Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

WILD HERITAGE NEWS

Fall 2018

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Photo Banner:
Algerine Swamp, a peatlands monitoring site in Tioga and Lycoming counties

David Yeany

Understanding Climate Change in Pennsylvania

by

Mary Ann Furedi

Climate change impacts are altering our planet. Rising temperatures, caused by increasing levels of atmospheric carbon dioxide, have resulted in a cascade of environmental alterations that will only continue to increase in the future. Rapidly melting Arctic sea ice, acidifying oceans, rising sea levels, and extreme weather events are just a few examples of climate change related impacts.

Although climate change may be more evident in some regions of the planet, no place is considered immune to its effects. Even the climate of Pennsylvania has experienced notable change. Over the past 110 years, a time period associated with industrialization and the use of fossil fuels, Pennsylvania has undergone a long-term warming trend of almost 2˚F and an overall increased precipitation trend.

Climate models show that this pattern will continue into the future at an accelerated rate. The Representative Concentration Path model, one of two emission models currently being used by climate scientists, shows that by 2050, Pennsylvania will be over 5°F warmer than at the end of the 20th century. The model also shows more precipitation in Pennsylvania as well (8% annual increase with a winter increase of 14%), but it will exhibit an altered pattern. More precipitation will fall in the winter, but as rain instead of snow. Alterations in these ecosystem drivers will result in a variety of effects such as a higher heat index in the summer, more extreme heat and storm events, and longer growing seasons. These changes will ultimately

Mary Ann Furedi

In the near future, we can expect more costly floods from extreme weather events due to climate change.

affect all aspects of life in Pennsylvania from human health and the economy to agriculture and water resources.

The Cornell Institute for Climate Smart Solutions (CICSS) online modeling tool projects climate changes by county. In Bucks County, PA the number of 90 degree days is projected to increase from 30 in 2010 to 96 by 2099. How many 90 degree days will you have in your county?

http://climatechange.cornell.edu/2018/10/24/climate-change-in-your-county/

Given these projected effects, it is likely that the plants, animals, and landscapes in Pennsylvania will be altered by climate change. The challenge now for those charged with the management and conservation of Pennsylvania's natural resources is how to adapt and mitigate for climate change. The projects described below are two examples of the work PNHP is doing to better understand which species and plant communities are most vulnerable to climate change and how to track those changes over time.

Identifying Climate Change Vulnerable Species

Climate change will likely alter the distribution and abundance of plant and animal species in Pennsylvania. However, the response to climate change will likely vary among species. Mobile species that are not restricted by habitat constraints and geographic or human-derived barriers may shift their ranges northward in response to climate change. Northern edge-of-range species that fall into this category may actually shift their ranges beyond Pennsylvania's borders while being replaced by species that were once distributed further south. Pennsylvania may even gain new species from surrounding states as ranges shift.

David Yeany

Extremely rare breeding birds like PA Endangered yellow-bellied flycatcher (*Empidonax flaviventris*) were found at new sites during this project. This species is vulnerable to climate change impacts as they nest only in red spruce wetlands.

David Yeany

Even very common feeder birds, like this white-throated sparrow (*Zonotrichia albicollis*), breed only in boreal habitats and are predicted to decline by as much as 30% globally over the next fifty to eighty years due to climate change.

On the other hand, some species may have very little ability to move in response to climate change due to various limitations and obstacles. These species are likely to experience a reduction in range and/or abundance. Other species may remain stable within their current range or even expand their range. This potential shift in species locations and ranges will create challenges for those agencies responsible for their conservation and management. The first step in addressing these challenges is to determine those species most vulnerable to climate change and the factors that influence their vulnerability.

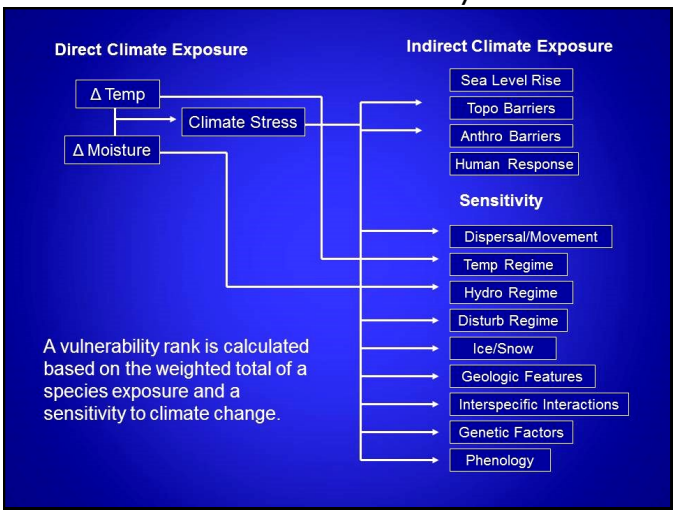


Diagram showing how the CCVI works

To contribute to this, PNHP biologists have been using the Climate Change Vulnerability Index (CCVI), an Excel-based tool developed by NatureServe. The CCVI is a user-friendly tool that requires some knowledge about species distribution and natural history. The CCVI uses factors related to exposure, sensitivity, and

adaptive capacity to calculate a climate change vulnerability rank. The vulnerability rank falls into one of five categories: extremely vulnerable, highly vulnerable, moderately vulnerable, less vulnerable, and insufficient evidence.

