the rescue by PGC biologists, the eggs from the second nest were transported to a facility in Michigan where they were hatched and raised. There have been a number of wonderful articles written on the plovers, including a great account of the egg rescue by shorebird monitor, Mary Birdsong, in an Audubon publication (<http://www.audubon.org/news/success-piping-plovers-nested-pennsylvania-first-time-60-years>). We were given the go-ahead to continue our survey and invasive plant control efforts at the end of August after the two surviving chicks from the first nest fledged.



A male piping plover from one of the Pennsylvania nests observed at Honeymoon Island State Park, Florida on October 19 by Florida DEP.

Dan Larremore, Environmental Specialist
Honeymoon Island State Park
Florida Department of Environmental Protection

Historically, the sandy beaches and low sand and cobble “sand plains” at Presque Isle supported up to 15 breeding pairs of piping plovers each year. Human disturbance and development along the Erie coast eliminated nesting activity by the 1950s. The only occurrences of piping plovers at Presque Isle were migrating individuals recorded by birders hoping that a breeding pair would take up residence for the summer. This scenario was not limited to Presque Isle. The piping plover had seen a drastic reduction in population size across the Great Lakes and was granted protection



Wikimedia commons

Gull Point, Presque Isle State Park

under the Endangered Species Act in 1985. As part of the recovery strategy for the species, which also included a captive rearing program in the Great Lakes, the U.S. Fish and Wildlife Service designated several kilometers of Presque Isle’s shoreline (east of the lighthouse) as Piping Plover Critical Habitat in 2001. Additionally, a monitoring plan called for daily visits between April and June by professional and volunteer birders to watch for plovers during the breeding season.

The quality of the sand plain habitat had been at the top of people’s minds as managers and scientists had observed great changes within the wetlands at Presque Isle over the past 30 years. Plovers favor the sparsely vegetated sand and cobble flats of the Great Lakes Region Dry Sand Plain community for nesting; the birds forage in the wet-sandy Palustrine (Wetland) Sand Plain. Other natural communities of Gull Point include Beach Grass Dune Ridges, Great Lakes Emergent Wetlands, Cottonwood – Bayberry Woodlands, as well as Wet Meadows with many rare species of plants. These communities are part of a dynamic complex of plant



Ephraim Zimmerman

Palustrine sand plain

communities, regularly shifting in extent and composition with changes in the water level of Lake Erie, and growing or receding with the amount of sand deposition along the shore. Longtime visitors to Gull Point familiar with wind, waves, and winter storms know just how dynamic this ecosystem is and notice changes such as an increase in invasive plant cover in the area. Along with sand and cobble, waves carry all sorts of plant material such as seeds, roots, and rhizomes (underground stems). Invasive plants like giant reed (phragmites), narrow-leaf cattail, and purple loosestrife take root and grow on the newly formed sand spits, smother native plants, and have very little value to native wildlife.

In a 2007 habitat assessment conducted by the Pennsylvania Game Commission, Cathy Haffner, now a biologist with the PGC, noted the presence of phragmites, as well as native willows and eastern cottonwood in the dry and palustrine sand plains. She concluded that even though there appeared to be plenty of sand and cobble substrate, and that the area was protected as a Critical Habitat Area, plovers might be avoiding the area because of the prevalence of invasive plants and tall woody native shrubs. These invasive plant species alter the sand plains and emergent wetlands by crowding and shading out natives, and creating dense stands of one or two species. The cottonwood, willows, and other trees like black locust, black alder, and European white birch that grow in the plover's nesting habitat also provide cover for predators like raccoons, coyotes, and raptors. With the PGC report as guidance, and in partnership with Pennsylvania Audubon and the Cleveland Museum of Natural History, we developed a plan to remove these invasive and nuisance plants and to manage the area for shorebirds and ground nesting species, as well as the rare native plants.



Palustrine sand plain invaded by phragmites

Ephraim Zimmerman



Sand plain invaded by tall willows and cottonwoods in 2012

Ephraim Zimmerman

The initial treatments in 2012 were very successful. We cleared nearly all of the target vegetation from the treatment area, about 35 acres at the very eastern end of Gull Point. This stuff grows back like crazy, and we knew it would be a number of years before we had the nuisance species under control. Over the past five years, we continued to conduct control efforts along with Presque Isle State Park staff and interns, Penn State University, and the Lake Erie Watershed Cooperative Weed Management Area partnership (LEW-CWMA).



Presque Isle intern applying herbicide to willows.

