Snyder County

Natural Heritage Inventory 2007





SNYDER COUNTY NATURAL HERITAGE INVENTORY

December 2007

Prepared for:

Snyder County Planning Commission

Snyder County Courthouse (Basement Level) P.O. Box 217 Middleburg, PA 17842

Prepared by:

Pennsylvania Natural Heritage Program

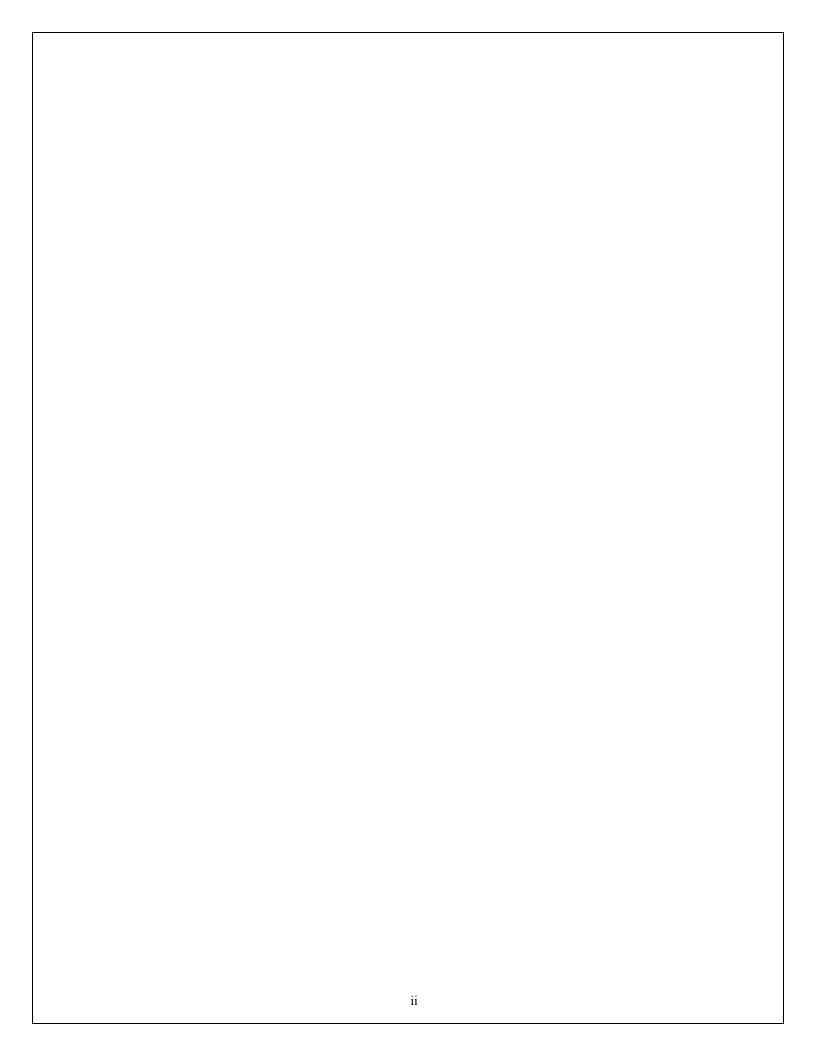
Western Pennsylvania Conservancy 208 Airport Drive Middletown, Pennsylvania 17057

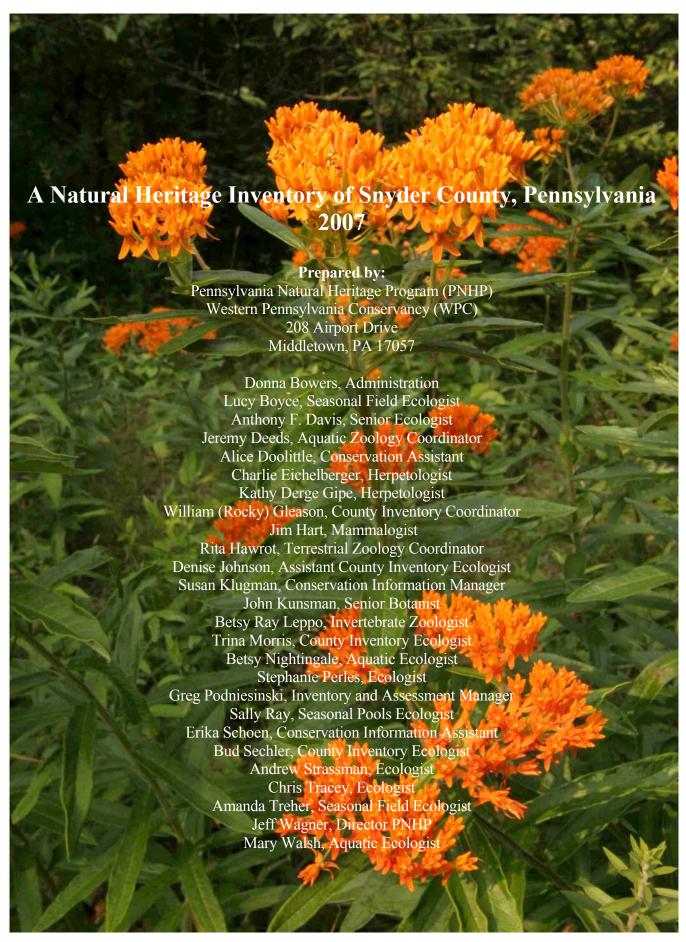


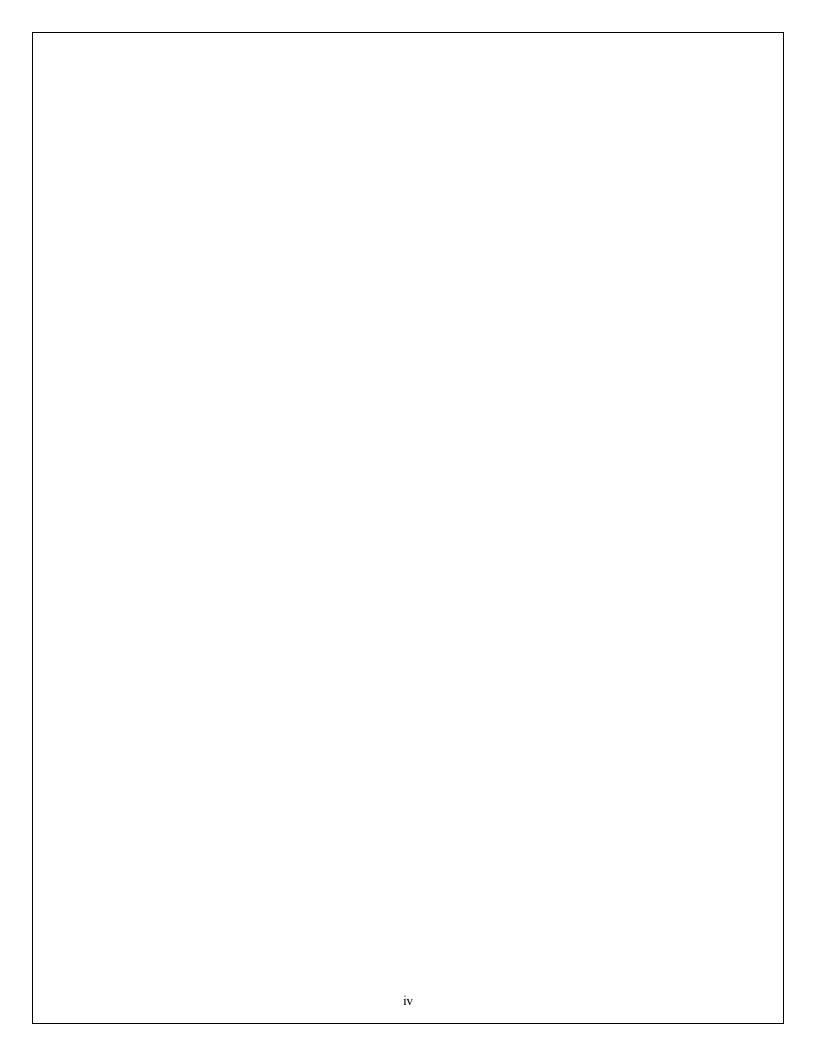
The Pennsylvania Natural Heritage Program (PNHP) is a partnership between the Western Pennsylvania Conservancy (WPC), the Pennsylvania Department of Conservation and Natural Resources (DCNR), the Pennsylvania Game Commission (PGC), and the Pennsylvania Fish and Boat Commission (PFBC). PNHP is a member of NatureServe, which coordinates natural heritage efforts through an international network of member programs—known as natural heritage programs or conservation data centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean.

This project was funded through grants supplied by the DCNR Wild Resource Conservation Program and the U.S. Fish and Wildlife Service State Wildlife Grant Program administered by the PGC.

Copies of this report are available in electronic format through the Pennsylvania Natural Heritage Program website, www.naturalheritage.state.pa.us, and through the Snyder County Conservation District.







PREFACE

The Snyder County Natural Heritage Inventory is a document compiled and written by the Pennsylvania Natural Heritage Program (PNHP), a partnership between the Western Pennsylvania Conservancy (WPC), the Department of Conservation and Natural Resources (DCNR), the Pennsylvania Fish & Boat Commission (PFBC), and the Pennsylvania Game Commission (PGC). It contains information on the locations of rare, threatened, and endangered species and of the highest quality natural areas in the county; it is not an inventory of all open space. It is intended as a conservation tool and should in no way be treated or used as a field guide. Accompanying each site description are general management recommendations that would help to ensure the protection and continued existence of these natural communities, rare plants, and animals. The recommendations are based on the biological needs of these elements (communities and species). The recommendations are strictly those of PNHP and do not necessarily reflect the policies of the state or the policies of the county or townships for which the report was prepared.

Managed areas such as federal, state, county and township lands, private preserves, and conservation easements are also provided on the maps where that information was available to us. This information is useful in determining where gaps occur in the protection of land with locally significant habitats, natural communities, and rare species. The mapped boundaries are approximate and our list of managed areas may be incomplete, as new sites are always being added.

Implementation of the recommendations in this report is up to the discretion of the landowners. However, cooperative efforts to protect the highest quality natural features through the development of site-specific management plans are greatly encouraged. Landowners working on the management of, or site plans for, specific areas described in this document are encouraged to contact the Pennsylvania Natural Heritage Program for further information.

Although an attempt was made through advertising, public meetings, research, and informal communications to locate the sites most important to the conservation of biodiversity within the county, it is likely that many things were missed. Anyone with information on sites that may have been overlooked should contact the Snyder County Planning Commission (see address on following page) for inclusion into a future update of this report.

The results presented in this report represent a snapshot in time, highlighting the sensitive natural areas within Snyder County. The sites in the Snyder County Natural Heritage Inventory have been identified to help guide wise landuse and county planning. The Snyder County Natural Heritage Inventory is a planning tool, but is *not* a substitute for environmental review, as information is constantly being updated as natural resources are both destroyed and discovered. Applicants for building permits and Planning Commissions can conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the Pennsylvania Natural Heritage Program's website, at http://www.naturalheritage.state.pa.us/. If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources. If additional information on species of special concern becomes available during environmental review, the review may be reconsidered by the jurisdictional agency.

ACKNOWLEDGEMENTS

This project was funded in part by a state grant from the DCNR Wild Resource Conservation Program. Additional support was provided by the Department of Community & Economic Development. Additional funding was provided by the U.S. Fish and Wildlife Service through State Wildlife Grants program grant T-2, administered through the Pennsylvania Game Commission and the Pennsylvania Fish and Boat Commission. Thanks to everyone who provided financial and administrative support for the inventory. Without your help, this study would not have been possible.

The species information utilized in the inventory came from many sources as well as our own field surveys. We wish to acknowledge all of those who carried out botanical and zoological survey work over the years. Without their contributions, this survey would have been far less complete.

The report benefited from the help of local naturalists and conservationists who gave generously of their time. Thanks for all the help and support given by Steve Bernardi, for much help with the natural history of the county; Steve Johnson, for Lepidopteran information; Larry Klotz, for botanical surveys; Rick

Koval, for photographs; Carol Loeffler, pilot for aerial surveys; Tracey Olson for help with cave invertebrate photography; and Jamie Flickinger, for photographs. Thanks to the many other private citizens who contacted our office with information on natural areas.

