



Pennsylvania Natural Heritage Program

information for the conservation of biodiversity

Wild Heritage News

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Following the Life of Northeastern Bulrush

by

Mary Ann Furedi

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Photo Banner:
Mary Ann Furedi

Northeastern bulrush population found in a large vernal pool in Tioga State Forest

Nowadays it is easy to follow what people are doing in their everyday lives by using social media. Through avenues such as Facebook and Twitter, we know where people are, what they are up to, and how they are feeling. We can develop an understanding of the dynamics of someone's life just by reading their posts and tweets. Unfortunately, we can't learn about plants and animals by friending them. We have to use the old fashioned approach of going out where they live and following their lifecycles over time. The Pennsylvania Natural Heritage Program is currently conducting a monitoring project to do just that for a plant in Pennsylvania, the northeastern bulrush.

Northeastern bulrush (*Scirpus ancistrochaetus*) is a rare plant found in some vernal pools in our state. The species once occupied a larger range in the northeastern United States and southeast Canada, but its distribution has shrunk over time. Threats such as habitat alteration and destruction have resulted in the loss of the species. Now, scattered populations are found from West Virginia and Virginia to New York, New Hampshire,

and Vermont. One historic location of northeastern bulrush is known from Canada, but the population is likely extinct. Because of the rarity of the species throughout most of its range, northeastern bulrush is listed as a federally endangered species by the United States Fish and Wildlife Service (USFWS).

Pennsylvania is included in the range of northeastern bulrush, but is an exception to the distribution pattern seen in other states within the range. While most states have few populations, Pennsylvania has about 80; making it the stronghold for the species. However, comparisons of old



Northeastern bulrush clump found in the wettest section of a vernal pool in Centre County

Steve Grund

notes taken during sporadic visits to some of the populations indicate population decline over time. In some populations, the cause of the decline is evident, given changes that occurred either in the pool itself or in the surrounding landscape. In other populations, it may be more difficult to draw conclusions about the reason for population decline, given the time between site visits (sometimes greater than 20 years). Evidence suggests that northeastern bulrush populations can be very dynamic meaning it can have some good years and some bad years depending on a number of factors that can vary from year to year.

Like many plant species, northeastern bulrush has specific habitat requirements. In Pennsylvania, the species is generally found in small depressional wetlands surrounded by forest, otherwise known as vernal pools. These wetlands may exist as a single pool or may be a complex of multiple pools with only some containing northeastern bulrush. Most pools receive water primarily from precipitation although some may be influenced by ground water. An ideal northeastern bulrush pool will contain water from late fall through late spring, but will begin to dry out by mid-summer to mid-fall; a period which corresponds to the peak growing season of the species. Variations in the annual filling and drying (hydrological cycle) of pools may have a direct impact on the growth of northeastern bulrush.

Light availability is also an important habitat requirement for northeastern bulrush. Pools that support the species usually have less canopy cover than pools without northeastern bulrush. Evidence suggests that changes in light availability can affect population dynamics so that as a pool becomes more shaded, the population may decline. The opposite is also likely true.



A drainage culvert leading into a northeastern bulrush pool that could alter the site

Mary Ann Furedi

Northeastern bulrush is a “leafy bulrush” within the genus *Scirpus* that forms clumps of drooping leaves usually consisting of one or more plants arising from an underground rhizome (root). Erect culms (stems) may be present with terminal flowers that resemble arcing exploding fireworks. With its flowering culm, the entire plant can reach



A close-up of the northeastern bulrush flower

Chris Tracey

almost three feet in height. Flowering occurs from mid-June to July and seeds set between July and September. Barbs on the seed coat suggest that seeds are animal dispersed, but it is likely that gravity and movement by water also contribute to short distance dispersal. New seedlings are seldom seen in populations and it is likely that population growth within a site is mostly clonal with new shoots arising from shared subterranean rhizomes or sprouts from the nodes of downed plants. This hypothesis is supported by the genetic work of Kendra Cipollini (Wilmington College), who we worked in partnership with during our studies. Her research showed that individual plants within isolated pools were genetically similar.

In the event of a disturbance event such as a tree fall that opens the canopy, a population may increase in size.

It is likely that landscape alterations that affect these environmental variables contribute to the decline of the species over time, given the sensitivity of northeastern bulrush to changes in hydrology and light availability. Some threats may be natural, such as succession. Other threats are anthropogenic and include conversion or destruction of wetlands, forest fragmentation, and development.