Presque Isle State Park

To study the effectiveness of the treatment and to document the change in the communities over time, we established transects across the peninsula through the treatment area – approximately 30 acres of sand plain, dune, wet meadow, and sparsely vegetated beach habitat. In 2012, willows dominated many of the transects through the central portion of the restoration area. On the edge of the treatment area, cottonwood seedlings grew in lines along the beach pools, the pattern created as seedlings establish in newly formed sand plains deposited by Lake Erie waves. Within the emergent wetlands and shores of the ponds, the



Transect sampling in 2017

Ephraim Zimmerman

invasive phragmites, narrow-leaf cattail, and purple loosestrife were common. This year marked five years after the initial treatment of the area, and we had planned to re-assess the vegetation. Even though we had returned each year to the area for control efforts and to conduct rare plant surveys, it wasn't until

we stretched the transects across the treatment area that we were able to grasp just how much change had taken place.

The first half of 2017 had been very wet. The lake was so high we had reports of flowing water across the peninsula, separating Gull Point from the rest of Presque Isle. Other parts of the trail to the tip of Gull Point were flooded in some places and a mucky mess in others. Walking the beach was nearly impossible. What was left of our nice sandy beach trail was a jumble of plant roots, downed trees, and driftwood the size of small sailboats (luckily no sailboats). The beach quickly dropped off into deep water. The bay side of the peninsula was a murky slack water swamp of cattails, native emergent vegetation, and phragmites growing out of the muck – not easy walking either. While it was accessible on foot, the two-mile round trip hike was too difficult to carry the multiple backpack sprayers, loppers, and hatchets we used to combat the invasive weeds in the treatment area. To tackle the invasive plants, we had to go by boat.

When we finally made it out to the treatment area, we found the communities were considerably different from 2012 when the thick willow and cottonwood stands dominated the central portion of the restoration area and dense stands of giant reed, cattail, and loosestrife were choking out the palustrine sand plains and ponds. We were happy to observe that our continued targeted control efforts had considerably reduced these infestations in the treatment area. What

was interesting was just how much the sand plains and dune communities had changed since we last surveyed the transects. There was so much water that some of the dry, desert-like sand plains were flooded, or turned into palustrine sand plains, complete with wetland vegetation.



Open sand plain and pond after several years of treatment

Ephraim Zimmerman

The amount of sand plain habitat, which is the critical area for the piping plovers, increased substantially between 2012 and 2017. Over the last five years, Lake Erie deposited several acres of sand forming long mini-peninsulas extending into Presque Isle Bay. A quick look at historical aerial photographs over the last 30 years indicates that the entire habitat where we have been working since 2012 formed after 2000. This does not suggest that there was not any habitat prior to 2000; it was just IN A DIFFERENT PLACE!

Google's time-lapse imagery on their Earth Engine is a great way to visualize the changing nature of Gull Point click on this link <https://earthengine.google.com/timelapse/> and zoom into Presque Isle. Hit play to see how the Gull Point Natural Area, at the tip of the Presque Isle Peninsula has been changing since 1984.

This natural process resulted in new nesting areas for the plovers. Along with the restoration work, the availability of this new sand plain habitat made the area more desirable. The goal is to keep this constantly expanding community free and clear of invasive plants. However, it appears that this will be a constant struggle. The cottonwood and willow, as well as the phragmites,



New willow and cottonwood seedlings in the treatment area.

Ephraim Zimmerman

loosestrife, and narrow-leaf cattail will continue to be a problem in this area, compromising the habitat quality for nesting plovers and other shorebirds as waves constantly bring seeds to the newly formed sand plains.

While our efforts have made significant progress, continued vegetation control activities are required to maintain the open dry and palustrine sand plain habitats at the eastern edge of Gull Point. We like to think of this work as whole ecosystem management, despite our focus on one keystone species. Phragmites and narrow-leaf cattail no longer choke out native plants from the emergent wetlands. Shorebird monitors have observed an increase of all shorebird species, not just the plovers, on the point over the years as management activities have taken place, attributing this increase to a greater availability of high quality habitat. Our control of the invasive plants will promote establishment and growth of native species as these systems evolve from sandy, open beach and dry and palustrine sand plains to Cottonwood - Bayberry Woodlands, which commonly occur on the interior lowlands of the peninsula. Over



Great Lakes Region Beach Grass Dune Ridge Community at Gull Point, Presque Isle State Park

Ephraim Zimmerman

time, these will become stabilized dunes, supporting black oak, lupines, and prickly-pear cactus similar to the dunes on the Dead Pond trail further west at Presque Isle. This story is not just about bringing back the piping plover to Pennsylvania; it is also about the restoration of an entire ecosystem. We cannot emphasize enough the importance of multi-agency collaboration, which involved a combination of regulation, land management, and restoration to improve the habitat for an extremely rare bird species. Our efforts along with the addition of new habitat from natural processes furnished conditions that enticed the plovers to return and nest at Gull Point after so many years away. We are fortunate to be part of such a wonderful team of dedicated people and organizations.