Many thanks to all who participated in the Draft Review Committee for their suggestions to the Snyder County Natural Heritage Inventory. Those who contributed include Steve Bernardi, Pennsylvania Game Commission; Craig Bingman, Snyder County Conservation District; Amy Griffith, Bald Eagle State Forest; Larry Klotz, Shippensburg University; and Kevin Staschiak, Snyder County Planning Commission.

Finally, we especially wish to thank the many landowners who granted us permission to conduct inventories on their lands. The task of inventorying the natural heritage of Snyder County would have been far more difficult without this tremendous pool of information gathered by many people over many years.

- Charlie Eichelberger Pennsylvania Natural Heritage Program

Copies of this document may be obtained from:

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Snyder County Courthouse (Basement Level)
P.O. Box 217
Middleburg, PA 17842
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Or in electronic format from the Western Pennsylvania Conservancy at:

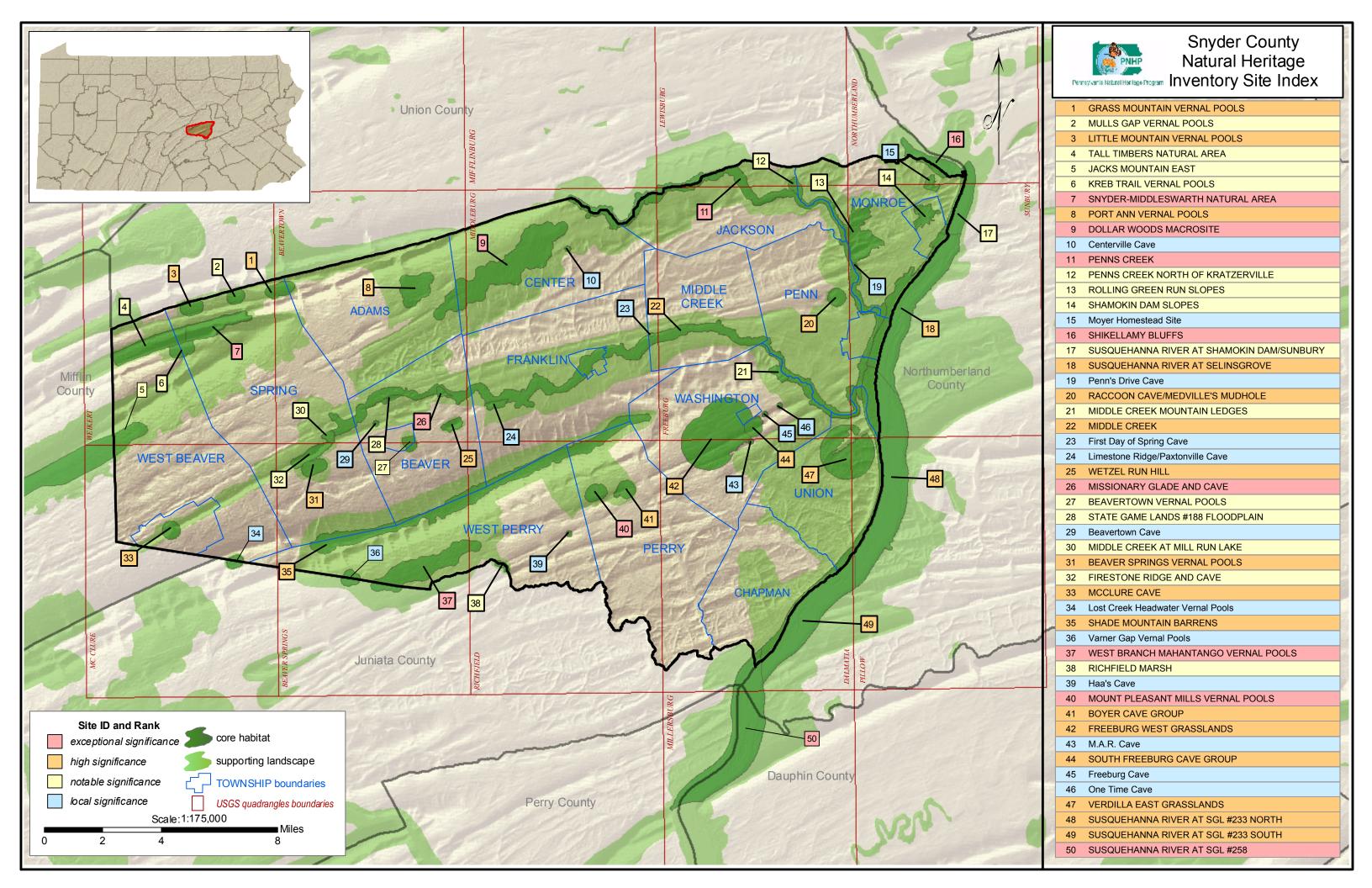
http://www.paconserve.org/

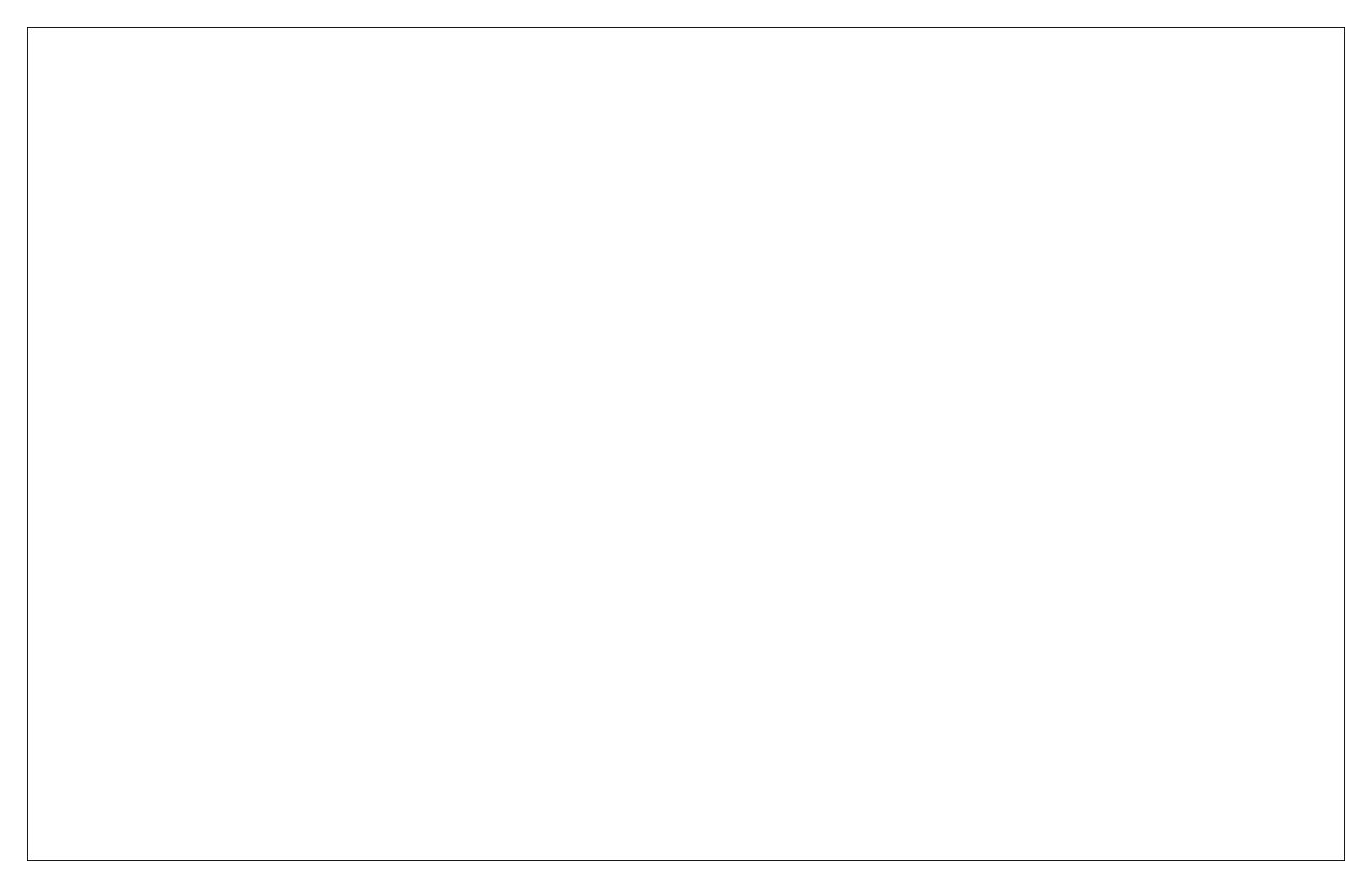
or

http://www.naturalheritage.state.pa.us/

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Pennsylvania Natural Heritage Program. 2007. A Natural Heritage Inventory of Snyder County, Pennsylvania. Western Pennsylvania Conservancy. Middletown, PA.





Snyder County Natural Heritage Inventory Site Index

#	Site Name	Municipality	USGS quadrangle	Page #
32	BEAVER SPRINGS VERNAL POOLS	Spring Township	Beaver Springs quad	129
29	Beavertown Cave	Beaver Township	Beavertown quad	84
27	BEAVERTOWN VERNAL POOLS	Beaver Township	Beaver Springs, Beavertown quads	79
41	BOYER CAVE GROUP	Perry Township	Richfield quad	125
10	Centerville Cave	Center Township	Middleburg quad	89
9	DOLLAR WOODS MACROSITE	Adams, Center Townships	Beavertown, Middleburg quads	74,88
31	FIRESTONE RIDGE AND CAVE	Spring Township	Beaver Springs, Beavertown quads	130
23	First Day of Spring Cave	Middle Creek Township	Middleburg quad	106
45	Freeburg Cave	Washington Township	Freeburg quad	146
42	FREEBURG WEST GRASSLANDS	Washington Township	Dalmatia, Freeburg quads	144
1	GRASS MOUNTAIN VERNAL POOLS	Adams, Spring Townships	Beavertown, Weikert quads	75, 131
39	Haa's Cave	West Perry Township	Richfield quad	157
5	JACKS MOUNTAIN EAST	West Beaver Township and Mifflin County	Alfarata, Burnham, McClure, Weikert quads	149
6	KREB TRAIL VERNAL POOLS	Spring, West Beaver Townships	Weikert quad	131,149
24	Limestone Ridge/Paxtonville Cave	Franklin Township	Middleburg quad	98
3	LITTLE MOUNTAIN VERNAL POOLS	Spring Township and Union County	Weikert quad	132
34	Lost Creek Headwater Vernal Pools	West Beaver Township and Juniata County	McClure quad	151
43	M.A.R. Cave	Washington Township	Dalmatia, Freeburg quads	146
33	MCCLURE CAVE	West Beaver Township	McClure quad	150
22	MIDDLE CREEK	Beaver, Franklin, Middle Creek, Penn, Spring, Union, Washington Townships	Beavertown, Freeburg, Middleburg, Sunbury quads	80,96,106, 118,132, 138,145
30	MIDDLE CREEK AT MILL RUN LAKE	Spring Township	Beaver Springs, Beavertown quads	133
21	MIDDLE CREEK MOUNTAIN LEDGES	Washington Township	Freeburg quad	145
26	MISSIONARY GLADE AND CAVE	Beaver Township	Beavertown quad	81
40	MOUNT PLEASANT MILLS VERNAL POOLS	Perry Township	Richfield quad	125
15	Moyer Homestead Site	Monroe Township	Northumberland, Sunbury quads	115
2	MULLS GAP VERNAL POOLS	Spring Township	Weikert quad	133
46	One Time Cave	Washington Township	Freeburg quad	146