To date, more than 100 plants and animals have been examined using the CCVI, and we continue to analyze more. An on-going project is focusing on about 40 plant species that are mostly found at their northern or southern range extents in Pennsylvania. There are some general vulnerability patterns emerging from this work. We've found that generalist species tend to be less vulnerable to climate change. Species that do not have specific habitat requirements, are mobile and able to move longer distances, and are not dependent on other species are less vulnerable to climate change. Whereas, certain groups of species are more vulnerable to climate change because they have particular life history needs, are tied to specific habitats, and are dependent on other species for some phase of their life cycle.

Mary Ann Furedi

Creeping snowberry (*Gaultheria hispidula*) is extremely vulnerable to climate change and a plant target for peatlands monitoring.

The results of this project provide us with greater insight into the fast approaching challenges associated with climate change. There will be winners and losers as the climate changes, and we need to incorporate the findings from projects like this to help guide the future management of our resources.

Monitoring Habitats Vulnerable to Climate Change

Monitoring is an important tool used by scientists to track changes in species populations or systems over time. PNHP biologists are currently conducting a monitoring effort to better understand how biological components of peatlands are changing, possibly in response to climate change.

Mary Ann Furedi

A monitoring plot in Titus Bog

Peatlands represent a unique group of wetlands in Pennsylvania. They are characterized as having a significant accumulation of semi-decomposed, water-logged organic material (a.k.a. "peat") and are generally found at higher elevations and higher latitudes. In Pennsylvania, peatlands are found in the glaciated regions of the state and at high elevations in the Appalachian Mountains. These wetlands are typically cooler and provide a special environment that supports plants and plant communities ordinarily found farther north in the United States. Pennsylvania peatlands exist as pockets of boreal refugia and provide habitat for some of our rarest bird species. The effects of climate change, such as rising temperatures and alterations in the hydrological cycle, will likely alter the environmental conditions that support the unique biological assemblages found in these wetlands.

Beginning in 2010, PNHP biologists established a long term monitoring network at 30 sites to begin to

Mary Ann Furedi

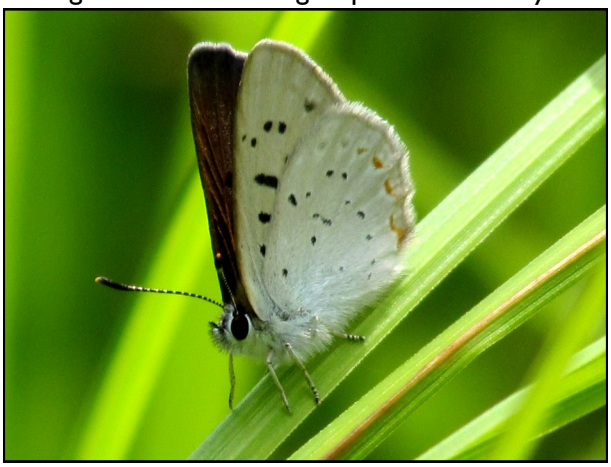
How will climate change affect this beautiful Hemlock – Palustrine Forest at Two Mile Run?

Mary Ann Furedi

David Yeany conducts a bird survey in Bear Meadows Natural Area, a peatlands monitoring site in Centre County.

understand and document the effects of climate change on peatlands in Pennsylvania. The original effort was focused on establishing permanent sample plots and transects in target plant communities to see how they change over time. We also included a census of target plant species that were vulnerable to climate change based on CCVI results. We were interested in collecting baseline data to examine changes in plant community structure and composition, shifts in plant communities within sites, and whether some of the rarer species populations are declining and what species are replacing them.

In 2016, we returned to our sites to conduct a second round of monitoring. In addition to target plant species and plant communities, we added bryophytes, birds, and flying insects. Some species within these groups are highly susceptible to the habitat changes projected under current climate change scenarios so they serve as excellent barometers for change within these systems. Adding these taxonomic groups to our surveys will also provide more opportunities to inventory areas where they have been less well-documented.



Betsy Leppo

Bog copper (*Lycaena epixanthe*) was found at multiple monitoring sites and is extremely vulnerable to climate change.

We completed monitoring of all sites this summer and are about to begin data analyses so it is too early to tell what, if any, changes have occurred during the time interval between sampling. However, we have had some exciting species finds as a result of the new survey efforts. Our bryologist, Scott Schuette, documented several new locations for pom-pom peat moss (*Sphagnum wulfianum*). It is a globally widespread species but restricted to mature red spruce palustrine forests in our region. His surveys also resulted in the addition of seven new liverwort species to the state list. David Yeany, our ornithologist, recorded the presence of 13 bird Species of Special Concern along with documenting 21 of 22 focal bird species for peatlands. Several of Pennsylvania's rarest (S1 – S3 ranked) invertebrates were also documented at the monitoring sites. Hopefully these biologically rich areas will not be lost from the landscape due to climate change, but only long-term monitoring and time will tell.

Scott Schuette

New locations of pom-pom peat moss (*Sphagnum wulfianum*) were discovered as part of the peatlands monitoring project.

About the Author

Mary Ann has worked with the Pennsylvania Natural Heritage Program for 10 years as a community ecologist and currently serves as the Ecological Assessment Manager. She received her B.S. in Biology from Fairleigh Dickinson University and her Ph.D. in Biology from West Virginia University. Her projects generally focus on characterizing the current conditions of different natural systems in Pennsylvania and understanding how these systems change over time.