The plovers have occupied a significant amount of time for some of us, especially Mary Birdsong, Cathy Haffner, Tim Hoppe, Jerry McWilliams, Sarah Sargent, staff from the PGC and Presque Isle State Park, as well as others who have been involved in the restoration project over the years. However, the news of the nesting plovers was made public only recently. Since then the plovers have been all over the Erie news and you can find these stories here:

<http://www.goerie.com/news/20170725/piping-plovers-nest-at-presque-isle-first-in-50-years>

<https://www.alleghenyfront.org/piping-plovers-nest-in-pennsylvania-for-first-time-in-sixty-years/>

<http://www.eriereader.com/article/two-nests-four-small-birds-and-enormous-joy>

About the Author

Ephraim has worked with the Pennsylvania Natural Heritage Program for 14 years as a natural community ecologist, and currently serves as the Science Director for the Natural Heritage Program at the Western Pennsylvania Conservancy. He has been involved in many projects to map, describe, and assess plant communities and ecosystems of Pennsylvania's state parks, national parks, and other public and private lands. With members of the Pennsylvania Biological Survey's Ecological Communities Technical Committee, Ephraim updated the wetland portion of Pennsylvania's Plant Community Classification in 2012 and is currently working on an update of the terrestrial communities.



Peat Mosses: A Primer on Pennsylvania's Sphagnum Diversity

by
Scott Schuette

In our last issue, we explored some neat places in Pennsylvania, including our unique peatland ecosystems, which are home to many species of concern. In addition to the rare, threatened, and endangered species that call peatlands home there is a suite of species that make up the dominant vegetation layer from which other plant species can grow. This layer is primarily composed of a single genus, *Sphagnum*, commonly referred to as peat moss. *Sphagnum* is a unique moss genus with around 285 species worldwide. With 42 species known to occur in Pennsylvania, *Sphagnum* accounts for more species than any other genus of moss in the state! That means nearly 15% of the world's known *Sphagnum* species diversity can be found in the open and forested peatlands of Pennsylvania, and this single genus accounts for nearly 10% of our total moss diversity. There are currently 32 species of *Sphagnum* considered rare, threatened, or endangered in Pennsylvania.

The high diversity of *Sphagnum* in Pennsylvania mirrors the evolutionary history of the genus. *Sphagnum* is a very old genus that has been rapidly diversifying for the last 30 million years. Rapid diversification leads to numerous recognizable species, all with the same unique biology that separates them from other mosses. To put that into perspective, bryophytes as a group are the oldest known land plants with evidence suggesting they began diversifying some 500 million years ago. Although *Sphagnum* is comparatively young, many species come in a variety of sizes, shapes, and colors that can change with differences in their environments.



Sphagnum palustre with capsules from the hemlock palustrine forest around Columbus Bog

Scott Schuette



Extensive cover of *Sphagnum palustre* in the red spruce palustrine forest at Two Mile Run Natural Area.

Scott Schuette

In shaded environments such as palustrine forests, the species exhibit a range of green hues. The most common palustrine forest dweller is *Sphagnum palustre*. It has a large, plump form that covers old stump hummocks and can be a component of extensive moss lawns giving the forest an ancient appearance.

The moss lawn in these forests generally is dominated by *Sphagnum fallax*, a large, wispy, deep green moss. Also mixed in this lawn is another striking species, *Sphagnum girgensohnii*, which has a distinctive star-shaped head with a prominent central bud, but the branches tend to have light green, widely-spaced leaves.



Sphagnum fallax showing green color due to the shaded condition of a palustrine forest surrounding Christner Bog.

Scott Schuette



Sphagnum girgensohnii with a star-shaped heads and wispy branches in palustrine forest surrounding Columbus Bog

Scott Schuette

There are few palustrine forest moss species that have any red coloration and that is due in part to shading from the canopy. However around the edges of a palustrine forest as it transitions into a more open bog or fen, *Sphagnum capillifolium* is found forming hummocks of



Hemispherical heads and reddish color *Sphagnum capillifolium* around palustrine forest edges

Scott Schuette

tightly packed plants with hemispherical heads that have a distinctive pinkish to red coloration. As you move into more open peatlands, the species composition shifts as does the coloration of the species. The most distinctive species in open peatlands are differently colored and occupy different microhabitats. Sometimes the brown *S. fuscum* dominates the well-developed, high hummocks, but occasionally the rarer also brown, *S. flavicomans* is the primary high hummock peat moss. This species has the appearance of brown cauliflower due to the tightly packed and rounded heads. Hummock sides are generally covered with *S. magellanicum*, probably our most recognizable species due to the deep maroon to purple color. Another deep red species is *S. rubellum*, which along with its common co-dominant golden brown *S. papillosum*, generally form