In order to better understand the dynamic nature of northeastern bulrush populations, it is necessary to follow populations over a shorter timeframe to document fluctuations and their relationship to environmental variables. With funding from USFWS and Pennsylvania’s Wild Resource Conservation Program (WRCP), we are implementing a low-intensity

monitoring effort that will allow us to visit all northeastern bulrush populations in Pennsylvania in a shorter rotational period than in the past. Known populations have been divided into five spatially related clusters of 15-16 populations each. Each cluster of populations will be visited once every five years. We have just completed the second year of this low-intensity effort.

For the low-intensity monitoring effort, data is collected at each pool that can be used to characterize the site, estimate the size of the northeastern bulrush population, and assess the condition of the population. Each site is characterized by recording information such as pool location, pool size and shape, percent canopy shading the pool, hydrological condition, and companion species around and within the pool.

Several metrics are used to estimate population size. First, we estimate the overall area occupied by the population. Then, population size is determined by either physically counting all individuals when populations are small or by estimating the number of individuals through subsampling and extrapolating when populations are too large or difficult to count. Population condition assessment is based on the presence of flowers and seedlings, and other observations such as overall plant condition, evidence of deer browse, and other threats like the presence of invasive species. Photographs are taken of the entire pool and population. The same data will be recorded every time a population is revisited.



Mary Ann Furedi

Volunteer Andrew Nevin assisting with stem counts to estimate population size.

In addition to low-intensity monitoring, we are also engaged in a higher level of monitoring (high-intensity monitoring) at ten of the northeastern bulrush pools. Site and population level information is similar to what



Mary Ann Furedi

Nathan Dewar and Kelly Sitch installing a well that houses a water level data logger.

is being collected for the low-intensity monitoring but with a greater effort directed at understanding changes in water levels and light availability since previous research has indicated the importance of these environmental variables on northeastern bulrush population growth. This fall, we began installing data loggers at some of the high-intensity sites that will measure the hourly water level and water temperature over multiple years so that we can develop a better understanding of the hydrological cycles of these pools. Several methods will also be used to measure annual variation in light availability. Additional environmental variables, such as basic water and soil chemistry, will be measured at these sites as well. Differing from the low-intensity effort, high-intensity monitoring will require multiple visits to the same sites each year and will be a multi-year effort. This will allow us to examine population and environmental variation that occurs within and across consecutive years. Some of the pools selected for high intensity monitoring are also sites where northeastern bulrush populations may benefit from active management. This project will allow us to collect data before and after management activities which can then be used to gauge the benefits of these actions.

It is important for us to understand and protect our populations, given that Pennsylvania is home to the majority of northeastern bulrush populations. Projects like this one help fill our knowledge gaps about species, which leads to better informed species conservation and management.

Rooted in Collaboration: Conservation Planning on State Game Lands

by
Adam Hnatkovich



Adam Hnatkovich

A yellow lady's slipper found in a cool hemlock forest on a State Game Land in Huntington County.

Conservation planning has always been a valued service of PNHP. Since 1991, we have provided conservation planning information to every county in Pennsylvania, and have worked closely with land managers at both public agencies and private conservation groups. Most recently, PNHP has extended this relationship to the Pennsylvania Game Commission. State Game Lands constitute 1.4 million acres of public land, making the Game Commission the second largest manager of public lands in Pennsylvania; DCNR manages over 2.2 million acres. The Game Commission manages a variety of habitats, including swamps, peatlands, fields and grasslands, and mature forests. This habitat diversity allows game lands to support an equally diverse suite of species: approximately 11% of all Pennsylvania Endangered, Threatened, and Special Concern species have been documented on State Game Lands.

The Game Commission's management of these diverse ecological communities requires well-designed and informed habitat management goals, for which adaptive management and proactive conservation planning are especially well suited tools. The Pennsylvania Game Lands Management Tool (PGLMT) is an interagency effort to improve conservation planning for rare, threatened, and endangered species on Pennsylvania State Game Lands. Initiated by the Pennsylvania Game Commission in 2011, this project incorporates management guidance from the Pennsylvania Department of Conservation and Natural Resources (Bureau of Forestry), Pennsylvania Fish and Boat

Commission, and U.S. Fish and Wildlife Service. When completed, the tool will provide this management guidance to the Game Commission's regional staff by way of a network-based, geospatial tool.