What Should Be Protected in a Changing Climate?

by

Charles Bier and Christopher Tracey

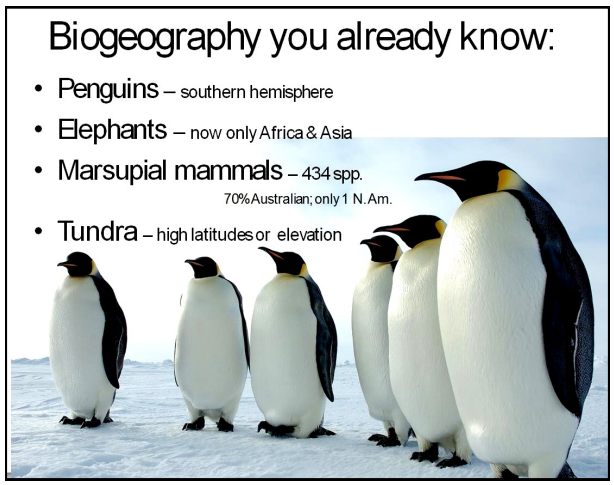
Pennsylvania Natural Heritage Program (PNHP) data has been used to guide biodiversity conservation and land protection since the early 1980s. Over time, PNHP data sets have expanded and there are increased resources available for use in guiding conservation planning for land protection. Basic data describing highly ranked species and significant natural communities are incorporated into the county natural heritage inventory projects where more explicit details are provided about the elements of diversity as well as the sites harboring them. Core habitat and supporting landscape mapping further enriches the information that planners can utilize. Typically, PNHP site descriptions focus on precise details regarding the species of special concern, significant natural communities, and habitats.

While species information is the key to the quality and value of PNHP data, information describing the site and its landscape has been a secondary focus. A critical function of PNHP data in guiding biodiversity protection efforts is to prioritize any group of sites by those most important to maintaining global biodiversity. When we protect sites with high globally ranked species (G1-G3), we have always believed those are the real success stories. However, as global climate change progresses, this perspective and the related land protection approaches are being revisited.

Robert Coxe

Painted trillium (*Trillium undulatum*) and Pennsylvania range map with collection sites (red dots). This plant favors cool, moist habitats which are found mostly at high elevations or northern latitudes.

'Biogeography' is the natural spatial pattern of the distribution of life on earth. The biogeography of biodiversity has, to some extent, always been in flux. While chance and mystery are factors in some biogeographic patterns, the patterns are always driven by environmental conditions, both geologic and climatic, that describe the range of variables that species have adapted to over their evolution. The key variables include precipitation, temperature, elevation, soils and land forms, and major ecosystem types, e.g., marine, alpine, etc. For many different reasons, the distribution of any given species is, at least in part, defined by its tolerance to a range in environmental conditions. If the climate changes and alters environmental factors beyond a species' tolerance or beyond the tolerance of its food source, the species will shift its distribution "in search" of new locations within the range of those tolerances, or it will simply die out in the attempt to find its sweet spot again.



Glenn Grant, National Science Foundation
Wikimedia commons

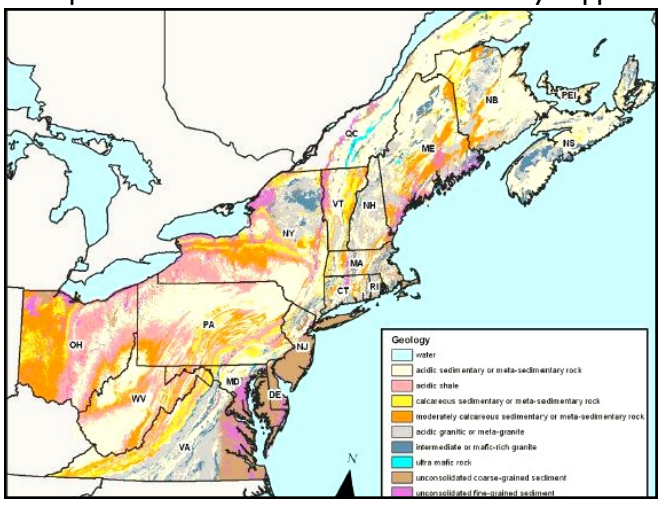
While climatic changes affect certain environmental drivers of species distribution (e.g., annual precipitation, maximum temperature, estuary salinity), it has little or no effect on other drivers (e.g., presence of bedrock outcrops, soil type, or pitch and aspect of slope). The bottom line is that life on Earth has always been

governed by climate and climate has varied before. Previous climate changes have resulted in range shifts for flora and fauna. However, any time a species is forced to modify its range, the plant, animal, fungus or microbe, still has to find habitat that is derived from climatic and other environmental conditions that are within its tolerances.

In hindsight, it is now apparent that some species (e.g., yellow-throated warbler) were already shifting ranges as early as the 1950s, probably due to early changes in climate. Now with elevated levels of greenhouse gases and the increasing number of 'warmest year on record' events, scientists expect to see more changes in distribution and accelerated movement of species. If possible, species that can no longer sustain themselves in portions of their present ranges will disperse to regions still within their tolerances for survival. Species that cannot move quickly enough or run into habitat road blocks will become extinct.

While humanity struggles to deal with excessive greenhouse gases that are the basis for climate change, the biodiversity conservation community of governmental and non-governmental organizations must ask the question: Do we need to alter our conservation practices in order to maintain biodiversity? Many scientists and land managers are answering yes.