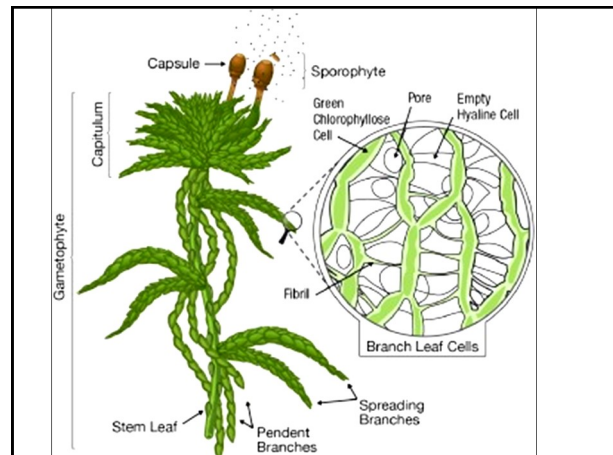


Exposed, open peatlands at Ricketts Glen State Park showing color variation of *Sphagnum* species

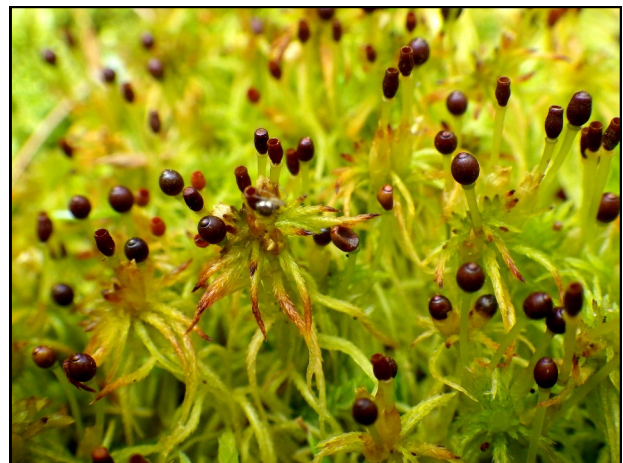
Scott Schuette

extensive carpets of contrasting colors that attract botanists to these very special habitats (See page 8 for pictures of these species).

This is a small sample of the common, but distinctive *Sphagnum* species in Pennsylvania. There are many other species that are identifiable by their very interesting and ornate microscopic characters involving cellular structure and arrangement of the leaves. It is these sets of characters that also make *Sphagnum* very different from other groups of mosses. On the outside, *Sphagnum* simply looks like a really big moss. It has a stem, branches, leaves, and head called a capitulum but it is the internal structure and function that makes these mosses amazing.



Generalized *Sphagnum* plant showing different parts and a close up schematic diagram of the leaves.



Sphagnum fimbriatum with abundant capsules

Scott Schuette

Sphagnum can hold more than 20 times its weight in water due to the large dead cells that are separated by green living cells. These dead cells have large open pores that allow for the cell wall to expand and hold massive amounts of water. The size, location, and arrangement of these pores are used as diagnostic

With more than 40 different species of *Sphagnum* in the state, it is likely that one can encounter several common and some uncommon species in any given peatland in Pennsylvania. This great diversity can be seen in the many colors, textures, and general shapes on display. From the expansive, tie-dyed appearance of *S. rubellum*/*S. papillosum* lawns to the brown, cauliflower-textured hummocks of *S. flavicomans* and *S. fuscum*, the *Sphagnum* in our peatlands is certainly more than “just a moss.” It is the palette from which beauty is created on a miniature landscape and a foundation on which many other plants and animals depend for food, shelter, and life.



Golden brown color of *Sphagnum papillosum*, a co-dominant component of peat carpet at Ricketts Glen State Park



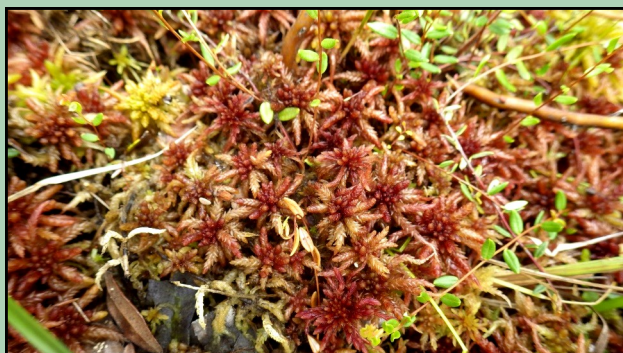
Brown “cauliflower” look of the upper hummock forming *Sphagnum flavicomans* at Ricketts Glen State Park



Brown, hummock forming *Sphagnum fuscum* at the Nansen wetland complex in Allegheny National Forest



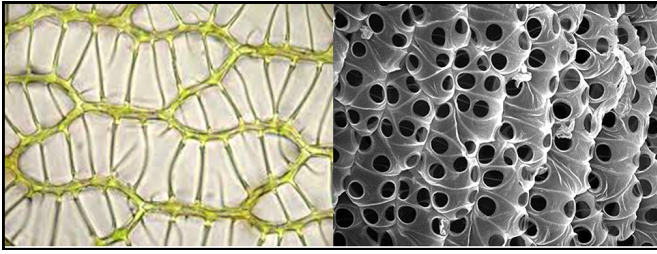
Deep maroon color of *Sphagnum rubellum*, a co-dominant component of peat carpet at Ricketts Glen State Park



Deep maroon to purple color of *Sphagnum magellanicum*



Distinctive coloration of the *Sphagnum papillosum*/*Sphagnum rubellum* peat carpet at Algerine Natural Area.