The PGLMT provided an opportunity to revisit populations of state-listed species on game lands. State-listed species include plants, reptiles, amphibians, fish, aquatic invertebrates, mammals, and birds protected by Pennsylvania state law which are managed by the Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Fish and Boat Commission, and Pennsylvania Game Commission. For the PGLMT, inventory staff revisited 265 known plant populations across 80 plus game lands. During our surveys, we were able to locate most populations and found that many forest and wetland habitats were free of invasive species; a good sign for the long-term persistence of state-listed plant species on game lands. We also documented new plant species of interest on State Game Lands. These noteworthy botanical finds include dwarf bulrush (*Lipocarpa micrantha*; Pennsylvania Endangered) on SGL 290 in Dauphin County, and northern adder's-tongue (*Ophioglossum pusillum*) on SGL 197 in Warren County. Inventory work for the PGLMT was integrated with other PNHP projects.



John Kunsman

Dwarf bulrush, known only to occur in a few locations in Pennsylvania, was found on a State Game Land in 2013.

Through the Wild Resource Conservation Program and other DCNR funding, we were able to collect detailed, population information for great-spurred violet (*Viola selkirkii*) and northeastern bulrush (*Scirpus ancistrochaetus*) on game lands, which will significantly

improve conservation planning for these species. In addition to botanical inventories, we have conducted habitat assessments at 19 sites on game lands that support butterflies and moths.

Inventory work for the PGLMT also included amphibians. We documented six new populations of green salamander on a game land in southwestern Pennsylvania, and located this species at ten other sites where it had been documented in past surveys. Green salamanders, a Pennsylvania Endangered amphibian, occupy cool, moist, mature forests that contain boulders or rock-faces where salamanders can forage and breed. The green salamander also finds the northern edge of its range in Pennsylvania. Because of their strict habitat requirements, green salamanders could be sensitive to forest disturbances. Our inventory work on game lands, as well state forests, suggest that public lands in southwest Pennsylvania could be strongholds for green salamander and should be managed accordingly.



Ryan Miller

Green salamander

Plant species, and other state-listed species, often share habitat preferences or employ similar survival strategies that are relevant to habitat management. For management purposes in the PGLMT, plant species were placed into guilds (groups of species with similar habitat and ecological needs). We then crafted best management practices (BMPs) for each of these guilds that were highly specific to day-to-day operations on game lands. Day-to-day operations considered included forestry, wildlife habitat improvement, maintenance and development of game lands infrastructure (e.g., roads, bridges, parking lots), agriculture, and applications of prescribed fire. By applying best management practices, the Game Commission's regional staff can streamline their environmental review process, making regional

operations more efficient without compromising conservation needs of listed species.

State and/or federally listed species often co-occupy the same habitat on game lands. Occasionally, species occupying the same habitat could have different or even contrasting conservation needs. In order to clearly identify ecologically important habitats, and account for potential management conflicts among species, we developed Conservation Management Units (CMUs). CMUs are unique to the PGLMT, and are the basic unit of conservation for game lands management plans. CMUs and associated BMPs are integrated in game lands management plans along with recommendations that could improve habitat conditions or bolster population growth of specific species.

Habitat improvement recommendations for plants can be passive or active, depending on the nature and severity of threats to populations. In many cases, passive management for plant species is the best course of action. Among other options, passive management typically includes monitoring for invasive species. Active management suggestions are more diverse, and could include prescriptions for control of invasive species or clearing of woody vegetation (e.g., thinning the forest canopy, removing shrubs) to improve light availability. For animals, especially for species that have a history of active management in Pennsylvania (e.g., Allegheny woodrat, timber rattlesnake), habitat improvement recommendations can be highly detailed and prescriptive. As the PGLMT enters its third year, the majority of game lands management plans have been drafted. At a small number of sites, management plans have already been put into action.

While the PGLMT is proactive in nature, the tool must be robust enough to account for changes in species' status, site conditions, or the condition of populations. Therefore, part of the PGLMT has focused on the creation of lasting lines of communication (both digital and other) between the Game Commission and agency partners. We are looking forward to the final stages of the PGLMT, as the interactive, geospatial tool is conceptualized and implemented.

BMPs and Guilds

For many of our state-listed plant species, regionally specific conservation information is almost never available. Therefore, we often consider range-wide information for these species, or species with similar habitat requirements (guilds) to develop conservation strategies for Pennsylvania. In plant ecology, a guild can be defined as any group of species that require similar resource or habitat conditions, including soil nutrients, soil moisture, light availability, or the frequency of disturbance or flooding.