Today, conservation biologists are considering two things when determining how to protect biodiversity in a changing climate: (1) degree of site resilience and (2) type of geophysical setting. Resilience is how well a site can absorb stress and maintain conditions that support the species and communities that it currently supports.



Bedrock geology of the northeast. Colors indicate bedrock types. Examples: calcareous or limestone (bright yellow), moderately calcareous (orange), acidic sedimentary (light yellow), acidic shale (pink)

An evaluation of a site's resiliency provides an assessment of how resistant the qualities of the site are to changes brought about by alterations in the climate. Complexity of terrain and degree of connected land cover are the key resiliency factors. For example, an undeveloped deep serpentine valley with steep slopes that are facing multiple directions, and thereby provide a range of temperature and moisture, is more resilient than a shallow linear valley that includes highways, cleared land, and buildings and where species have fewer options for meeting their habitat requirements. While climate resiliency is often the first thought in climate change planning, it is geophysical settings that must be the primary consideration in maintaining regional biodiversity.

Paul Wiegman

Referred to as eastern deserts, Appalachian shale barrens are good examples of unique geophysical settings that harbor very rare species and are critical to the mid-Atlantic region's biodiversity.

Geophysical settings are defined by the combination of geology and topography. The Nature Conservancy's Eastern Conservation Science team conducted an analysis for the northeast from the Gaspé Peninsula, Quebec to Virginia based upon several environmental parameters and compared those to biodiversity richness. The team determined that (1) the number of surface geology types, (2) the elevation, (3) the presence of calcareous substrate, and (4) the latitude for sites across the region, were the most predictive factors of existing biodiversity richness. This work has been confirmed through similar findings by other researchers. In considering an approach to biodiversity protection across Pennsylvania, geophysical settings are an important if not primary factor for selecting new sites to protect.

PNHP

Prickly pear cactus (*Opuntia humifusa*), listed as PA Rare, is a shale barren species.

Secondly, as a way of guiding future land protection, the team also summarized the degree to which each geophysical setting is already protected under some type of management (e.g., dedicated natural area, state forest, general open space) per conservation management status from the U. S. Geologic Survey's Gap Program. The results of this exercise show us which geophysical settings have been successfully protected and where there is still work to do to protect and manage other setting types.

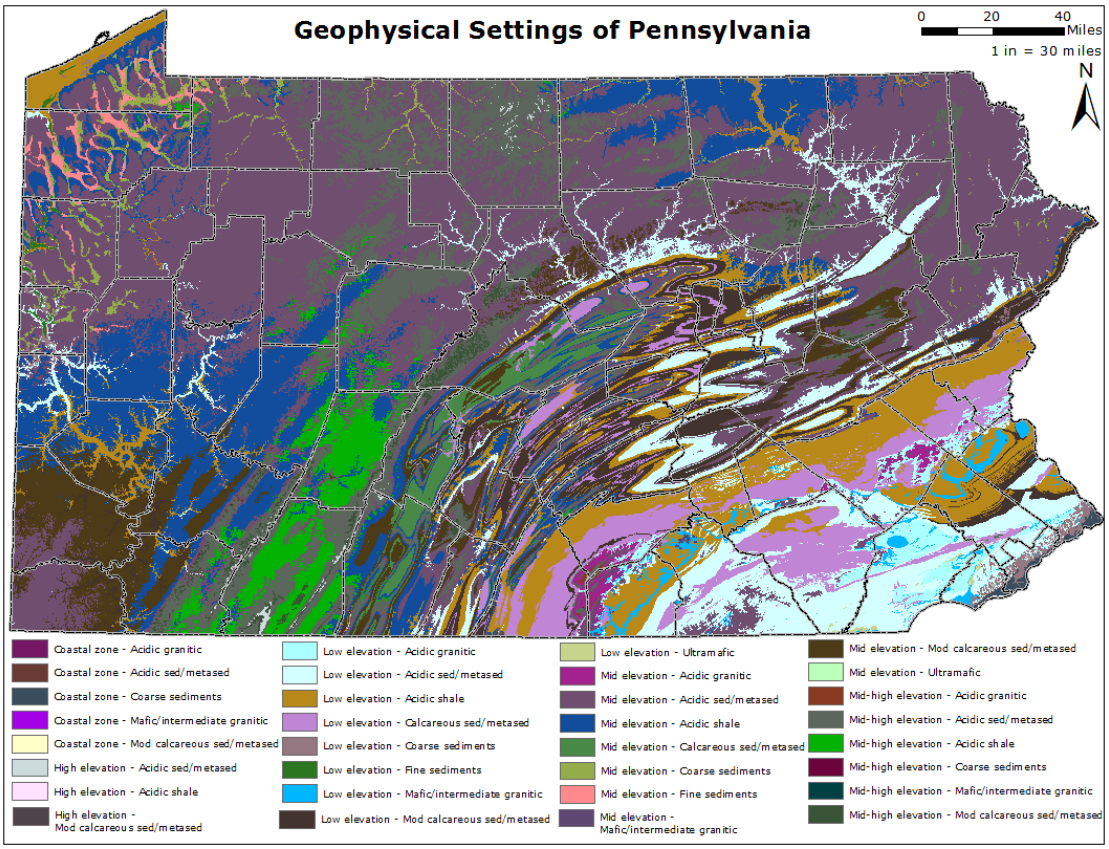
While we can work to keep habitats as resilient as possible, ultimately, species will shift their ranges to survive. The entire regional portfolio of habitats must be protected; especially the rich group of sites on geophysical settings that are under-protected to date and which will be required by a significant portion of Pennsylvania's future biodiversity.