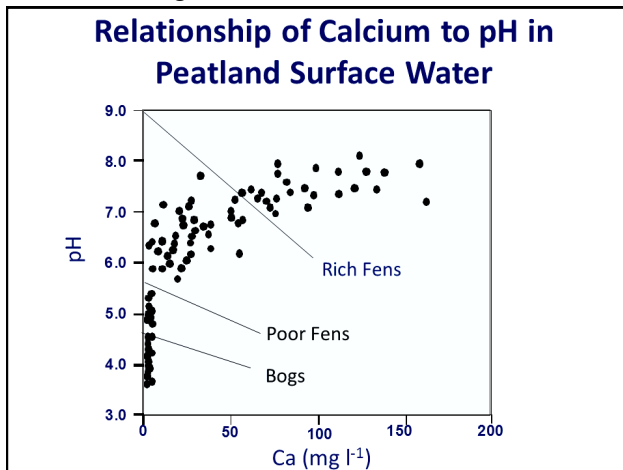


Left: Microscope image of large dead cells and green living cell in *Sphagnum* leaf.

Right: Electron micrograph of dead cells showing large pores.

Photos by Dale Vitt, Professor Emeritus, Southern Illinois University, Carbondale

characters for determining species within some sections of *Sphagnum*. In addition to being taxonomically informative, the water-holding capacity of these cells allows chemical processes to happen that change the environment. The ability of *Sphagnum* to hold large volumes of water combined with the absorption of elements like sodium, magnesium, and calcium while releasing hydrogen ions, acidifies its environment and makes conditions more suitable for other sphagnum to colonize and grow.



Dale Vitt, Professor Emeritus
Southern Illinois University, Carbondale

Surface water pH is used to determine the type of peatland community.

Ecologically, *Sphagnum* species are indicative of different kinds of peatlands. In general, peatlands are classified into two groups, fens and bogs. We further classify fens as either poor fens or rich fens depending on the pH of the system due to the amount of calcium present in the source water. Poor fens generally have pH values between 5.5 and 7.0 while rich fens tend to have pH values above 7.5. *Sphagnum* dominates peatlands that have surface water with pH values below 7.0, so you find more *Sphagnum* diversity in bogs and poor fens than in nearly neutral to rich fens. The more acidic peatlands have slower decomposition in part due to the chemistry, but also due to the resistance of *Sphagnum* cell walls to decomposition. Over time this slow rate of

decomposition and rapid rate of *Sphagnum* growth are what allow for peat accumulation. As the peat accumulates, so too does the depth of the filter provided by the *Sphagnum* component that sequesters atmospheric nitrogen, phosphorus, and carbon.

This amazing ability to sequester carbon and nutrients is most important under current climate change scenarios where the expansive boreal peatlands are thought to sequester more than 30% of the world's terrestrial carbon. That is more than any other ecosystem on the planet. In addition, the ability to hold on to nitrogen and phosphorus in the headwaters of a watershed creates a filter for downstream water bodies, which keeps streams clean and supports a high diversity of aquatic organisms. In essence, *Sphagnum* can shift the conditions in the environment to ensure competitive success and create more available habitat for itself and other acid loving organisms. This defines a keystone species and, in these systems, *Sphagnum* clearly is the keystone. If we removed *Sphagnum* from our peatland systems, it would dramatically shift those habitats to entirely different ecosystems.

In short, *Sphagnum* as a genus has tremendous ecological importance on local, regional, and global scales. Our current Environmental Protection Agency grant to monitor high elevation peat wetlands is providing us with the opportunity to document the *Sphagnum* species and develop future research questions that address the functions of these species on the landscape.

About the Author

Scott has worked with the Pennsylvania Natural Heritage program for six years as an inventory botanist and bryologist. He currently serves as the Manager of Natural Heritage Inventory at the Western Pennsylvania Conservancy. He has advanced understanding of Pennsylvania's bryophyte diversity. As chair of the Pennsylvania Biological Survey's Bryophyte and Lichen Technical Committee, he has worked with members to develop a list of bryophyte species of concern to include with the other tracked plants in Pennsylvania.