PNHP has developed guild-level best management practices for most of our plant species. This allows us to apply the best available science in our conservation planning consistently across Pennsylvania. For the PGLMT, we considered the potential impact of day-to-day operations, such as (e.g., prescribed fire, forestry) on each of our plant guilds, and developed best management practices for these activities. As you can imagine, it is possible for a plant species to occupy multiple guilds with possibly conflicting management. For instance a species that depends on wetlands, a habitat we typically would not recommend for active management, might also require frequent disturbance to facilitate reproduction. Therefore, our selection of the most appropriate best management practices will depend on site-specific conditions. Below are some examples of plant guilds, and how guild-level management was applied in the PGLMT.



Great-spurred violet

Adam Hnatkovich

Upland Forest

These plants most often occur in upland (non-wetland), forested habitats and include heartleaf meehania (*Meehania cordata*), puttyroot orchid (*Aplectrum hyemale*), and great-spurred violet (*Viola selkirkii*). Great-spurred violet occurs in northcentral Pennsylvania and is thought to prefer mature, undisturbed hardwood forests. Not surprisingly, management activities that could impact this species include forestry operations. Timbering can alter light availability for understory plant species and can directly disturb soils. Like other forest violet species, the seeds of great-spurred violet may be dependent on ants for dispersal and/or germination. Therefore, great-spurred violet could be sensitive to soil disturbances that affect ant colonies. Based on the preference of this species for mature forests, and the potential role of ants and soil conditions for violet reproduction, we

propose that forestry operations be limited or avoided in rich forests that support great-spurred violet.

Barrens

Barrens species prefer high light and/or frequent disturbances, and often occupy extreme soil conditions (e.g., very dry or nutrient poor) that are less suitable for other plant species. Examples of barrens species include shale-barren evening-primrose (*Oenothera argillicola*), prickly-pear cactus (*Opuntia humifusa*), and Appalachian sandwort (*Minuartia glabra*). Appalachian sandwort occurs in northwest Pennsylvania and prefers exposed sandstone rocks. In this particular case, certain management activities could benefit Appalachian sandwort. Prescribed fire, for instance, can be applied for a variety of habitat management services, including control of invasive species, to stimulate forest regeneration, or to improve habitat for certain wildlife species, such as ruffed grouse. Therefore, not only is prescribed fire acceptable on game lands that support Appalachian sandwort, it's encouraged!



Appalachian sandwort

PNHP

Palustrine

Palustrine species include plants that occupy wetland habitats, such as forested swamps, bogs, or fens. The palustrine guild is significant, as it accounts for approximately 50% of all species that occur on Pennsylvania State Game Lands! Examples of palustrine plant species include Clinton's wood fern (*Dryopteris dintoniana*), dragons mouth orchid (*Arethusa bulbosa*), and creeping snowberry (*Gaultheria hispidula*). Creeping snowberry is a low-growing, evergreen species found in north-central and northeastern Pennsylvania. There are many activities that could potentially impact creeping snowberry and associated wetland habitats, including habitat modification for wildlife. Managing wetlands for the purpose of improving wildlife habitat is common on game lands. Wildlife habitat improvement can include managing woody vegetation or manipulating water levels in man-made wetlands. Specifically, raising water levels could negatively impact wetland plants like creeping snowberry and for some populations, we might recommend that consistent water levels be maintained to avoid over-saturation of soils supporting this species.



Creeping snowberry

Pete Woods

Shells of their Former Selves

by
Pete Woods

Even when the 2013 field season was over and winter had set in, there were still plenty of discoveries to be made. I took out the box of vials I had been collecting all year, and began to examine nymphs and cast-off skins (exuvia) of dragonflies and damselflies. When most people think of dragonflies or damselflies (collectively referred to as odonates), they think of the flying adult life stage, but odonates spend most of their lives, often several years, as aquatic nymphs.



Pete Woods

Tiger spiketail nymph

Surveying for adult odonates can be tricky, because some species only fly for several weeks each year, and some species only fly in the late afternoon or evening. Furthermore, adults of some species stay far from shore when they are not roosting in treetops, making them extremely difficult to catch. So, when Heritage biologists visit a site to survey for odonates, we make the most of a single survey by also looking for aquatic nymphs as well as the cast-off skins they leave on stream banks when the adults emerge.

To find the nymphs, we sift through sand, silt, muck, piles of sticks, and leaf packs. To find the shed exuvia we scan shorelines, trying to guess which logs, rocks, bare soil, plant stems, and tree trunks are most likely to be chosen by the nymphs. A certain amount of luck is involved here, because the shed skins don't last long before being dislodged by rain, wind, or high water.