Biodiversity protection today must recognize that climate change will result in shifts in species ranges. However, just as actors come and go on a theater stage, species will similarly vary their locations to adjust to the stresses of an altered climate, so long as the proper stage (geophysical setting) is protected for their entrance.

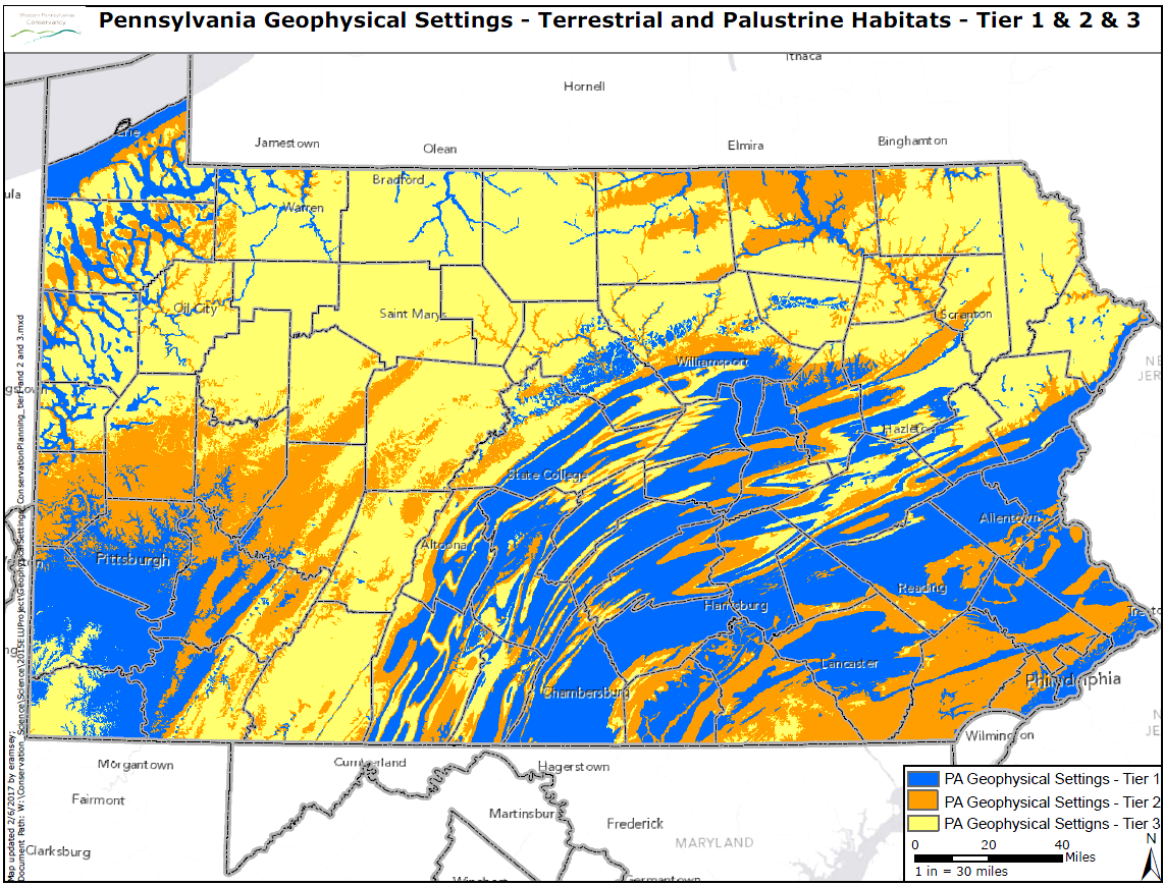
The TNC geophysical settings framework may be vital to on-the-ground biodiversity protection in the coming years. Western Pennsylvania Conservancy (WPC) is interested in applying this approach, and conducted additional analyses utilizing PNHP and WPC conservation science staff expertise over the past year. That work produced refined data sets customized for specific use in the commonwealth.

In customizing the regional analysis of geophysical settings, we made significant modifications to the glaciated sections of the northwestern corner of Pennsylvania. Here, the massive influence of the continental ice sheets is more relevant to biogeography than bedrock, which now lies largely buried under glacial deposits. Similar work for northeastern Pennsylvania is yet to be accomplished.

Habitat protection in Pennsylvania has been governed by the economics of land use. In general, higher



Geophysical settings are a combination of bedrock type and elevation. Examples include Low elevation - acidic shale, Mid elevation - calcareous, Mid-high elevation - coarse sediments.



Pennsylvania's 36 geophysical settings shown in 3 tiers of biodiversity importance. The vast majority of land protection in Pennsylvania has historically occurred within Tier 3 high elevation acidic geophysical settings (yellow). The species rich Tier 1 (blue) and Tier 2 (orange) settings have received less conservation attention.