Notes from the Field

Eared False-Foxglove Keeps Outfoxing the Odds

John Kunsman



John Kunsman

Eared false foxglove (*Agalinis auriculata*)

Eared false-foxglove (*Agalinis auriculata*) is a globally rare and Pennsylvania Endangered plant that inhabits grasslands and other open places, particularly in the prairie states. There are several historical records in Pennsylvania, but at present PNHP has documented only one existing population in Lehigh County. Although the habitat at this site is anything but pristine, PNHP has made the colony a priority for conservation because of the high global rank and the single state population. We have done a yearly census of the species since 1991 and conducted stewardship activities since 2005.

This species has an annual life cycle, meaning that all plants in a given population live for a season and depend upon the germination of seeds from the previous year(s). As a result, the population size varies from year to year. The Lehigh colony has had as many as 258 individuals in 1994 and as few as 7 individuals in 2012, with the median over the last 27 years being 36 individuals. In 2017, 54 individuals were present, which is the most since 2009. The seeds appear to require light in order to germinate, so those that become buried in the substrate probably will not develop into plants. The species may or may not connect itself to the roots of certain other species in order to acquire nutrients. Eared false-foxglove plants are often six inches or less in height at the Lehigh population, and competing vegetation may easily overtop them.

In addition to these biological and ecological obstacles for the species itself, the Lehigh colony has survived other challenges in the last quarter century, including a continual development threat, change in ownership of the land, very wet and very dry summers, competition from exotic species, and indiscriminate herbicide spraying. To say the least, this population has been amazingly persistent.

Discovery of Running Buffalo Clover

Steve Grund

PNHP botanists have an informal list of what we call “Holy Grail” species, which are species with ranges that come very close to, or even skip over, Pennsylvania. We got very excited when Fraser’s magnolia (*Magnolia fraseri*) was found in Fayette County a few years ago (Wild Heritage News Fall 2015). Fraser’s magnolia is common in the southern Appalachians, but extending its known range north into Pennsylvania is a big deal for botanists.

Extending the known range of a species that is common at the core of its range is one thing. Extending the known range of a species that is rare throughout its range is, well, rare. Running buffalo clover has long been on our Holy Grail list because it is known both from northwestern West Virginia and from eastern Ohio. PNHP biologists have looked for years trying to find this species in Pennsylvania, and finally this spring there was a payoff when we found a small population in Greene County.

Some of the habitats where running buffalo clover is found are not the sorts of places one generally expects



Gabriel Malone

Running buffalo clover (above) looks very much like a larger version of white clover (*Trifolium repens*), which probably grows in your lawn. The most notable difference is the presence of two leaves on the vertical stem that supports the flower head.

to find rare plants. It is thought that this species was historically closely associated with the activities of bison, and that some human activities, including mowing, mimic the disturbance of bison grazing closely enough to enable the species to survive in the absence of their large, furry, ecological partners. Flooding of streams also can provide the appropriate disturbance level.

In the case of Pennsylvania's population, it appears that both disturbance types play roles. The plants are near a stream, in an area that probably floods several times in a decade, or perhaps more frequently. Additionally, the running buffalo clover is growing along a private road, in an area that is mowed infrequently.

We will continue to search for more running buffalo clover in southwestern Pennsylvania, and thanks to a conservation-minded landowner, this new addition to the flora of Pennsylvania has a bright future.

Ohio River Mussels

Ryan Miller

Intensive natural resource extraction (e.g., oil extraction, coal mining, and timbering) has occurred in the Ohio River valley since industrialization. Commercial uses of the river for shipping, discharge of industrial waste-water, and sand and gravel dredging have diminished the aquatic resources in the Ohio River so much that by the turn of the 20th century a once biologically rich ecosystem was functionally dead.



Ryan Miller

Preparing for a dive on the Ohio River downstream of Shippingport near Phillis Island.

Despite past and ongoing threats, the river has experienced improvements in water quality since the federal Clean Water Act. While recent surveys provided some insights into the improving health of the river, the state of numerous species are not well

understood. In 2016, PNHP received a State Wildlife Grant and a Wild Resources Conservation Program grant to survey the least disturbed portions of the river for freshwater mussels.

During the month of September the WPC SCUBA team conducted multiple freshwater mussel surveys on the Ohio River. The surveys focused on the New Cumberland and Montgomery Pools. After a very rainy summer postponed most of the work, the dive team was anxious

to get the surveys underway. The divers braved murky waters with 1.5-meter visibility to find eight species of mussel during this year's surveys. The most common species were the pink heelsplitter and mapleleaf. The divers also found mussels that had been relocated from the Hunter's Station Bridge mussel relocation project on the Allegheny River. A significant number of the mussels that were located had invasive zebra mussels attached to them. Unfortunately, zebra mussels can suffocate and eventually kill native mussels by attaching to and growing over their siphons. Considering the once dismal state of the river, it is amazing to find living mussels persisting, even if they are in small pockets of relatively undisturbed river bottom. We should complete the Ohio River mussel survey in 2018 if next year has a more normal rainfall pattern.