Least clubtail emerging from exuvia



Pete Woods

Darner exuvia on grass

Identifying the nymphs and exuvia takes patience. While adult odonates generally wear bold color markings that make identification relatively easy, the nymphs have no such markings. We have to examine them under a microscope, looking at characters such as the shape of abdominal segments, the number and shape of spines on those segments, the shape of the mouthparts, the number of hairs on certain body parts, and the measurements of specific segments on the antennae.

This winter's microscope sessions have turned up a number rare species, including harpoon clubtails (*Gomphus descriptus*), rapids clubtails (*Gomphus quadricolor*), green-striped darners (*Aeshna verticalis*), and ocellated darners (*Boyeria grafiana*). Several common species were documented in Beaver County for the first time, including rusty snaketails (*Ophiogomphus rupinulensis*), dusky clubtails (*Gomphus spicatus*), and umber shadowdragon (*Neurocordulia yamaskanensis*).



Pete Woods

Notes from the Field

iMapInvasives

Since the Pennsylvania iMapInvasives database went live in March 2013, PNHP staff have been actively seeking individuals and agencies interested in using the iMapInvasives centralized on-line database to track invasive species in the state. The system is accessible to many users, and ultimately, invasive species distributions in iMapInvasives can be used to inform policies and treatments, and prioritize survey efforts. With these goals in mind, we conducted several trainings in the fall of 2013 and have additional trainings scheduled for winter and spring to continue broadening iMapInvasives' audience and boost the number of users.



Reed canary grass threatens natural wetlands by forming dense monotypic stands that outcompete most native plant species and have little value to native wildlife.

Jamie Nielsen, University of Alaska Fairbanks
Cooperative Extension Service

In the fall, PNHP staff presented an overview of the iMapInvasives database to members of the Pennsylvania Invasive Species Council (PISC), a group that meets quarterly to discuss invasive species issues affecting the Commonwealth. Members of the Pennsylvania Game Commission, Pennsylvania Fish & Boat Commission, Pennsylvania Department of Agriculture, and several other agencies were present. We also presented iMapInvasives at the North Central Weed Science Society in Columbus, Ohio; the Regional Science Consortium at the Tom Ridge Environmental Center in Erie, PA; the Western Pennsylvania Conservation Conference at Clarion University; and the annual meeting for Water Pollution Biologists with the Pennsylvania Department of Environmental Protection at Bald Eagle State Park.

To make the iMapInvasives database more beneficial to users, additional records are needed to convey the current standing of



Economic costs to control quagga mussel populations are in the billions of dollars.

Amy Benson
U.S. Geological Survey

invasive species locations within the state, as well as the density of each known population. In working toward this particular goal, we provided an advanced training for a representative of the Weed Warriors (a program funded by Pennsylvania Sea Grant and comprised of volunteers working to remove invasive plants). After the training was completed, the Weed Warriors added numerous observation and assessment records of invasive plants found in Presque Isle State Park to the Pennsylvania iMapInvasives database. As the iMapInvasives project moves forward, we will seek invasive species distribution and treatment information for invasive terrestrial and aquatic plants and animals in Pennsylvania.

To learn more about Pennsylvania iMapInvasives, please visit www.imapinvasives.org or send an email to imapinvasives@paconserve.org.



Red-eared sliders often start out as household pets, although they are frequently released to local waterways when pet owners no longer wish to care for them. Due to the red-eared slider's aggressive behavior, this species of turtle easily outcompetes native turtles for food, basking areas, and nesting sites.

Joy Viola, Northeastern University

Vernal Pool Research and Conservation Funding



Betsy Leppo

Pike County vernal pool

The Western Pennsylvania Conservancy (WPC) received a \$73,000 Community Conservation Partnerships Program (C2P2) grant from the Pennsylvania Department of Conservation and Natural Resources Bureau of Recreation and Conservation to conduct vernal pool research and conservation activities. WPC will contribute an additional \$73,000 in match for a total grant package of \$146,000.

WPC will use this grant to build upon over a decade of work that the Pennsylvania Natural Heritage Program has undertaken to advance vernal pool education, inventory, management, and long-term conservation. We will audit vernal pool management plans developed during a previous C2P2 grant, identify and write management plans for additional high quality pools, and support monitoring programs. In addition we will

create and implement a vernal pool restoration project in a state park, provide training and workshops for partners and volunteers, and extend our public outreach in collaboration with partners to promote long-term vernal pool protection.