Prioritize Geophysical Settings for Conservation

Tier I	Tier 2	Tier 3
Coastal Zone - Acidic Granitic	High Elevation - Acidic Shale	High Elevation - Acidic Sed/Metased
Coastal Zone - Acidic Sed/Metased	Low Elevation - Acidic Granitic	Mid Elevation - Acidic Sed/Metased
Coastal Zone - Coarse Sediments	Low Elevation - Acidic Sed/Metased	Mid High Elevation - Acidic Granitic
Coastal Zone - Mafic/Intermediate Granitic	Low Elevation - Acidic Shale	Mid High Elevation - Acidic Sed/Metased
High Elevation - Mod Calcareous Sed/Metased	Low Elevation - Mafic/Intermediate Granitic	Mid High Elevation - Acidic Shale
Low Elevation - Acidic Shale	Low Elevation - Ultramafic	
Low Elevation - Calcareous Sed/Metased	Mid Elevation - Acidic Granitic	
Low Elevation - Coarse Sediments	Mid Elevation - Acidic Shale	
Low Elevation - Fine Sediments	Mid Elevation - Mafic/Intermediate Granitic	
Low Elevation - Mod Calcareous Sed/Metased	Mid Elevation - Ultramafic	
Mid Elevation - Calcareous Sed/Metased	Mid High Elevation - Calcareous Sed/Metased	
Mid Elevation - Coarse Sediments	Mid High Elevation - Coarse Sediments	
Mid Elevation - Fine Sediments	Mid High Elevation - Fine Sediments	
Mid Elevation - Mod Calcareous Sed/Metased	Mid High Elevation - Mafic/Intermediate Granitic	
	Mid High Elevation - Mod Calcareous Sed/Metased	

Specific geophysical settings grouped by three tiers of conservation attention need.

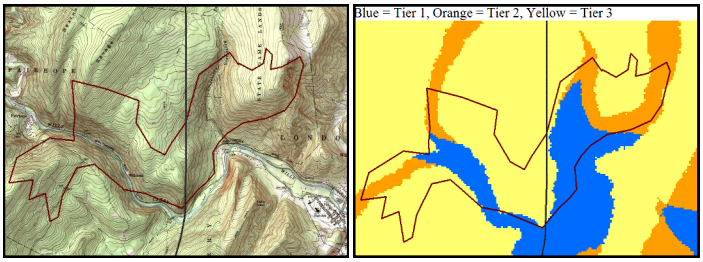
Nowhere to Go for Limestone Loving Species

Betsy Leppo

The northern metalmark (*Calephelis borealis*) caterpillars feed only on round-leaved ragwort (*Packera obovata*), which grows only in low to mid elevation limey soils.

We often think of species adjusting their ranges by moving north or to higher elevations to adjust to climate induced extremes in temperature and moisture. But for species obliged to live in limestone based habitats, which are often found only at low elevations, there is no limestone upslope to migrate to, and if suitable habitats have not been protected further north, there is no escape at all.

elevation geophysical settings have been less developed, cheaper, and therefore more available for protection. The result is unequal protection for the state's habitat types. The habitat settings composed of low and mid elevation limestone, coarse and fine sediments, and shale have received much less protection. A critical component of the biodiversity harbored in these settings is not found elsewhere.



As a key PNHP product, Natural Heritage Areas (NHAs) indicate important conservation sites (map on left). Geophysical settings indicate the climate change conservation significance of each NHA site (map on right).

The total set of 36 geophysical settings is generally too much detail for use in land protection planning; therefore these were consolidated into three groups (see page 8). The three-tier system was based upon grouping biodiversity settings along with consideration for the degree of protection already in place. Tier one settings are very rich in species, but have been provided the least protection. The tier three group has received the majority of land protection to date. Through this new climate lens, geophysical settings can now be utilized as part of the protection planning tool box in order to prepare for more climate change induced shifting of biodiversity.

About the Authors

Charles Bier is Sr. Director-Conservation Science at WPC where he works to keep scientific underpinnings within various programs. PNHP is near and dear to him, having joined in the small initial staff in 1982 as botanist, zoologist, ecologist, data handler, etc. Later he worked as the WPC Heritage Director until 2006. When not in rattlesnake country, he is often joined by Olive Mae in the field.

Christopher Tracey has been with the Heritage program since 2005 and serves as the Conservation Planning Manager. Although, his background is in plant ecology, he now dabbles across most of Pennsylvania's taxonomic groups to provide science-based analyses for planning and decision making.

Notes from the Field

New Moth Species Discovered in Pennsylvania

David Yeany

In 2011 a team of lepidopterists from New Jersey initiated a global citizen-science project called National Moth Week (www.nationalmothweek.org) to encourage worldwide study of moth species and promote their conservation. PNHP biologists actively participate in this event each year by hosting programs to increase awareness of Pennsylvania moth species and by setting up moth light stations and traps for closer study of moths. There is still much to be learned about the distribution and natural history of moths in Pennsylvania. For example, our long-running partnership with the Marienville Area Library in Forest County led to several successful "moth night" surveys during National Moth Week. In 2017, the effort yielded new county records for 17 moth species, including a species that had only been recorded three other times in the state—the white edge moth (*Oruza albocostaliata*).

David Yeany

White edge moth (*Oruza albocostaliata*)

The benefits of citizen-science efforts and the fact that important discoveries often come when they are least expected were exemplified in late July 2018 when PNHP staff were testing a new moth light setup – mercury vapor lights with a portable framed sheet – in preparation for a National Moth Week program and survey. While viewing and photographing moths attracted to the new light station set up in an Allegheny County woodlot, we noticed an unfamiliar-looking dagger moth, so named for their black dagger-like forewing markings. After further study and consulting Lepidoptera experts, we confirmed

David Yeany

Heitzman's dagger moth

a new moth species for Pennsylvania, Heitzman's dagger moth (*Acronicta heitzmani*).