Alysha Trexler

WPC dive team retrieving the transect that was placed on the bottom of the river for the divers to follow.



Mary Walsh

Mapleleaf mussel collected from the river bottom with invasive zebra mussels attached.

Flight 93

Adam Hnatkovich

This fall, the PNHP initiated a new project with the National Park Service (NPS) at the Flight 93 National Memorial with a goal of completing a Natural Resource Condition Assessment for the park. To accomplish this, the PNHP will compile historical, geographical, and ecological information, drawing from both PNHP and NPS data sources to summarize ecological conditions at the park. Using these data, PNHP will also identify factors influencing ecological conditions, and identify park resources that may require management or enhanced conservation.

In 2005, as part of the site planning and environmental impact statement that were required for establishing the National Memorial, Heritage staff participated in an assessment of ecological resources and biodiversity at the site. The inventory described the flora, fauna, and natural communities found on the 1,360 acres at the Flight 93 National Memorial. This data, as well as other data collected regionally since 2005, will be useful in evaluating ecological conditions and will inform future management at the Flight 93 National Memorial.



Sunset over the wetlands near the Memorial Plaza. The return of wildlife habitats is part of the long-term plan for the memorial landscape.

National Park Service

A New, Yet Old, Cactus Species for Pennsylvania

Chris Tracey

Many people are surprised to know that Pennsylvania is home to a native cactus species, the eastern prickly-pear (*Opuntia humifusa*). This species, considered rare in Pennsylvania, grows in a variety of dry habitats including sand dunes, shale barrens, and ridgetop barrens. However, recently, PNHP ecologists uncovered another species hiding in plain sight. Acting on information on the presence of another prickly-pear species (*Opuntia cespitosa*) in other states in the



Opuntia cespitosa

Christopher Tracey

northeast, we began to research this species and its presence in Pennsylvania.

Recent research by Lucas Majure, has proposed a split in of *O. humifusa* into two species—*O. humifusa* and *O. cespitosa*. PNHP botanist Steve Grund agreed that it appeared to be a valid taxonomic split that was supported by both morphological and genetic evidence. Interestingly *O. cespitosa* is originally a name given by Rafinesque in the 1800s. Like many of the species Rafinesque described, there was no type species available and, over time, the concept was lumped into *O. humifusa*.

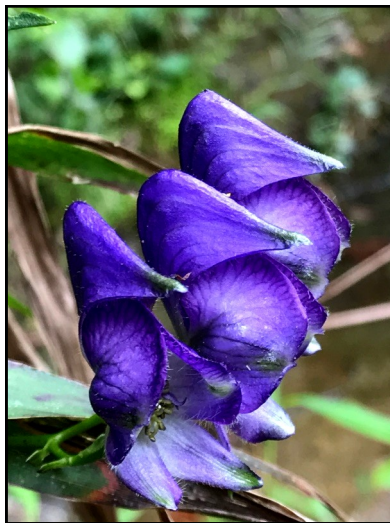
Looking in online herbarium databases (the benefits of digitized collections), we found evidence of this species in Pennsylvania from an 1862 specimen collected along the Susquehanna River. Not being aware of any extant populations, we thought the species might be extirpated from Pennsylvania. However, a few months later we were in Erie County working on vegetation plots, when we came across a small population of *Opuntia* that we had not documented a few years earlier during the Erie County Natural Heritage Inventory update. Back then, we had assumed that it was *O. humifusa*, as we were not aware of another species of *Opuntia* in the state at the time. During this visit, the species was in bloom. With its bright orange-red flower color and many long spines, it was obvious that it was indeed *O. cespitosa*. Additionally, Larry Klotz from Shippensburg University, recently uncovered a potential third occurrence of this species in Franklin County and we plan to visit this site next field season. It is exciting to have a confirmed population of the species in Pennsylvania and to know there is the possibility of finding more.

Retrospective: Rare Plants along the Yough

Charles Bier

Do you know what you were doing on June 17, 1985? I do; the same thing that I was doing on August 15, 2017, hopping boulders along the Youghiogheny River gorge through Chestnut Ridge, and watching for both copperheads and rare plants at the same time. But this time I was not by myself. I had the company of crack botanist Steve Grund. Our work focused on revisiting occurrences of special concern plants that we had not reassessed in recent years. We also wanted to explore the north side of the river, because botanists had not previously explored it due to difficulty with access.