Betsy Leppo

PNHP staff will follow up with landowners to evaluate vernal pool management plans that were developed in the previous C2P2 project.

A major focus of this grant is to bring together private landowners, conservation organizations, and natural resource agencies statewide to advance

direct protection and conservation of vernal pools. We will work with partners to match landowners to the organizations best positioned to guide them towards long term protection options such as easements, acquisition, or other arrangements. Through this project, we believe we will provide good data for vernal pool conservation efforts, and develop stewardship recommendations that will result in increased resiliency in vernal pool habitats to stressors such as invasive species, forest pests, climate change impacts, and energy development.

Biotics 5—New Capabilities for Heritage Data

Biotics is the database management system for species and community records for the network of Heritage Programs across the country and internationally. A major upgrade of this database has been underway, and PNHP completed its conversion to Biotics 5 at the end of 2013.



Kierstin Carlson

PNHP Harrisburg staff attend Biotics 5 training

The new version is now a web application that is based on the ArcGIS platform. Compared to the previous version of the application, which was hosted on a local server on an internal network, the new version has greatly improved the usability and accessibility for all PNHP partners. Now, we can directly use a variety of basemaps (such as topographic or imagery) for mapping, the spatial and tabular data are integrated in a single application, and we are no longer tied to an outdated and unsupported platform. We can also access the data using Map Services, which allows us to view and copy data directly from FIND (our field survey geodatabase) into Biotics, and Biotics can be viewed live from FIND, streamlining workflow for biologists and data managers alike.

The database is housed on a password-protected, web-based server, and partners in state agencies will be able to access the database directly over the internet instead of relying on static data exports, enhancing the speed and clarity of communication about individual records

and resolving other questions. Put it all together and it adds up to a more timely understanding of the status of the flora and fauna of Pennsylvania, which should positively impact their conservation.

Zoology Crew Searches for Rock Dwellers



Charlie Eichelberger

Zoologist Ryan Miller examines the contents of an Allegheny woodrat cache discovered in a natural rock tunnel. This cache contained ferns, mushrooms, rhododendron leaves, and bones from a deer carcass. Staff conducted extensive surveys of rock formations this past field season for Allegheny woodrats, timber rattlesnakes, and green salamanders. This particular site was rather large and contained all three species of concern.

Time at the Museum

PNHP counts on museums, both in and out of state, as a reference for taxonomic questions, as a resource for identification of specimens, to discover new records for species that we track, and to deposit specimens that we collect in the field. Over the years, PNHP biologists have made significant contributions to the collections of Pennsylvania's major museums. Heritage staff spend a lot of time at the museums, particularly in the winter, processing their field collections. Carnegie Museum of Natural History in Pittsburgh and the Academy of Natural Sciences in Philadelphia have been our traditional go to museums, being large institutions with large collections. But in recent times, we have forged a relationship with the State Museum in Harrisburg and are now involved in the active curation of plants and mammals.

John Kunsman, one of our botanists, is now in the process of sorting through the museum's plant specimens to organize and update the collection; a



Charlie Eichelberger

Assistant zoologist, Joe Wisgo, enters mammal specimen data into the museum ledger, and later into the State Museum digital database.

collection that we are now populating with our specimens. Charlie Eichelberger and Joe Wisgo, two of our zoologists, have been busy processing the many small mammals they collected over the past several years while working on projects in previously under-surveyed areas of the state. Their work in some of Pennsylvania's most remote forests and streams has resulted in many new records.

Our arrangement with the museum complements the needs of the museum for additional curatorial capacity and PNHP's needs to have convenient, accessible collections where we can contribute and reference specimens for a variety of purposes. We look forward to a continuing role in the curation of the collections of Pennsylvania's State Museum.

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 (2013)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Cumulative Total	Percent of Annual Goal
Biotics Records Updated	200	60	105	125	76	366	183%
New EOs Documented	800	147	295	106	82	630	79%
New Records Entered into HGIS	300	71	129	76	43	319	106%
Field Surveys Reported	500	0	122	173	9	304	61%
New CPPs Developed	4000	894	1205	1426	311	3836	96%
NHAs Updated	120	0	107	3	38	148	123%
Outreach to Local Government	20	0	2	4	2	8	40%

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 HGIS 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 Performed 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.

Outreach to Local Government is a measure of our initiative to increase interaction with local government and reflects our commitment to seeing our information used and refined to meet the needs of planning efforts within the counties and municipalities of the commonwealth.