site significance rank: exceptional high notable local

Snyder County Natural Heritage Inventory Site Index

Site #	Site Name	Municipality	USGS quadrangle	Page #
19	Penn's Drive Cave	Monroe Township	Sunbury quad	115
11	PENNS CREEK	Center, Jackson, Monroe, Penn, Union Townships and Union County	Freeburg, Lewisburg, Middleburg, Sunbury quads	88,102,111, 118,138
12	PENNS CREEK NORTH OF KRATZERVILLE	Jackson, Monroe Townships	Freeburg, Lewisburg quads	102,111
8	PORT ANN VERNAL POOLS	Adams Township	Beavertown quad	76
20	RACCOON CAVE/MEDVILLE'S MUDHOLE	Penn Township	Freeburg quad	120
38	RICHFIELD MARSH	West Perry Township and Juniata County	Richfield quad	155
13	ROLLING GREEN RUN SLOPES	Monroe Township	Freeburg, Sunbury quads	112
35	SHADE MOUNTAIN BARRENS	Beaver, Franklin, Perry, Spring, Washington, West Perry Townships	Beaver Springs, Middleburg, Richfield quads	82,97,126, 134,146, 155
14	SHAMOKIN DAM SLOPES	Monroe Township	Sunbury quad	112
16	SHIKELLAMY BLUFFS	Monroe Township and Union County	Northumberland quad	113
7	SNYDER MIDDLESWARTH NATURAL AREA	Spring Township	Weikert quad	134
44	SOUTH FREEBURG CAVE GROUP	Washington Township	Freeburg quad	144
28	STATE GAME LANDS #188 FLOODPLAIN	Beaver Township	Beavertown quad	82
18	SUSQUEHANNA RIVER AT SELINSGROVE	Monroe, Penn Townships and Northumberland County	Sunbury quad	114,120
48	SUSQUEHANNA RIVER AT SGL #233 NORTH	Penn, Union Townships and Northumberland County	Pillow, Sunbury quads	121,139
49	SUSQUEHANNA RIVER AT SGL #233 SOUTH	Chapman, Union Townships and Northumberland County	Dalmatia, Pillow quads	92,140
50	SUSQUEHANNA RIVER AT SGL #258	Chapman Township and Dauphin, Northumberland, Juniata, Perry County	Dalmatia, Millersburg quads	93
17	SUSQUEHANNA RIVER AT SHAMOKIN DAM/SUNBURY	Monroe Township and Northumberland, Union Counties	Northumberland, Sunbury quads	115
4	TALL TIMBERS NATURAL AREA	Spring, West Beaver Townships and Mifflin County	Weikert quad	135,151
36	Varner Gap Vernal Pools	West Perry Township and Juniata County	Beaver Springs quad	158
47	VERDILLA EAST GRASSLANDS	Union Township	Dalmatia, Freeburg, Pillow, Sunbury quads	140
37	WEST BRANCH MAHANTANGO VERNAL POOLS	West Perry Township and Juniata County	Beaver Springs & Richfield quads	156
25	WETZEL RUN HILL	Beaver Township	Beavertown quads	83

EXECUTIVE SUMMARY

Introduction

Our natural environment is key to human health and sustenance. A healthy environment provides clean air and water; supports fish, game, and agriculture; and furnishes renewable sources of raw materials for countless aspects of our livelihoods and economy. The first steps in ensuring protection of our natural environment are to recognize environmentally sensitive or ecologically important areas and to provide information regarding their sensitivities to various land use activities.

A County Natural Heritage Inventory (NHI) is designed to identify and map areas that support species of special concern, exemplary natural communities, and broad expanses of intact natural ecosystems that support important components of Pennsylvania's native species biodiversity. Its purpose is to provide information to help municipal, county, and state governments, private individuals, and business interests plan development with the preservation of an ecologically healthy landscape for future generations in mind.

• Natural Heritage Inventory Classification

To provide the information necessary to plan for conservation of biodiversity at the species, community, and ecosystem levels, sites identified in the NHI were designated and ranked as to their ecological significance. These sites, as well as areas identified from the Important Mammal Area and Important Bird Area Projects, are mapped and described in this report.

A Natural Heritage site is an area containing plants and/or animals of special concern at state or federal levels, exemplary natural communities, or exceptional natural diversity. Sites are mapped to include both the immediate habitat and surrounding lands important in the support of these special elements.

<u>Conservation Planning Application</u>: Sites are mapped according to their sensitivity to human activities. "**Core habitat**" areas delineate essential habitat that cannot absorb significant levels of activity without substantial impact to

the elements of concern. "Supporting Natural Landscapes" include areas necessary to maintain vital ecological processes or secondary habitat that may be able to accommodate some types of lowimpact activities.

Methods

Fifty-two out of sixty-seven county inventories have been completed in Pennsylvania to date. The Snyder County NHI followed the same methodologies as previous inventories, which proceeded in the following stages:

Information Gathering

A review of the Pennsylvania Natural Heritage Program (PNHP) database determined where locations for special concern species and important natural communities were known to exist in Snyder County. Knowledgeable individuals were consulted concerning the occurrence of rare plants and unique natural communities in the county. Geological maps, United States Geologic Survey (USGS) topographical maps, National Wetlands Inventory maps, United States Department of Agriculture (USDA) soil surveys, recent aerial photos, and published materials were also used to identify areas of potential ecological significance. Once preliminary site selection was completed, reconnaissance flights were conducted to assess these areas.

Field Work

Areas identified as potential inventory targets were scheduled for ground surveys. With permission from landowners, sites were examined to evaluate the condition and quality of the habitat and to classify the communities present. The flora, fauna, level of disturbance, approximate age of natural communities and local threats were among the most important data recorded for each site. Sites were not ground surveyed in cases where permission to visit a site was not granted, when enough information was available from other sources, or when time did not permit.

Data Analysis

Data obtained during the 2005 and 2006 field seasons were combined with prior existing data and summarized. All sites with species or communities of statewide concern, as well as exceptional examples of more common natural communities were mapped and described. Spatial data on the elements of concern were then compiled in a geographic information system (GIS) format using ESRI ArcGIS 9 software.

The boundaries defining each site were based on physical and ecological factors, and specifications for species protection provided by government jurisdictional agencies. The sites were then assigned a significance rank based on size, condition, rarity of the unique feature, and quality of the surrounding landscape.

Results

Fifty areas of ecological significance are recognized in the Snyder County NHI (page ix), including caves as important geologic and ecological features in the county. Spatial distribution of Natural Heritage sites across the county is shown in the site index map on page vii. Significance ranks (exceptional, high, notable, and local) of Natural Heritage sites in order of their contribution to the protection of the biological diversity and ecological integrity of the region are given in the results section of the report.

Conservation Recommendations

Snyder County has a number of groups pursuing the protection of natural areas within the county. The following are general recommendations for protecting the biological diversity of Snyder County.

- 1. Consider conservation initiatives for natural areas on private land.
- 2. Prepare management plans that address species of special concern and natural communities.
- 3. Protect bodies of water.
- 4. Provide for buffers around natural areas.
- 5. Reduce fragmentation of the surrounding landscape.

- 6. Encourage the formation of grassroots organizations.
- 7. Manage for invasive species.
- 8. Encourage community education
- 9. Incorporate County Natural Heritage Inventory (CNHI) information into planning efforts.

Discussion and Recommendations

Planning for Biodiversity and Ecological Health Provisioning for the future health of ecological resources in Snyder County will require a combination of efforts. These include the active stewardship of specific sites that host unique species and communities, broader-scale planning to maintain the unique contiguity of its forested regions, and restoration efforts to alleviate water pollution and restore ecological function to damaged landscapes and waterways.

o Forest Communities

In the forested landscapes, objectives for large-scale planning should include maintaining and increasing contiguity and connectivity of natural land. Contiguity is important for the enhanced habitat values outlined above; however, for many species, it is equally critical that natural corridors are maintained that connect forests, wetlands and waterways. For example, many amphibians and dragonflies use an aquatic or wetland habitat in one phase of their life then migrate to an upland, forested habitat for their adult life. Either habitat alone cannot be utilized unless a corridor exists between them.

Municipal and regional land use plans can support maintenance of forest contiguity by encouraging residential or commercial projects to re-develop in existing town centers or re-use previously altered landscapes, rather than orienting new infrastructure through unfragmented natural landscapes.

o <u>Wetland/Aquatic Communities</u>

Snyder County's waterways, ranging from headwater mountain streams to the Susquehanna River, include some of Pennsylvania's most scenic features. Objectives for large-scale

planning should include restoration of water quality in the county's waterways through a reduction in the release of pollutants into runoff, including sediments, nutrients, and chemical contaminants.

Stewardship or restoration of native forest communities in riparian buffers will greatly improve water quality and enhance the habitat value for various aquatic and semi-aquatic species. Attending to the basic ecological functions of streams and wetlands will ensure the continued availability of quality water for human communities, enabling the restoration of healthy fisheries, and enhancing the quality of life for which the region is known.

o Cave Features

Caves and karst features are fragile resources that have unique recreational and ecological value, providing habitats for common, rare, and threatened and endangered species. These systems serve as direct conduits to the groundwater table, a serious issue for Snyder County's rural communities that rely on well water. Conservation of cave and karst resources needs to be a concern for all who use or impact the cave environment as well as for communities in karst areas that rely on clean groundwater.

Most caves in Snyder County do not occur within ecologically natural landscapes. The sites containing caves are within a disturbed matrix of agriculture, roads, residences, and industry. Thus the usual approach to protecting natural areas does not apply here. Conservation efforts should focus on buffering cave entrances, preventing contamination of the groundwater, and limiting access to caves that host hibernating bats.

o <u>Evaluating Proposed Activity within Natural</u> Heritage Sites

A very important part of encouraging conservation of the sites identified within the Snyder County NHI is the careful review of proposed land use changes or development activities that overlap with Natural Heritage sites. The following overview should provide guidance in the review of these projects or activities.

• Always contact the Snyder County Planning Commission.

The County Planning Commission should be aware of all activities that may occur within Natural Heritage sites in the county so that they may interact with the County Conservation District and other necessary organizations or agencies to better understand the implications of proposed activities. They can also provide guidance to the landowners, developers, or project managers as to possible conflicts and courses of action.

• Conduct free online preliminary environmental reviews.

Applicants for building permits should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the PNHP website, at www.naturalheritage.state.pa.us. If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources.

Depending upon the resources contained within the Natural Heritage site, the agencies/entities responsible for them will then be contacted. The points of contact and arrangements for that contact will be determined on a case-by-case basis by the county and PNHP. In general, the responsibility for reviewing natural resources is partitioned among agencies in the following manner:

- o *U.S. Fish and Wildlife Service*: all federally listed plants or animals.
- o *Pennsylvania Game Commission*: all birds and mammals
- Pennsylvania Fish and Boat Commission: all reptiles, amphibians, fish, and aquatic invertebrates.
- Pennsylvania Department of Conservation and Natural Resources: all

plants, all natural communities, and terrestrial invertebrates (with PNHP).

If additional information on species of special concern becomes available during environmental review, the review may be reconsidered by the jurisdictional agency. PNHP and agency biologists can provide more detailed information with regard to the location of natural resources of concern in a project area, the needs of the particular resources in question, and the potential impacts of the project to those resources.

· Plan ahead.

If a ground survey is necessary to determine whether significant natural resources are present in the area of the project, the agency biologist reviewing the project will recommend a survey be conducted. PNHP, through the Western Pennsylvania Conservancy, or other knowledgeable contractors can be retained for this purpose. Early consideration of natural resource impacts is recommended to allow sufficient time for thorough evaluation. Given that some species are only observable or identifiable during certain phases of their life cycle (i.e., the flowering season of a plant or the flight period of a butterfly), a survey may need to be scheduled for a particular time of year.

• Work to minimize environmental degradation.

If the decision is made to move forward with a project in a sensitive area, PNHP can work with municipal officials and project personnel during the design process to develop strategies for minimizing the project's ecological impact while meeting the project's objectives. The resource agencies in the state may do likewise.

Finally, preliminary consultation with PNHP or another agency does not take the place of the environmental review. However, early consultation and planning as detailed above can provide for a more efficient and better integrated permit review, promoting a better understanding among the parties involved as to the scope of any needed project modifications.