In particular, we were searching the harsh and moderate scour zones for special concern species that are largely restricted to the margins of the Youghiogheny in Fayette and Somerset counties, along with a few other tracked species. In particular, we were hoping to locate the species I had



Blue monkshood (*Aconitum uncinatum*)

Charles Bier

documented in 1985: large-flowered marshallia (*Marshallia grandiflora*), blue monkshood (*Aconitum uncinatum*), buffalo-nut (*Pyrolaria pubera*) and Carolina tassel-rue (*Trautvetteria carolinensis*), along with the now tracked sand grape (*Vitis rupestris*), rock skullcap (*Scutellaria saxatilis*), mountain bugbane (*Actaea podocarpa*), veiny pea (*Lathyrus venosus*), umbrella magnolia (*Magnolia tripetala*) and stiff-cowbane (*Oxypolis rigidior*). The sand grape is a globally rare and Pennsylvania Endangered species that was not found along the river 32-years ago (i.e., I missed it).

Museum records are so valuable to natural heritage work and are the initial evidence for the general distribution of rare species. However, these records rarely include the extent and abundance of populations, and do not indicate their continued survival. Take blue monkshood for example; the historical specimens begin in 1903 and document that this species was found in the Youghiogheny valley at and within a few miles of Ohiopyle, Fayette County. Subsequent work by the

nascent PNHP confirmed most of those early records, but also better documented the range of this Pennsylvania Threatened member of the buttercup family, as well as other rare species in the area, including the Pennsylvania Endangered large-flowered marshallia. The 1985 boulder hopping, which extended the range of the monkshood (as well as the marshallia) 25-kilometers downstream to the limits of the Allegheny Mountains, was then followed by more work that extended the range even further downstream and out into the Pittsburgh Plateau.

Our 2017 work reaffirmed most of the 1985 locations of the monkshood and other species, as well as expanding the known occupied habitat. We used a canoe to visit habitats along the side of the river that is difficult to access on foot. Although navigating the rapids was a little more challenging than local experts led us to believe, we managed to keep the canoe upright, and only had to bale it three times. We discovered new locations for four species, including one for the globally rare large flowered marshallia, and three for the globally rare sand grape. This work just solidifies our previous conclusion that the Youghiogheny Gorge is one of the most important areas for plant biodiversity in Pennsylvania.



A canoe was used to reach the inaccessible side of the river.



Steve Grund collecting field data

Charles Bier

Charles Bier

Measures of Progress

The following Measures of Progress represent a significant cross-section of results of the work that we do as a program. These measures will be reviewed and updated, as needed, to best reflect the activities and goals of PNHP. Progress for these measures reflects seasonality of program activity.

Measure of Progress	Annual Goal (2017)	1st Quarter	2nd Quarter	3rd Quarter	Cumulative Total	Percent of Annual Goal
Biotics Records Updated	300	137	207	111	455	100%
New EOs Documented	800	234	286	141	661	83%
New Records Entered into PACE	350	0	0	291	291	83%
Field Surveys Reported	300	76	104	127	307	100%
New CPPs Developed	400	275	228	141	644	100%
NHAs Updated	150	0	0	0	0	0%
Sites Actively Monitored	35	0	0	42	42	100%

PNHP performs many functions and provides many services as part of its mission. The measures of progress that are detailed here are meant to capture a number of important program activities and provide a picture of our progress in achieving our essential goals. The program goals and the measures provided for those goals will change over time as we complete certain aspects of our work and as new program responsibilities arise.

Biotics Records Updated indicates the amount of activity expended in improving and updating the more than 20,000 records in the PNDI database.

New EOs Documented is a way to measure the success of our inventory effort in finding new occurrences of elements of ecological concern (plants, animals, and exemplary natural communities). Biotics records are created for each new Element Occurrence documented.

New Records Entered into Pennsylvania Conservation Explorer (PACE) indicates our level of activity in reviewing, quality controlling, and entering biotics records into the environmental review data layers. The timely and consistent refreshment of these data are critical to providing protection to the state's species of greatest concern.

Field Surveys Reported is a strong indicator of the effort expended on one of the basic functions of the program – inventory of the state's flora and fauna. Every field visit results in the entering of a field survey, regardless of the outcome of the survey.

New Conservation Planning Polygons (CPPs) Developed is a measure of our progress in creating ecological based mapping for the species and natural communities that we track as part of the PNDI database. Our goal is to have CPPs for all species and communities that we track.

NHAs Updated is a measure of our effort in developing, mapping, and describing sites (Natural Heritage Areas - NHAs) that are important to conservation of Pennsylvania's biodiversity. This process began with County Natural Heritage Inventory projects and will now continue at a statewide level with the updating of existing sites and the creation of new sites. Site polygons will be based upon and consistent with CPPs.

Sites Actively Monitored indicates how many established geo-referenced plots that we visited and sampled. These sites allow us to collect data on structure, species composition, and physical context (soils, hydrology, etc.) in a systematic way and by following the same protocols to directly compare future data to previous data.