Heitzman's dagger moth is a rare species known from the Midwest United States, first collected in Missouri in 1964 and described to science in 1992 (Covell and Metzler). Various range maps are in disagreement, but the species' original distribution was described as Arkansas, Missouri, Illinois, Kentucky, and Ohio. Other sources report North Dakota, Indiana, Georgia, and West Virginia. Now we can add Pennsylvania to that distribution list. Although the moth's host plant is unknown, it appears to occur in oak-hickory forest and woodland, as was the case with our Allegheny County record.

One final addendum to this story is that there was an additional observation of Heitzman's dagger moth during a National Moth Week event at Raccoon Creek State Park in Beaver County on the very same night. As with many scientific discoveries, the initial answers often lead to more questions than before, requiring further investigation. Why was this species only discovered now? Why were the first occurrences on the same night? What host plant(s) support this species? Is its range expanding, or is the species just very rare or difficult to detect? For now, we have opened a new chapter to the book of Pennsylvania's biodiversity with the discovery of Heitzman's dagger moth.

Species Specific Moth Surveys

Pete Woods

Most of PNHP's black light moth survey efforts are general all-taxa surveys. We select interesting natural habitats with a diversity of plant species and set our black light traps in those habitats mostly during June through August, the months of peak moth abundance. This year, however, as part of the Southwest Regional Inventory, we have been targeting specific species with our black light traps. Of three species targeted this summer, there was one hit, one miss, and one case that won't be resolved until next year.

The woodrat moth (*Idia majoralis*) lives in the nests of Allegheny woodrats (*Neotoma magister*). As woodrats have strongly declined in the northeast in recent decades, the woodrat moth has also become quite scarce. This moth has only been found once in Pennsylvania, in Northumberland County in 2004, but as far as we know, no one has specifically targeted this moth at known woodrat sites, so there is potential for many undiscovered localities. We deployed our black light traps at four sites with outcrops of Pottsville sandstone that are known to support woodrats, but we did not find the moth.

Pete Woods

When our target species aren't found, there remains the chance of an unexpected discovery. In one of our woodrat moth traps, we found these two Packard's lichen moths (*Cisthene packardii*), a vulnerable species in Pennsylvania.

The Tuscarora emerald (*Nemoria tuscarora*) is a small bright green moth whose caterpillars eat only bushy St. Johnswort (*Hypericum densiflorum*), which is a rare plant in Pennsylvania. The moth has only been found once in Pennsylvania, in 2005 in southwest Fayette County, where our largest populations of bushy St. Johnswort grow. With only one data point in the area, it was tricky to predict the peak flight time to survey for this species. We were probably a few weeks too late, because none of our traps caught the main target, but at each site we collected caterpillars that we suspect are the Tuscarora emerald. We raised them for several weeks until they pupated, and now we must wait until they emerge next summer to confirm their identity.

Pete Woods

The distinctive forewings of the waterleaf moth (*Stamnodes gibbicostata*) are unpatterned except at the leading edge.

The waterleaf moth (*Stamnodes gibbicostata*) lives in rich forested valleys, where its caterpillars eat several species of waterleaf (*Hydrophyllum* spp.). We targeted this moth at four sites, and found it at all four. The catch from these traps has not been processed yet, but the high diversity of plants at these sites makes it likely that there will also be a high diversity of moths.

PNHP Research Is Taking Off

Brad Georgic

PNHP is taking its work to new heights by way of a DJI Phantom 4 Pro drone. The Unmanned Aerial System (UAS) provides a unique perspective that visually demonstrates how various landscape components are affected by one another. In addition, staff are using the drone to collect a series of straight down (nadir) images and stitching them together to form a GIS basemap image. This data provides scientists with a current image for delineating natural communities and can be produced year after year to see how communities are changing. The basemap images that are created are one inch pixel resolution and provide detail like no other dataset has before. Typical GIS imagery has two feet

Brad Georgic

High resolution aerial photography from drones improves the accuracy of vegetation mapping on the Tuscarora Summit in Fulton and Franklin counties.

and greater resolution. The drone can also be used for communication of project location and scale. The FAA sets a 400 foot above ground level (AGL) limit and the drone must be kept in sight. Future projects include site scouting, plant delineation, and possibly wildlife detection.

Clermont Tract Inventory

Adam Hnatkovich

The PNHP initiated a new inventory of Bureau of Forestry lands in Elk State Forest. The Clermont Tract, which was acquired by the Western Pennsylvania Conservancy and transferred to the Bureau of Forestry in 2015, is a 17,000 acre tract of land that sits near the southern border of McKean County. The Clermont Tract is comprised of hardwood-dominated forests typical of northern Pennsylvania, and a suite of wetland communities that can be found along the East Branch of the Clarion River, Potato Creek, and Brewer Run (a tributary of Potato Creek). This tract also provides protection for a portion of Catherine Swamp, a wetland classified as a peatland, which supports state-listed plant and invertebrate species.

Adam Hnatkovich

Teutonia wetland, a beaver-influenced wetland in the Clermont Tract, Elk State Forest

The abundant wetland plant communities found throughout the Clermont Tract were a major focus of survey work in 2018. We updated a number of records for state-listed plants, including creeping snowberry (*Gaultheria hispidula*) and Wiegand's sedge (*Carex wiegandii*), both of which are documented in peatlands. Because the Clermont Tract is heavily managed for timber resources and natural gas, PNHP staff are mapping wetland communities in great detail, and will be providing management guidance to the Bureau of Forestry to enhance conservation in these areas.