Using the Natural Heritage Inventory in Snyder County

The following are specific recommendations that will serve to incorporate the information in this report into planning and land conservation activities in Snyder County.

- 1. Accept the Snyder County Natural Heritage Inventory report by resolution. The county should work to incorporate the NHI into the implementation of the comprehensive plan (in particular the Environmental Sensitive Resources section, Chapter 3) and to use the NHI to guide future planning, subdivision review, acquisition, development and conservation initiatives.
- 2. Incorporate the Snyder County NHI into any future Greenway or Open Space plans. The NHI should serve as a framework for these future plans. Because the NHI represents a window in time, the report should be updated before the creation of any Greenway or Open Space plans.
- 3. Revise the county future land use planning map to include the NHI core habitats and supporting landscape. At the time the Snyder County comprehensive plan was written, the sensitive environmental resources included vistas, wetlands, steep slopes, floodplains, forests, and soils, but did not incorporate information on rare, threatened, and endangered plants, animals, and natural communities. Some of the Natural Heritage sites can be compatible with rural land uses, given that appropriate management practices are encouraged, and could be incorporated into any future Open Space plans.
- 4. Make the NHI report available to all municipalities in the county. Copies of the final report were provided to each municipality. GIS layers resulting from the NHI will be available from the Snyder County Planning Commission.
- 5. Provide the NHI report to local watershed organizations and conservation organizations, such as the Central Pennsylvania Conservancy for prioritizing conservation actions.

Table 1: Snyder County Natural Heritage Sites Categorized by Significance

The sites of significance for the protection of biological diversity in Snyder County are categorized by significance. More in-depth information on each site including detailed site descriptions and management recommendations can be found in the text of the report following the maps for each municipality. Quality ranks, legal status, and last observation dates for each species of special concern and natural communities are located in the table that precedes each map page. Notice that natural areas with species of concern are in capital letters while locally significant sites without species of concern are in title case letters throughout the document.

Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
excep	otional significance		
9	DOLLAR WOODS MACROSITE Adams & Center Townships (Beavertown & Middleburg quads)	This massive wetland complex is the largest in all of Snyder County, and is one of the most extensive wetland systems in the central portion of the state. Four animal species of concern, one plant species of concern, and 2 unique natural communities are known from this site. This wetland complex should be a priority for conservation efforts.	74, 88
26	MISSIONARY GLADE AND CAVE Beaver Township (Beavertown quad)	This site consists of a limestone hill, with sparse woody vegetation on the crest. Three plant species of concern are noted from this site, including two that are characteristic of prairie, as well as a rare unique plant community in the state. Additionally, the hill contains two other plants of interest, and several cave openings, both natural and manmade. This site should be a priority for conservation in the county and must be actively managed to limit the encroachment of woody vegetation.	81
40	MOUNT PLEASANT MILLS VERNAL POOLS Perry Township (Richfield quad)	This site contains more than 45 vernal pools that dot the landscape and provide critical habitat for a species of special concern and a number of amphibian species that require these fish-free pools for breeding.	125
11	PENNS CREEK Center, Jackson, Monroe, Penn & Union Townships and Union Co. (Freeburg, Lewisburg, Middleburg, & Sunbury quads)	Three freshwater mussel species of concern are known from this site. Freshwater mussels are an important component of our waterways and provide a critical service by filtering the water, and cleaning our streams, creeks, and rivers. Establishment of forested buffers around the creek would benefit both the common and rare species that occur at this site.	88, 102, 111, 118, 138
16	SHIKELLAMY BLUFFS Monroe Township and Union Co. (Northumberland quad)	The cliffs at this site offer a scenic overlook of the Susquehanna River, as well as providing habitat for two plant species of special concern, and a unique natural community.	113
7	SNYDER MIDDLESWARTH NATURAL AREA Spring Township (Weikert quad)	This site is considered a "Natural Area" by the Bureau of Forestry and is composed of one of the highest quality stands of virgin timber in the state. In addition to providing a unique view into Pennsylvania's natural heritage, the site provides critical habitat for many species. This site is also recognized as an Important Bird Area by the Pennsylvania chapter of the Audubon Society.	134

EXECUTIVE SUMMARY (continued)			
Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
excei	otional significance (continued)		
50	SUSQUEHANNA RIVER AT SGL #258 Chapman Township and Dauphin, Northumberland, Juniata, & Perry Counties (Dalmatia & Millersburg quads)	The Susquehanna River is undoubtedly one of the state's most extensive natural features. In addition to serving as the source for the Chesapeake Bay, the largest estuarine system in North America, the river is home to several species of special concern in Snyder County. The stretch of the Susquehanna River at this site hosts five species of special concern, including four rare freshwater mussels. These mussels are a critical filtering system, cleaning the surrounding waters, and ultimately improving the water quality of the Chesapeake Bay.	93
37	WEST BRANCH MAHANTANGO VERNAL POOLS West Perry Township and Juniata County (Beaver Springs & Richfield quads)	This extensive group of vernal pools lies at the base of Shade Mountain. These pools are under considerable threats. Some of the pools are being filled in by the landowners. These pools provide critical habitat for breeding amphibians, as well as a rare plant and a rare animal species. This wetland complex should be a conservation priority in the county.	156
high	significance		
41	BOYER CAVE GROUP Perry Township (Richfield quad)	This cluster of caves provides critical habitat for two species of special concern. A forested buffer should be established around the cave entrances to protect these species and to avoid contamination of groundwater.	125
42	FREEBURG WEST GRASSLANDS Washington Township (Dalmatia & Freeburg quads)	The grasslands at this site serve as critical foraging habitat for a species of special concern. Lower intensity farming practices could benefit this rare species. Development of the site should be avoided to maintain the foraging grounds required for this species.	144
1	GRASS MOUNTAIN VERNAL POOLS Adams & Spring Townships (Beavertown & Weikert quads)	This site contains a group of 30 vernal pools, a unique natural community in Pennsylvania, and a healthy population of brown sedge (<i>Carex buxbaumii</i>), a Pennsylvania species of concern.	75, 131
3	LITTLE MOUNTAIN VERNAL POOLS Spring Township and Union County (Weikert quad)	The unique natural community of vernal pools at this site provides critical habitat for numerous amphibian species, as well as a plant species of special concern. Maintenance of Hunter Road should be conducted to limit the runoff that is infilling some of the pools.	132
33	MCCLURE CAVE West Beaver Township (McClure quad)	This cave provides critical habitat for a species of special concern. The proximity of the cave to the center of the town of McClure places it under considerable threat. Any development activity at this site should be carefully examined to ensure that the rare species can persist. A forested buffer should be established around the cave entrance where possible to protect the fragile habitat and limit the possibility of groundwater contamination.	150
22	MIDDLE CREEK Beaver, Franklin, Middle Creek, Penn, Spring, Union, & Washington Townships (Beavertown, Freeburg, Middleburg, & Sunbury quads)	Middle Creek runs through the heart of Snyder County and is one of the largest waterways in the county. The creek provides numerous habitats for many aquatic and terrestrial species. Recently, a population of the Yellow Lampmussel was located at the site.	80,96 106, 118, 132, 138, 145

Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
high s	significance (continued)		
8	PORT ANN VERNAL POOLS Adams Township (Beavertown quad)	This site contains a community of several dozen vernal pools along the base of Jack's Mountain on private property.	76
20	RACCOON CAVE/MEDVILLE'S MUDHOLE Penn Township (Freeburg quad)	This cave provides critical habitat for a species of special concern. Additionally, the cave serves as a direct link to the groundwater table. The entrance to the caves should have forested buffers around them to protect this unique habitat and to avoid groundwater contamination.	120
35	SHADE MOUNTAIN BARRENS Beaver, Franklin, Perry, Spring, Washington & West Perry Townships (Beaver Springs, Middleburg & Richfield quads)	This unique plant community relies on periodic fires to maintain the plant and animal composition. Unfortunately, fires have been suppressed at this area for too long, and the community could disappear if management practices are not performed. This site is one of the most unique spots in the state for rare moth species.	82,97 126, 134, 146, 155
44	SOUTH FREEBURG CAVE GROUP Washington Township (Freeburg quad)	This site provides critical habitat for a species of special concern. The cave entrances are direct conduits to the groundwater table and should have forested buffers to protect the habitat for the rare species at this site, and to protect the groundwater table from contamination.	144
18	SUSQUEHANNA RIVER AT SELINSGROVE Monroe & Penn Townships and Northumberland County (Sunbury quad)	The Susquehanna River through this stretch provides habitat for a population of rare freshwater mussels. All mussels filter the waters of the Susquehanna and remove contaminants from the system, improving the water quality locally, as well as downstream in the Chesapeake Bay.	114, 120
48	SUSQUEHANNA RIVER AT SGL #233 NORTH Penn & Union Townships and Northumberland County (Pillow & Sunbury quads)	This stretch of the Susquehanna River provides critical habitat for a rare freshwater mussel species and two other species of special concern. The habitat of these species could be maintained by avoiding development of the floodplain to ensure foraging habitat and limiting contaminated runoff into the river.	121, 139
49	SUSQUEHANNA RIVER AT SGL #233 SOUTH Chapman & Union Townships and Northumberland County (Dalmatia & Pillow quads)	Along this stretch of the Susquehanna River, a population of the Yellow Lampmussel was located in 2001. These mussels are a critical filtering system, cleaning the Susquehanna's waters here in Snyder County, and eventually improving the water quality of the Chesapeake Bay.	92, 140
4	TALL TIMBERS NATURAL AREA Spring & West Beaver Townships and Mifflin County (Weikert quad)	This tract of old-growth forest contains massive, ancient trees. These giants are representative of the forests once found throughout Pennsylvania. This forest also provides critical habitat for resident and migrating birds, and is recognized as an Important Bird Area by the Pennsylvania chapter of the Audubon Society.	135, 151
47	VERDILLA EAST GRASSLANDS Union Township (Dalmatia, Freeburg, Pillow & Sunbury quads)	The agricultural lands at this site provide critical foraging grounds for a species of special concern. Less intensive agricultural practices at this site would maintain the habitat used by this rare species.	140
25	WETZEL RUN HILL Beaver Township (Beavertown quads)	Two plant species of special concern and a prairie remnant are known from this site. This prairie glade is rather small and may be able to be expanded if some of the woody vegetation is removed from the surrounding woodland.	83

Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
notah	le significance		
32	BEAVER SPRINGS VERNAL POOLS Spring Township (Beaver Springs quad)	This community of vernal pools provides critical breeding habitat for a unique suite of amphibian species. The pools are unfortunately highly isolated and in close proximity to agricultural fields. An increase of the forested buffer around these pools would improve the quality of the site and help protect the species that rely on these unique wetlands.	129
27	BEAVERTOWN VERNAL POOLS Beaver Township (Beaver Springs & Beavertown quads)	This vernal pool community is within the borough limits of Beavertown. The landscape context of the pool community has been greatly altered. While most of the pools are completely forested, agriculture and housing developments surround the remaining forested patch that contains the vernal pool community. Further encroachment into the forest surrounding the pools should be discouraged.	79
31	FIRESTONE RIDGE AND CAVE Spring Township (Beaver Springs & Beavertown quads)	This limestone ridge contains a cave opening, as well as a plant species of special concern. The area around the rare plant population should be managed to maintain the habitat. A forested buffer should be established around the cave opening to avoid groundwater contamination.	130
5	JACKS MOUNTAIN EAST West Beaver Township and Mifflin County (Alfarata, Burnham, McClure & Weikert quads)	The open scree woodlands and south-facing slopes of Jacks Mountain provide excellent habitat for the Timber Rattlesnake. Specific locations of dens and summer birthing sites have not been well inventoried along this ridge. The length of Jacks Mountain is host to one of the largest blocks of contiguous forest in the region and provides an important corridor for wildlife, including raptor and songbird migrations, connectivity of populations of forest inhabitants, and dispersal of growing populations. The majority of Jacks Mountain is in private ownership, and is thus subject to potential future alterations of habitat through forest clearing or development. Further surveys to determine specific concentrations of rattlesnakes could improve protection of these sites.	149
6	KREB TRAIL VERNAL POOLS Spring & West Beaver Townships (Weikert quad)	This cluster of vernal pools provides critical habitat for breeding amphibians. The site is being degraded by runoff from Hunter Road. Measures should be taken to limit the gravel and silt runoff that threatens this unique natural community.	131, 149
30	MIDDLE CREEK AT MILL RUN LAKE Spring Township (Beaver Springs & Beavertown quads)	This site contains a population of a rare plant species. Habitat for this species would likely be improved if the earthen dam were removed from the site.	133
21	MIDDLE CREEK MOUNTAIN LEDGES Washington Township (Freeburg quad)	These steep ledges that overlook Middle Creek house a population of a plant species of special concern. Invasive exotic species at this site should be monitored and managed to avoid the displacement of the unique species found at this site.	145
2	MULLS GAP VERNAL POOLS Spring Township (Weikert quad)	This cluster of vernal pools, a unique natural community in the state, provides critical breeding habitat for a suite of amphibian species. Forested buffers should be established around these pools to protect the terrestrial habitats of these vernal pool breeding amphibians.	133

Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
notal	ble significance (continued)		
12	PENNS CREEK NORTH OF KRATZERVILLE Jackson & Monroe Townships (Freeburg & Lewisburg quads)	One plant species of special concern was documented at this site, clinging to the rock outcrops overlooking Penns Creek. The rugged nature of the habitat affords a good bit of protection; however the existing invasive exotic plant species at the site should be removed.	102, 111
38	RICHFIELD MARSH West Perry Township and Juniata County (Richfield quad)	A population of a rare plant species is known from this site. Unfortunately, the wetland is extremely isolated and completely surrounded by roads. Limiting application of de-icing chemicals on the roads surrounding the wetlands could help maintain the water quality of the site and could help the rare plants found at the site to persist.	155
13	ROLLING GREEN RUN SLOPES Monroe Township (Freeburg & Sunbury quads)	This site is known to be critical foraging habitat for the Northern Myotis, a bat species that feeds on insect pests. Further fragmentation of the site should be avoided to maintain the existing forested blocks, and water quality of the streams that drain down the slopes.	112
14	SHAMOKIN DAM SLOPES Monroe Township (Sunbury quad)	These slopes are known to be foraging habitat for the Northern Myotis, a species of bat that feeds on insect pests. The site should remain forested to provide adequate habitat for the bats, and to maintain the water quality of the streams that cascade down the slopes.	112
28	STATE GAME LANDS #188 FLOODPLAIN Beaver Township (Beavertown quad)	This site is primarily owned by the Pennsylvania Game Commission, and sits on the southern edge of Middle Creek. A population of cattail sedge (<i>Carex typhina</i>), a plant species of special concern, was documented at this site.	82
17	SUSQUEHANNA RIVER AT SHAMOKIN DAM/SUNBURY Monroe Township and Northumberland & Union Cos. (Northumberland & Sunbury quads)	This site is known to house a population of rare freshwater mussels. This population may be declining from the contaminated runoff that enters the river from the adjacent urban and suburban municipalities.	115
local	significance		
29	Beavertown Cave Beaver Township (Beavertown quad)	While this cave is not known to harbor species of special concern, a forested buffer should be established around the cave opening to avoid groundwater contamination and protect the potential habitat that may be used by species of special concern.	84
10	Centerville Cave Center Township (Middleburg quad)	This cave opening was created artificially, but still serves as a direct conduit to the groundwater table and should be protected with a forested buffer to avoid water contamination.	89
23	First Day of Spring Cave Middle Creek Township (Middleburg quad)	This cave is not known to house species of special concern, but should be buffered with forest to prevent groundwater contamination.	106
45	Freeburg Cave Washington Township (Freeburg quad)	While species of concern are not known from this cave, a forested buffer should be established around the entrance to prevent contamination of this unique habitat.	146

Site #	Site Name Municipality (USGS quadrangle)	Description	Page #
local	significance (continued)		
39	Haa's Cave West Perry Township (Richfield quad)	A forested buffer should be established around this cave entrance to prevent groundwater contamination. While no species of special concern are known from this site, the habitat may be utilized by species of concern in the future and should be protected.	157
24	Limestone Ridge/Paxtonville Cave Franklin Township (Middleburg quad)	This site hosts a population of a plant species of interest and a cave opening. A forested buffer should be established around the site to protect the population of this unique plant and the groundwater table that the cave opening feeds into.	98
34	Lost Creek Headwater Vernal Pools West Beaver Township and Juniata County (McClure quad)	This small saddle in the headwaters of Lost Creek contains several pools comprising an Ephemeral/Fluctuating Natural Pools Community. These isolated pools offer an important breeding location for the surrounding amphibian community. The site is owned and managed by a pair of landowners. Logging within proximity to the pools without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland. At the very least, a forested buffer should be established around this pool complex.	151
43	M.A.R. Cave Washington Township (Dalmatia & Freeburg quads)	No species of special concern are known from this site, but the cave habitat may become occupied by species of concern in the future. A forested buffer should be established around the cave entrance to avoid groundwater contamination and to protect this unique habitat.	146
15	Moyer Homestead Site Monroe Township (Northumberland & Sunbury quads)	At this site, a population of a plant species of special concern may have been destroyed by a recent housing development that was built on the site. Additional surveys should be conducted to see if remnant populations occur in the area.	115
46	One Time Cave Washington Township (Freeburg quad)	Little is known about this cave but it does serve as a direct link to the groundwater table and should have a forested buffer established around it to limit the possibility of groundwater contamination.	146
19	Penn's Drive Cave Monroe Township (Sunbury quad)	This cave is not known to harbor species of special concern, but serves as a direct conduit to the groundwater table. A forested buffer should be established around the cave entrance to minimize the possibility of groundwater contamination.	115
36	Varner Gap Vernal Pools West Perry Township and Juniata County (Beaver Springs quad)	This site contains several closely grouped small pools comprising an Ephemeral/Fluctuating Natural Pools Community, owned and managed by numerous landowners. Logging within proximity to the pool without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of these wetlands. At the very least, a forested buffer should be established around this pool complex.	158

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INTRODUCTION

Snyder County, formed in 1855 from a part of Union County, was named for a former Pennsylvania governor hailing from Selinsgrove. The county has historically been an important region for trade and travel, related to its position among historic trails, highways, canals, railroads, and the Susquehanna River. Its shape reflects the patterns created by the mountains of the Valley and Ridge Physiographic Province. Bordering to the east, along the Susquehanna River, is Northumberland County, with Union County to the north, Mifflin County to the west, and Juniata County along the south. Middleburg is the county seat. The county has a total area of approximately 329 square miles, or 211.000 acres.

Snyder County's population has remained stable in recent decades, growing only slightly from 36,680 in 1990 to 37,546 in 2000. Despite the relatively slow population growth, development pressure on some of the sensitive natural areas of the county is increasing. Economically unsustainable farms are frequently sold to developers for residential and commercial uses. Farms represent many generations of cultural heritage and some farms contain a natural component or are adjacent to a natural area. The areas that comprise the natural heritage of Snyder County can be easily lost

Particular species names, common and scientific, are provided in coordination with the appropriate jurisdictional agency. Plants, terrestrial invertebrates, and natural communities are under the jurisdiction of the **PA Department of Conservation and Natural** Resources (DCNR). Mammals and birds are under the jurisdiction of the PA Game Commission (PGC). Aquatic animals, reptiles and amphibians are under the jurisdiction of the PA Fish and Boat Commission (PFBC). Certain species are subject to unauthorized collection and are therefore not identified in the text of this report, at the request of the jurisdictional agencies, in order to provide some measure of protection.

without careful planning of growth and development. Ironically, the scenic and remote nature of these areas may make them prime targets for residential developments. Protecting the integrity of these natural systems provides benefits to humans as well as providing for the survival of all flora and fauna, common and rare. Planning for long-term sustainability can maintain open space, including natural environments and the plants and animals associated with them. Using this Natural Heritage

Inventory as a conservation tool can steer development away from environmentally sensitive areas, creating a needed balance between growth and the conservation of scenic and natural resources.

It is important that county and municipal governments, the public, developers and planners know the location of such environmentally sensitive areas in order to maintain a balance and protection of these areas. Knowing where these areas are located can help prevent potential land-use conflicts, and help focus conservation efforts and limited funds on the most vulnerable areas.



Snyder County contains expansive areas of forested public land. These tracts provide Pennsylvania's residents with many options for recreation, as well house a significant portion of Snyder County's biological resources.

photo source: Andrew Strassman (PNHP)

The Middletown office of the Western Pennsylvania Conservancy, in cooperation with the Snyder County Planning Commission, has undertaken this project to provide a document and maps that will aid in the identification of these important areas.

The Natural Heritage Inventory report presents the known outstanding natural features, including the plants, animals and selected geologic features in Snyder County. The Inventory provides maps of the best natural communities (habitats) and the locations of animal and plant species of special concern (rare threatened and endangered) in Snyder County. Due to budget, access, and time constraints, some highquality areas in the county are likely to have been overlooked. The maps do not pinpoint the site of the species of concern but rather represent a conservation zone that is critical to the preservation of the site (core habitat), and a zone of potential impacts within the site's watershed (supporting natural landscape). A written description including threats and disturbances, conservation recommendations, and a summary table of the sites, including degree of rarity, last-observed date, and quality rank accompany each map.

Potential threats (threats and disturbances) and some suggestions for protection (conservation recommendations) of the rare communities, plants, or animals at the site are included in the individual site descriptions. Selected geologic features of statewide significance are also noted. In addition, the inventory describes locations of areas that are significant, but have not been ranked in this inventory because no species of concern were documented at these sites. These sites have great potential for high biological value, but due to time constraints were not surveyed during the field season. These "locally significant" sites are representative of habitats that are relatively rare in the county, support an uncommon diversity of plant species, and/or provide valuable wildlife habitat. Locally significant sites without documented species of concern are referenced in lower case lettering throughout this report.

The information and maps presented in this report provide a useful guide for planning commercial and residential developments, for sighting recreational parks, for conserving natural areas, and for setting priorities for the preservation of the most vulnerable natural areas. An overall summary identifies the highest quality sites in the county. All of the sites in this report were evaluated for their importance in protecting biological diversity on a state and local

level, but many also have scenic value, provide water quality protection, and are potential sites for low-impact passive recreation, nature observation, and/or environmental education.

The Natural Heritage Inventory will be provided to each municipality through the Snyder County Planning Commission. The Inventory is a conservation tool that will aid in the creation of municipal, county, and comprehensive plans. Its emphasis on biological diversity should inform county and regional open space plans already underway. Snyder County, its municipalities, land trusts, and other organizations can also use the Natural Heritage Inventory to identify potential protection projects that may be eligible for funding through state or community grant programs such as the Growing Greener Fund.

Landowners will also find this inventory useful in managing and planning for the use of their land; it gives them the opportunity to explore alternatives that will provide for their needs and still protect the species and habitats that occur on their land. For example, the Forest Stewardship program, coordinated by the Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry, assists landowners in creating management plans. These plans incorporate landowner objectives (e.g., wildlife or timber management). Other programs include the USDA's Forest Legacy Program and the Pennsylvania Department of Agriculture's Agricultural Land Preservation Program. Land managers may wish to consult with this report and the environmental review tool found on the Pennsylvania Natural Heritage Program's website in an effort to avoid potential conflicts in areas with species of special concern and/or identify ways of enhancing or protecting these resources. Users of this document are encouraged to contact the Middletown office of the Western Pennsylvania Conservancy (717-948-3962) for additional information.

Questions regarding potential conflicts between proposed projects and species of concern mentioned in this report should be directed to the Environmental Review Specialist at the Pennsylvania Natural Heritage Program (PNHP) Office in Harrisburg (717) 772-0258.

NATURAL HISTORY OVERVIEW OF THE COUNTY

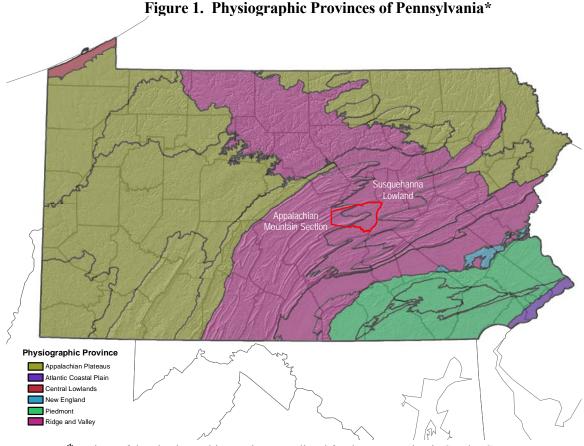
The climate, topography, geology, and soils have been particularly important in development of ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains) that occur in Snyder County. Many disturbances, both natural and human, have been influential in forming and altering many of Snyder County's ecosystems, causing extirpation of some species and the introduction of many others. These combined factors provide the framework for locating and identifying exemplary natural communities and species of special concern in the county. The following sections provide a brief overview of the physiography, geology, soils, surface water, and characteristic vegetation of Snyder County.

Physiography and Geology

Characteristic landscapes and distinctive geological formations classify Physiographic Provinces (Figure 1). Physiography relates in part to a region's topography and climate. These two factors, along with bedrock type, significantly influence soil development, hydrology, and land use patterns of an

area. Additionally, both physiography and geology are important to the patterns of plant community distribution, which in turn influences animal distribution. Because of the differences in climate, soils, and moisture regime, certain plant communities would be expected to occur within some provinces and not in others.

Snyder County lies entirely within the Ridge and Valley Physiographic Province, and is split between the Appalachian Mountain and Susquehanna Lowland sections (Cuff et al. 1989). The Ridge and Valley Province is a distinguished belt of long, narrow wooded ridges and broad agricultural valleys that sweep diagonally through central Pennsylvania. The ridges of this province are similar in structure and elevation, typically rising between 800-1200 feet (244-366m) above sea level, but occasionally to 2000 feet (610m). The ridges of Snyder County are primarily sandstone and include Penns Creek Mountain



*sections of the physiographic provinces are listed for those occurring in Snyder County

paralleling the northwestern border and Shade Mountain in the southwest. The valleys that dominate in this region are variable depending on the type of rock that underlies them. Snyder County's valleys typically have some Ordovician limestone bedrock. which are the flattest and the most fertile of valley types. Shale soils are also present in Snyder County, and are characteristic of a more hilly land and relatively poor soil (Cuff et al. 1989). Land use patterns in the county follow the Ridge and Valley geology; streams, roads, farms, parks, etc. all follow the lines of the mountains along a generally southwest to northeast distribution. Much of the valley lowlands are underlain by rocks dominated by carbonates (such as limestone), but common karst features such as sinkholes, sinking streams and natural cave entrances are largely absent (LaRock 1976). Several of the known caves in

Snyder County were opened through quarrying activities (LaRock 1976). The rest of the county lies in the Susquehanna River Valley.

All but the southwestern corner of Snyder County was partially glaciated during the Illinoian (350,000-550,000 years before present) glacial advances. As the ice age came to an end, the retreat of the ice pack northward carved the landscape and deposited glacial material, creating many of the forms that are seen today. Glacial deposits dammed some of the County's creeks and rivers creating a number of wetlands. Other waterways in the county swelled as a result of the large amounts of melt water, further deepening the valleys and accentuating the hills and mountains (Cuff 1989).

Watersheds

Snyder County is completely within the Susquehanna River drainage basin. Major watersheds in the county include Penns Creek, Middle Creek, Beaver Creek,



Snyder County is situated within the Ridge and Valley physiographic province. This province is characterized by highly varied topography, with ridges typically composed of harder, more weather resistant rock, and valleys composed of softer bedrock, overlain with thick layers of soil eroded from the ridges.

photo source: PHNP

and the North and West Branches of Mahantango Creek. More complete information on Snyder County's watersheds can be found in the Aquatic Community Classification section, found on page 43.

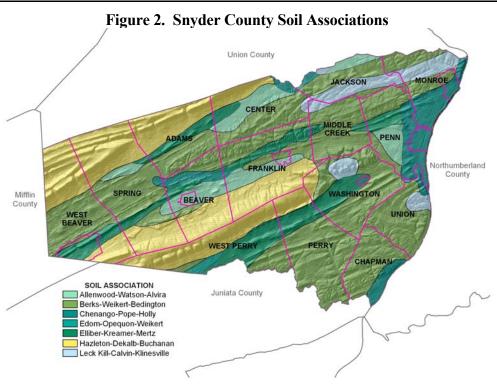
Soils

Snyder County contains a diverse mix of soils, typical to the ridge and valley province of the state. These soils include non-carbonate and carbonate rocks, as well as deposited glacial till and alluvial soils. These soil types range from poor, to excellent growing conditions for agriculture (Cuff et al. 1989).

A soil association is a group of soils with a distinctive, proportional pattern of occurrence in the landscape. This description of the soils of Snyder County comes from the *Soil Survey of Snyder County, Pennsylvania* (USDA, 1985) and more recent information provided by the Snyder County Conservation District. There have been seven soil associations mapped for Snyder County (Table 2, Figure 2).

Table 2. Soil associations described for Snyder County, adapted from The Soil Survey of Snyder County (USDA, 1985).

Soil Association	Description	Percentage of Area in County	Land Use
Berks Weikert- Bedington	Gently sloping to steep, shallow and deep, well drained soils on hills and ridges; formed in material weathered from shale and some sandstone	45.3	mainly crops and pasture, building sites with some areas in woodland and wildlife habitat
Hazleton- Dekalb- Buchanan	Nearly level to steep, deep and moderately deep, well drained soils on mountainsides and mountaintops; formed in material weathered from sandstone	25.4	largely wooded and suited for wildlife habitat
Elliber- Kreamer- Mertz	Gently sloping to steep, deep, well drained to somewhat poorly drained soils in valleys and on ridges; formed in material weathered from cherty limestone and in colluvium weathered from cherty limestone	10.7	mainly used for crops with some of the steep areas remaining wooded
Chenango- Pope-Holly	Nearly level to sloping, deep, very poorly drained to well drained soils on flood plains and terraces; formed in alluvial material and outwash deposits	6.8	mainly used for crops but urban development is fairly extensive
Allenwood- Watson- Alvira	Nearly level to moderately steep, deep, somewhat poorly drained to well drained soils on uplands; formed in material weathered from glacial till	6.7	mostly used for crops
Leck Kill- Calvin- Klinesville	Gently sloping to steep, deep to shallow, well drained soils on hills and ridges; formed in material weathered from red shale	4.7	mainly used for crops with the steep and shallow areas generally used for woodland and wildlife habitat
Edom- Opequon- Weikert	Nearly level to moderately steep, deep, well drained and moderately well drained soils on mountain side slopes and foot slopes; formed in colluvial material weathered from sandstone and shale	0.4	mainly in woodland, but some areas have been cleared for crops and pasture



SNYDER COUNTY'S NATURAL COMMUNITIES AND FEATURES

Terrestrial Natural Communities

The American chestnut (Castanea dentata) once dominated many of the Eastern North American Hardwood Forests from Maine to Michigan to Alabama. However, around 1904, a chestnut blight (Cryphonectria parasitica) was introduced to North America from Asia. The blight spread from the Bronx Zoo northward and southward, and by 1960, there were essentially no mature chestnuts left standing. Today, some young sprouts and shoots still remain, but due to the blight very few will ever reach maturity. The loss of the chestnut in the forest canopy left huge breaks all across the eastern United States. These holes have since filled with many of the chestnut's associate species, including species of oak and hickory. These species comprise the matrix of Northeastern Interior Dry-Mesic Oak Forest, Central Appalachian Dry Oak-Pine Forest, and Central Appalachian Pine-Oak Rocky Woodland found in Snyder County. These Ecological Systems, a new classification method developed by NatureServe, compose what was formerly known as the Appalachian Oak Forest Community. These Ecological Systems are found on a broad range of soils throughout the county.



Once the most common tree in Pennsylvania, the American chestnut (Castanea dentata) was crippled by the chestnut blight outbreak that occurred in the early to mid 1900s. This exotic outbreak eliminated all mature specimens of this tree from the state.

photo source: PNHP

Within this matrix of Ecological Systems are pockets of other communities considered much less common, frequently harboring the most interesting plants, animals, and communities. These terrestrial natural communities of interest in Snyder County are briefly described in the following section.





a pre and post chestnut blight forest

Characteristic species of the Appalachian Oak Forest

	<u>Trees:</u>
white oak	Quercus alba
northern red oak	Quercus rubra
chestnut oak	Quercus montana
sweet birch	Betula lenta
pignut hickory	Carya glabra
American beech	Fagus grandifolia
tulip poplar	Liriodendron tulipifera
eastern white pine	Pinus strobus
scarlet oak	Quercus coccinea
scrub oak	Quercus ilicifolia
black oak	Quercus velutina
	Clauriban

mountain-laurel
low sweet blueberry
lowbush blueberry
black huckleberry
witch hazel

Shrubs:
Kalmia latifolia
Vaccinium angustifolium
Vaccinium pallidum
Gaylussacia baccata
Hamamelis virginiana

Herbaceous Vegetation:Canada mayflowerMaianthemum canadensePennsylvania sedgeCarex pensylvanicateaberryGaultheria procumbensbracken fernPteridium aquilinumfalse Solomon's sealSmilacina racemosawild sarsaparillaAralia nudicaulismay applePodophyllum peltatum

Dryopteris spp.

wood ferns

Hemlock (White Pine) Forest*

In 1681, when William Penn was chartered the enormous tract of land in the new world now known as "Pennsylvania", the vast forests of the territory became the symbol of "Penn's Woods". At that time, Pennsylvania was known for seemingly endless forests, filled with majestic giant trees. Forests of eastern hemlock and eastern white pine in Pennsylvania were once widespread throughout the state, with stands of giant trees that towered over 200 feet (61m) tall. Today, only tiny fragments of this once great forest remain.

Patches of old-growth forest are not merely composed of large old trees; rather the nature of true old-growth forest depends on the functioning of the system. The USDA Forest Service has set up the following criteria for identifying old-growth forests. True stands of old-growth forest contain: (1) large trees for species and site, (2) wide variation in tree size and spacing, (3) accumulation of large, dead trees (snags, logs), (4) tree decadence (a process of deterioration), and (5) tree canopy structure (layers, gaps).



Hemlock (White Pine) forest

photo source: Andrew Strassman (PNHP)

In Snyder County, old growth forests can be seen at Tall Timbers Natural Area and Snyder Middleswarth Natural Area in Bald Eagle State Forest.

Most of these old-growth criteria are characters of a process known as gap formation. Gap formation occurs when old trees die and fall over, creating an opening in the canopy. Smaller shaded trees that have been waiting in the wings (sometimes for centuries) are suddenly able to take advantage of the newly opened gap and shoot towards the canopy. Gap formation implies the presence of large trees, some of which have died and fallen over, creating a mixed layer of dead woody material on the forest floor, and the naturally spaced sub-canopy trees filling the gap and growing skyward into the canopy.

Characteristic species of t	Trees:
eastern hemlock	Tsuga canadensis
eastern white pine	Pinus strobus
sweet birch	Betula lenta
yellow birch	Betula alleghaniensis
sugar maple	Acer saccharum
red maple	Acer rubrum
red oak	Quercus rubra
black oak	Quercus velutina
American beech	Fagus grandifolia
tuliptree	Liriodendron tulipifera
<u>.</u>	Shrubs:
rosebay	Rhododendron maximum
hobblebush	Viburnum lantanoides
maple leafed viburnum	Viburnum acerifolium
witch hazel	Hamamelis virginiana
<u>Herbace</u>	ous Vegetation:
partridge-berry	Mitchella repens
Canada mayflower	Maianthemum canadense
ground pine	Lycopodium spp.
teaberry	Gaultheria procumbens
New York fern	Thelypteris noveboracensis
Indian cucumber root	Medeola virginiana
Christmas fern	Polystichum acrostichoides

In addition to creating an incredibly scenic landscape, old-growth forests are also known to be extremely rich in biodiversity. Certain species of animals prefer old-growth forests. Many songbirds, raptors, weasels, rodents, shrews, bats, and amphibians thrive in old-growth stands. Some studies of old-growth have noted that the invertebrate biomass is more than five times the mass found in younger timber stands. Aside from being representatives of Pennsylvania's past landscape, the remaining patches of old-growth forests in the state offer tremendous biological significance and are incredibly unique natural communities that shape the character of the Commonwealth.