Based on wetland conditions that we documented, beaver activity appears to be an important driver of wetland ecology in the area. Additionally, historical density of deer at the site appears to have had a significant impact on maturing forests, which protect wetlands by providing a buffer from nearby disturbances. At the Clermont Tract, these forested buffers are dominated by black cherry (*Prunus serotina*), serviceberry (*Amelanchier* spp.), and a mix of shrubs and herbs that are usually found in meadow habitats; these cherry-serviceberry savannas may inspire the recognition of a new community type for Pennsylvania.

Brad Georgic

Drone imagery of Elk State Forest near Mount Jewitt. Drones allow PNHP staff to efficiently map plant communities in wetlands while reducing disturbance in sensitive habitats.

To address the need for detailed wetland and forested buffer maps, we utilized new drone technology to collect aerial imagery which improved mapping accuracy in these large, diverse wetlands.

A Prickly Situation

Rachel Goad

Eastern prickly pear cactus (*Opuntia humifusa*) has been thought to be the only cactus species in Pennsylvania and in most of the eastern U.S. Rare in Pennsylvania, this species is restricted to rocky slopes and outcrops, where dry, sunny conditions prevail. However, PNHP recently learned that there may be multiple species hiding in plain sight.

Rachel Goad

Large yellow blooms appear starting in late June in Pennsylvania

Prickly pear cacti (*Opuntia* spp.) are unmistakable mats of round, flat, green pads (that are actually modified stems) stacked on top of each other. The pads have diagonal rows of 'areoles' that host tiny tenacious barbs and sometimes long spines. Large yellow blooms appear in the summer. Despite this distinctiveness, prickly pear species have long been a source of botanical confusion in the eastern U.S. They are naturally variable, difficult to voucher (succulent plants with spines are just as challenging to dry and press as you might imagine), and hybridize easily. Together, these factors have made it difficult to understand the characteristics and distribution of species within the genus.

Rachel Goad

(Left) A population of pads without spines suggests *O. humifusa*. (Right) The presence of a few long spines on pads within a population suggests *O. cespitosa*.

Rachel Goad

Blooming *Opuntia* overlook the Delaware River.

Recent research used several tools and lots of field work to develop a better understanding of the taxonomy of *Opuntia* across its range. PNHP botanists visited our known populations in Pennsylvania to see how they might align with this new understanding. We were in search of two species known to have occurred in Pennsylvania: *Opuntia humifusa* and *Opuntia cespitosa*. The former never has spines, and has flowers that are pure lemon yellow, inside and out. The latter should occasionally have few long spines and flowers with a red or reddish-tinge in the center of its yellow flowers.

An observation of a red-centered prickly pear flower in Erie County by Chris Tracey in 2017 first hinted that *O. cespitosa* might be in the state. Chris and I then set out to visit populations in the eastern part of the state in June of this year. We paddled to an island in the Susquehanna where we found a cluster of plants high up on a rock outcrop. We found plants cascading down steep shale bluffs overlooking the Delaware River, further than we could safely venture without ropes. In Bucks County, we observed plants on a rock outcrop from a distance. We also began reviewing pictures from known populations and collecting observations from folks outside of our program.

While we're still working on determining what exactly our findings mean, we do seem to have significant variation within the state suggesting the presence of both *O. cespitosa* and *O. humifusa*. This work matters because effective conservation requires an understanding of which species we have and where they exist. Pennsylvania may have cactus species that are rarer than we realized. Additional field work in 2019 and beyond will no doubt help us to better understand this 'prickly' situation.

Acidic Bedrock Communities

Ephraim Zimmerman

Through projects, such as the assessment of the High Value Conservation Forest Area at Crystal Lake in Luzerne County and PNHP's Conservation Services to Land Trusts, as well as our ongoing efforts to update the terrestrial portion of the Pennsylvania Plant Community Classification, Heritage ecologists investigated acidic bedrock communities in Pennsylvania, particularly those found in the Pocono Mountains of eastern Pennsylvania.

Ephraim Zimmerman

Low Heath—Pitch Pine Outcrop

These communities are part of the Acidic Ridgetop Community Complex and are floristically similar to acidic bedrock "balds" much further north. In these communities, large outcrops of sandstone or conglomerate rock are exposed and surrounded by low-growing blueberries (*Vaccinium angustifolium, V. pallidum*), huckleberries (*Gaylussacia baccata*), scrub oak (*Quercus ilicifolia*), and pitch pine (*Pinus rigida*). Mountain laurel (*Kalmia latifolia*), sheep laurel (*K. angustifolia*), and gray birch (*Betula populifolia*) are often part of the community as well.

Ephraim Zimmerman

Pitch pine layering

Ephraim Zimmerman

Three-toothed cinquefoil

Because of the harsh winter conditions, hot summer temperatures, and lack of soil, the trees often exhibit a layering effect seen in "krumholtz" (stunted growth) zones just below the alpine zones in the mountains and further north. Due to their high elevation in relation to other areas in Pennsylvania and extreme winter conditions, these communities often support plant species with a more northern-affinity, such as mountain-ash (*Sorbus americana*), red spruce (*Picea rubra*), and the PA Endangered three-toothed cinquefoil (*Potentilla tridentata* – also called *Sibbaldiopsis tridentata*). Many of these sites are known conservation areas because of their spectacular vistas and interesting flora. However, our work in these communities this summer has resulted in several new occurrences of this Acidic Ridgetop plant community complex.