^{*} Recognized as a natural community of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program

Sparsely Vegetated Cliff*

The sparsely vegetated cliff plant community is not at all common in the Commonwealth. High quality examples of this community exist on extensive rock outcrops, ranging from dry to wet, and shaded to sunny. Shallow to nonexistent soils provide unique growing conditions that foster a suite of wildflowers, grasses, ferns, mosses, and lichens well adapted to this harsh habitat, including several plant species of concern. Most plants in this community are able to persist in periods of drought. For the most part, the vegetation is restricted to the narrow ledges and crevices in the rock face. Trees are typically absent from this community, but may be present in very stunted forms.

Because of the steep terrain and lack of soils, these plant communities are rather protected from the threats that jeopardize other communities in the state. The primary threat to this community is the encroachment of invasive species. Tree-of-heaven (*Ailanthus altissima*) tends to thrive in this habitat. This tree

grows incredibly fast, able to reach heights of over 30 feet (9m) in a handful of years, and mature specimens can produce hundreds of thousands of seeds per year. Tree-of-heaven also exhibits a trait known as "allelopathy," where toxic compounds are secreted into the surrounding soil and prevent any other species from growing. Examples of this community that are surrounded by forest are well protected from exotic species invasions, while those that may occur along waterways, roadways or railroads can be under attack from the invasive species often associated with these corridors. Other threats to the sparsely vegetated cliff community include destruction from blasting for road and/or railroad expansion.

A wonderful example of the Sparsely Vegetated Cliff community can be seen at Shikellamy State Park, just over the border in Union County. This park not only provides a scenic overlook of the West and North Branches of the Susquehanna River, the bluffs also provide habitat for a suite of unique plant species.



The sparsely vegetated cliff community is tailored to providing habitat for unique species because it creates very difficult growing conditions, which excludes many more common species.

photo source: PNHP

^{*} Recognized as a natural community of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program

Side-oats gramma calcareous grassland*

From a historic perspective, the very name "Pennsylvania" elicits thoughts of contiguous forest, unbroken by today's highways and agricultural lands. Though the Commonwealth has been traditionally associated with expansive forests, portions of the state have historically been covered in rather extensive grasslands. In 1775, traveling minister Philip Vickers Fithian noted in his journal that "[i]n this valley there are large open plains, cleared either by the Indians or accidental fire. Hundreds of acres are covered with fine grass and a great variety of flowers". While Fithian's description paints a picture not typically thought of as characteristic of Pennsylvania, remnants of these grasslands can be found throughout the Ridge and Valley Physiographic Province.



hoary puccoon (*Lithospermum canescens*)

A matrix of forests, wetlands, and grassland openings existed in the Northeast before European settlement. Grasslands were thought to be the product of intense management by Native Americans for hunting opportunities, and while their existence was certainly enhanced by the fires of these peoples, Pennsylvania naturally had prairie openings maintained for millennia by the grazing of large ungulates including the Pleistocene mega fauna, and more recently the Pennsylvania populations of the American Bison (Bison bison) and American Elk (Cervus elaphus).

Today, the remaining grasslands are usually thought of as prairie remnants, existing in small isolated patches

where harsh growing conditions deter other plant species from encroaching on the last of Pennsylvania's native prairie. In certain cases, grassland patches have been created by human disturbance, with the seeds of the prairie plants migrating over time from other patches of grasslands. Pennsylvania's prairies have soil features that are typically thought of as poor quality for farming or pasturing. The soils of Sideoats gramma calcareous grasslands are typically thin (rarely more than a few inches thick), and are composed of Opequon soil series, part of the Elliber-Kreamer-Mertz association. Today, prairie remnants are typically found on south to southwest facing slopes, restricted to areas thought to be too poor for agriculture, and not yet invaded by woody vegetation. Due to the rarity of these remnant communities, several of the plants and animals they support are also rare species.

As previously mentioned, Pennsylvania's prairie required disturbance through grazing or fire to disrupt natural succession where woody vegetation threatens to convert these habitats to forest and shade out the unique species at these sites. Today, most of Pennsylvania's prairies are threatened with succession of woody species. A lack of management aimed at setting back succession, could threaten the viability of these communities in the state. Removal of woody vegetation and in some cases removal of the thick layers of soil at these sites could help to maintain the character of these prairies and help maintain the habitats needed by the rare species that exist at these sites.



side oats gramma (Bouteloua curtipendula)
photo source: PNHP

^{*} Recognized as a natural community of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program

Limestone Solutional Cave*

Pennsylvania's karst landscapes are renowned nation-wide for their solutional caves. Solutional caves are formed in limestone or dolomite by the dissolving action of groundwater. Water has formed all of the caves in this region, eroding limestone both physically and chemically. Snyder County contains a number of caves, most of which have been uncovered by quarrying operations. While the entrances to these caves have been artificially created, the cave features themselves were naturally formed and small openings to the cave systems likely existed before the quarrying operations, but were simply too small for human exploration.

Caves and karst features are fragile resources that have unique recreational and ecological value, providing habitats for common, rare, threatened, and endangered species. Cave systems also serve as direct conduits to the groundwater table, a serious issue for Snyder County's rural communities that rely on well water. Conservation of cave and karst resources needs to be a concern for all who use or impact the cave environment as well as for communities in karst areas that rely on clean groundwater.



This cluster of hibernating bats serves a vital ecological role as well as being beneficial to humans. In the warmer months of the year, these bats will forage along wooded creeks and streams, eating insects as they hatch from the waters. A common myth is that bats swarm and often entangle themselves in people's hair. In reality, Pennsylvania's bats are incredibly agile fliers and will never strike a human. Bats do often fly around humans, but are usually busy plucking mosquitoes and other biting pests from the air. photo source: PNHP



A cave amphipod (Gammarus minus)
photo source: PNHP

Many human activities threaten caves and the fauna that depend on them. Terrestrial pollution in karst terrains results in a very real subterranean threat. Because water moves readily from the earth's surface down through solutional cavities and fractures and undergoes very little filtration, groundwater in karst limestone is easily polluted. Contamination of groundwater can come from contaminants from industrial sources as well as sewage, fertilizers, herbicides, and pesticides from municipal, agricultural, and household sources. Even stormwater may be considered a polluting substance as overland runoff transfers surface material, including pollutants.

roadsalts and excessive nutrients, into the fragile underground environment.

Identification of cave resources in this report is provided as a highlight of geologic and natural resources of the county and should not be considered a guide to cave exploration. Individual landowners control the access to caves on their property and should be contacted prior to visiting a cave. Caves that support over-wintering bats should not be visited from October 1 to May 1 in order to avoid disturbing the bats. When bats are disturbed in hibernation, they use up much of their fat reserves and may not survive through the winter. While bats have been unjustly feared and persecuted in the past, we are now realizing the critical ecological role and benefits to humans, especially to farmers, that these species provide in the form of insect control. More information about cave exploration in central Pennsylvania is available through the local cave clubs, such as Nittany Grotto, Pennsylvania Cave Conservancy, and the Mid-Atlantic Cave Conservancy. For more information on cave environments and the animals found within, see the Cave Environment fact sheet on page 187.

^{*} Recognized as a natural community of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program

Wetland Natural Communities

Wetlands are the key to the survival of many species of plants and animals considered rare in the state. Even though wetlands account for only two percent total of Pennsylvania's area, they are home to a diverse array of rare plants and animals and are an extremely productive part of the landscape as a whole (Cuff et al. 1989). While the recent Wisconsin glaciers advance did not reach Snyder County, the northeastern half of the county was covered by Illinoian glaciers, about 350,000-550,000 YBP. Glaciated regions make up 24% of Pennsylvania's area, while they contain 62% of the state's wetlands (Tiner 1987).

Wetlands differ in size, structure, and species diversity. Wetlands also differ according to their placement on the landscape: at stream headwaters, dips in valleys, or on slopes where ground water discharges; and whether the water contained is flowing or stagnant. These different scenarios result in peatlands, marshes, swamps, floodplain forests, forested wetlands, wet meadows, and seeps. Wetlands also differ in vegetative species cover. Tree species such as red maple (*Acer rubrum*), yellow birch (*Betula*

alleghaniensis), eastern hemlock (*Tsuga canadensis*) and ash species (*Fraxinus* spp.) usually dominate forested swamps. The understory typically consists of shrub species such as highbush blueberry (*Vaccinium corymbosum*), rhododendron and azaleas (*Rhododendron* spp.), winterberry holly (*Ilex verticillata*), alders (*Alnus* spp.), swamp rose (*Rosa palustris*) and many others.

Shrub swamps are wetlands occurring on mineral soils usually with a thick accumulation of peat moss (*Sphagnum* spp.) and other organic matter with water near or above the surface most of the year (Cuff et al 1989). Shrubs under 20 feet (6.1m) tall dominate this type of wetland. Shrub swamps in the county often include highbush blueberry, chokeberry (*Aronia* spp.), mountain holly (*Nemopanthus mucronatus*), alder, leatherleaf (*Chamaedaphne calyculata*), swamp rose, meadowsweet and steeplebush (*Spiraea* spp.), and sedges (*Carex* spp.).



Shrub swamp

photo source: PNHP

Mixed forb marshes, also known as emergent marshes, are wetlands are dominated by grass-like (graminoid) plants such as cattails, sedges, rushes, and grasses. This type of wetland may be found in association with slow streams or in areas with ground water seepages. Emergent marshes in the county are usually formed as successional communities following the deterioration of beaver dams or other impoundments.

This plant community was once very common, but has declined since European colonization from wetland draining and stream channel modification. This community is highly variable but is dominated by sedges, grasses, rushes, and tearthumbs (*Polygonum* spp.). Also associated with this community are beggar-ticks (*Bidens* spp.), jewelweeds (*Impatiens* spp.), dock (*Rumex* spp.), and sensitive fern (*Onoclea sensibilis*). Mixed Forb Marshes tend to occur where basins remain marginally wet year round. These wetland systems often have very slow flow, but are not stagnant.

In addition to being beautiful rich meadows that support a diversity of native plants, mixed forb marshes provide essential habitat for a number of birds, amphibians, reptiles, mammals, butterflies, moths, dragonflies and damselflies. The Marsh Wren (*Cistothorus palustris*), Northern Leopard Frog (*Rana pipiens*), and Spotted Turtle (*Clemmys guttata*), all species of concern in Pennsylvania, rely on the habitats found in mixed forb marshes.

This plant community is susceptible to invasions of exotic species including purple loosestrife (*Lythrum salicaria*) and the varieties of common reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*). These aggressive non-native invasions form monocultures, excluding the diverse array of native species that typify this plant community. Along with the still common shrub swamps and mixed forb marshes in Snyder County, one wetland natural community of special concern is known to occur in the county, and is described in the following section.



A graminoid marsh

photo source: PNHP

Ephemeral/fluctuating Natural Pool*

Also known as vernal pools or seasonal pools, these wetlands fill with water on an intermittent basis due to annual precipitation, rising groundwater, or surface water runoff (Kenney and Burne 2000). These pools become almost completely dry in most years, losing water through transpiration and evaporation. Because these pools are ephemeral and generally free of fish. they attract many species of breeding salamanders. frogs, and toads. Some species, like the Jefferson Salamander (Ambystoma jeffersonianum) are obligate vernal pool species. This species and other ambystomatid salamanders lay eggs exclusively in vernal pools. Plants typically associated with vernal pools include woolgrass (*Scirpus* spp.), three-way sedge (Dulichium arundinaceum), pin oak (Quercus palustris), highbush blueberry, red maple, and the federally endangered Northeastern bulrush (Scirpus ancistrochaetus).

Due to the rarity of undisturbed examples of these wetlands in Pennsylvania, all good examples of these habitats should be preserved whenever possible. Wetlands provide valuable habitat for breeding and migrating birds, mammals, reptiles, amphibians and insects and also act as a refuge for many species of wetland dependent rare plants. These systems also provide critical roles in maintenance of water quality.

Communities of vernal pools have historically received negative attention because they have been

thought of as mosquito breeding wastelands, with few benefits to humans. In recent years, we have begun to understand and appreciate the intricate ecology of these rare and isolated communities. Many of the misconceptions of these pool communities have been corrected through more recent vigorous scientific research.

For example, we now realize that vernal pool communities do not produce mass numbers of mosquitoes as was once thought. In fact, a few old tires in the woods can produce more mosquitoes than an entire vernal pool community! While mosquito eggs are laid in vernal pools, few of them survive to

adulthood because a group of highly specialized amphibians and insects have adapted to the unique growing conditions provided by vernal pools and eat the majority of the mosquito larvae before they hatch.

Pennsylvania's vernal pool origins are most commonly rooted in the glacial advances of the Illinoian and Wisconsin glaciations. In fact, these pools can allow glimpses into the past using paleobotany, in which historic plant species are identified by examining pollens housed in anoxic soils where they are in a preserved state due to a lack of decomposition. Paleobotany studies from some pools in Pennsylvania have identified tamarack pollens from a few feet down, indicating that a portion of the Commonwealth was covered by a boreal forest about 30,000 years ago when this particular pool was formed. Today, this tamarack forest is common to the boreal regions of northern Canada.

Pennsylvania's vernal pool communities certainly provide windows into the makeup of the landscape from eons ago, and represent a diverse suite of organisms specially adapted to vernal pool communities, including several plant and animal species of concern. Many vernal pool species have evolved some of the most interesting life histories of any North American animals. More information on the ecology of vernal pool animals can be found in the Ephemeral/fluctuating Natural Pool fact sheet found on page 189.



A springtime view of a vernal pool

photo source: PNHP

^{*} Recognized as a natural community of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program

Disturbance

Overview

Disturbances, whether natural or human-induced, have played a key role in shaping many of the natural communities and the associated species. The frequency and scale of these disturbances have played a large part in the appearance of natural communities today.

Natural disturbances, such as fire and flooding, can actually benefit certain natural communities and species. Periodic fires are needed to maintain pitch pine and scrub oak barren areas in order to sprout new growth of these species and keep out other successional species. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same

time, streams overtop their banks. At the same time, streamside wetlands hold excess water, thus reducing the scale of flooding downstream.

Deer

Another natural disturbance (exacerbated by human mismanagement), overbrowsing by deer, can have detrimental effects on natural communities and species (Rhoads and Klein, 1993). Excessive deer browse can decrease the understory of some forests, and halt regeneration of new growth of the canopy and understory. Deer feeding preferences can have a direct effect on rare plants and severely decrease essential habitat for other animal species including birds, mammals, reptiles, amphibians, and insects. Private landowners can be encouraged to control deer populations by allowing hunting on their lands. More information about deer management and forest health can be found in Latham, R. E. et al., 2005.

Beavers

Disturbances caused by beaver can be either beneficial or detrimental to wetland habitats within the county. On one hand, thinning the canopy and flooding by beavers can eventually create open wetland meadows upon which many unique species rely. On the other hand, damming by beavers can alter habitats to a degree that render the sites no longer suitable for some of the rare species of the county. For example, peatlands support an array of rare plants and

animals, but flooding by beaver can degrade these communities until they no longer support the uniquely adapted species. Beaver activity in the long term is critical to the cyclic pattern of wetland disturbance, but in the short term beaver activity can threaten the integrity of wetland habitats and jeopardize many of the unique species that inhabit these natural communities. This creates difficulty in assessing how beavers should be managed. The long-term benefit of habitat creation must be weighed against the potential short-term threat to the existing plants and animals. In certain situations, beaver removal is preferred and implementation of management practices with regard to beaver must be considered on a case-by-case basis.



This photograph showcases the destruction possible from an overpopulation of deer. While the park-like atmosphere of this forest might appear attractive to some people, there is very limited habitat in this type of forest and it is representative of a very degraded ecosystem. Allowing hunting could eventually allow this forest to recover, but this particular stand may require hands-on management to remove some of the hay-scented fern (*Dennstaedtia punctilobula*) that carpets the forest floor, shading out sprouting trees and shrubs.

photo source: PNHP

Humans

Human and natural disturbances create different habitats in different scenarios, but human disturbances often leave the most lasting effect on the environment. Many human disturbances can be beneficial, especially to species that require an early successional habitat. However, what may be beneficial to a few species is often detrimental to other species. Many rare species have become rare because they cannot

adapt to disturbance of their particular habitat, which is often a specialized niche. Consequently, many species have declined due to human alteration of the landscape. Human disturbances are semi-permanent parts of landscape, but decisions about the type, timing, location, and extent of future disturbances are important to the natural ecological diversity that remains.

From a historical perspective, human disturbance to the natural communities of the county has been occurring for hundreds of years. Because of Pennsylvania's central location in the original colonies and the abundant natural resources present, the state was a hub of human settlement and has subsequently served as a "keystone" in the developing economies of the emerging country. The rich valleys of Snyder County supported the growing human population by providing prime farming conditions. Snyder County farms were centered in the rich valleys of the county. Small farms have more recently declined and many of the old farmsteads have been converted to larger, more intense agricultural lands.

In many cases, human disturbances have directly affected natural communities and animal and plant species in certain areas. In Snyder County, farming and urbanization have created biological "islands" where small natural areas are surrounded by agriculture or development. This isolates gene pools of wildlife and/or plant species, inhibiting the gene flow between populations. In addition, logging and

mining can affect forest age and natural community structure. For example, old-growth forest has virtually disappeared despite the fact that some scattered pockets of old trees remain. Snyder County is extremely lucky in having some of the finest, albeit small, remnants of old-growth in Pennsylvania.

Additionally, many wetlands have been intentionally flooded or drained, resulting in loss of biodiversity at a given site. In fact, in less than 25 years Pennsylvania lost 50% of its natural wetlands through draining and filling. Though some progress has been made in protecting our remaining wetlands, these efforts often rely

on wetland mitigation, where artificial wetlands are created to replace those that are destroyed. From a biological standpoint, mitigated wetlands tend to be poor quality and do not provide the diversity of species and functioning food webs that natural wetlands provide.

As farming remains an important industry in Snyder County, some farm practices and abandoned farmland make conditions favorable for some grassland birds. Birds such as Barn Owl, Eastern Meadowlark, Bobolink, Henslow's Sparrow, and Vesper Sparrow have benefited from human created and managed early successional habitats

Mining, industry, agriculture, residences, road building, and other activities have contributed to the degradation of water quality in many areas of the county. Protecting the quality and purity of surface and groundwater resources from degradation contributes to the future well being of all plants and animals including human communities. The Pennsylvania State-wide Surface Waters Assessment Program can provide information on specific potential sources of water impairment within Snyder County. Much information on the water and geological resources of the county can be found on the PA DEP eMap web page:

(http://www.depweb.state.pa.us/dep/cwp/view.asp?a=3&q=461149&depNav=|).



The recent beaver activity at this site is beginning to flood the hemlock palustrine forest, which houses a population of a rare plant.

photo source: PNHP

Dams

Pennsylvania has thousands of dams on its rivers, creeks and streams. Some of these dams currently serve important purposes, but many of these dams no longer serve their intended uses and have fallen into a state of disrepair. These unnecessary structures can be a liability to their owners, as many run-of-the-river dams* create dangerous hydraulic conditions at their base, making them a threat to river users in the area. Due to this public safety threat, owners of existing run-of-the-river dams and permittees for the construction of new run-of-the-river dams are required to mark the areas above and below the dam to warn river users of the dangerous conditions around the dam structure. This requirement went into effect on January 1, 1999 through an amendment to the Fish and Boat Code known as Act 91 of 1998 (P.L. 702, No. 91). Failure to comply with the responsibilities of Act 91 can lead to a civil penalty between \$500 and \$5,000 annually for each calendar year of noncompliance.

Besides acting as liabilities and maintenance headaches, dams cause numerous environmental impacts including reduced water quality, thermal pollution, disrupted sediment transport processes that increase sedimentation in impounded areas and increase streambed and streambank erosion in downstream areas, altered flow regimes, and habitat destruction and fragmentation. By removing the unused, unnecessary dams from our rivers and streams, we can re-establish natural free-flowing dynamics which support diverse ecosystems, reduce localized flooding and erosion, improve water quality and restore habitat and access to upstream habitat for aquatic organisms. To address the impacts to resources under their management, the PA Fish & Boat Commission has authority (PA Code Chapter 57, Section 22) to request that dam owners install fish passage structures on dams to benefit migratory or resident fish species.

Pennsylvania currently leads the nation in dam removal and Governor Rendell received a National Award of Merit from the Association of State Dam Safety Officials in 2004 for his commitment to dam safety in Pennsylvania. Numerous agencies, non-profit organizations and engineering firms have experience with dam removal in Pennsylvania. For more information on dam safety, dam owner requirements and dam removal, please contact the Department of Environmental Protection Division of Dam Safety, at 717-787-8568 or at http://www.dep.state.pa.us/dep/deputate/watermgt/we/damprogram/main.htm.





In addition to being dangerous to swimmers and boaters, small dams, such as those shown above, can serve as significant barriers to aquatic organisms. Dams block the movement of fishes, which may serve as hosts for freshwater mussels. Consequently, dams can inhibit the colonization of freshwater mussels from other stretches of the waterway. Healthy mussel populations are critical to water quality maintenance and dam removal is typically considered beneficial to freshwater mussels, though dam removal must be considered on a case by case basis.

photo source: Sara Deuling

^{*}At normal flow levels, run-of-the-river dams permit all flow entering the impoundment to pass over the spillway within the banks of the river—see Act 91 of 1998 (P.L. 702, No. 91)

Invasive species

Natural habitats within Snyder County are threatened by the invasion of exotic (non-native) plant and animal species. These invasive species are plants, animals or other organisms that do not naturally occur in the area and are likely to cause harm to the natural environment, the economy or to human health. Because they have no natural enemies to limit their reproduction, they usually spread rampantly. Once established, it is extremely difficult to control their spread. Invasive species are recognized as one of the leading threats to biodiversity and impose enormous costs to agriculture, forestry, fisheries, and other enterprises, as well as to human health (Swearingen et al., 2002).

The introduction of non-native species into Pennsylvania began with the initial European settlement in the 17th century (Thompson 2002) and continues to this day. Plants and animals have been deliberately introduced for a variety of reasons including food sources, erosion control, landscaping, and game for hunting and fishing. Other species have been accidentally introduced as 'stowaways' through increases in global trade and transportation. These introductions have had drastic effects on Pennsylvania's biodiversity over time. For example, over 37% of the plant species now found in the Commonwealth did not occur here during the first period of European settlement (Thompson 2002).

Invasive Plants Species

Invasive plants are ones that reproduce rapidly, spread quickly over the landscape and have few, if any, natural controls such as herbivores and diseases to keep them in check. Invasive plants share a number of characteristics that allow them to spread rapidly and make them difficult to remove or control:

- 1) spreading aggressively by runners or rhizomes
- 2) producing large numbers of seeds that survive to germinate
- 3) dispersing seeds away from the parent plant through various means such as wind, water, wildlife and people

Invasive plants are capable of displacing native plants from natural communities, especially those with rare, vulnerable, or limited populations (Swearingen et al. 2002). This initial impact is worsened by the tendency for native wildlife to prefer native species over invasive species for food. (Swearingen et al. 2002). In some cases, a switch to the invasive plant food supply may affect the physiology of the prey species. For example, many invasive shrubs, including the bush honeysuckles, provide fruits that native birds find attractive, yet these fruits do not provide the nutrition and high-fat content the birds need in their diets (Swearingen et al., 2002).



Garlic mustard (Alliaria petiolata), an invasive herb of forests and woodlands.

photo source: Robert Coxe (PNHP)

Aggressive invasive plants can also transform a diverse small-scale ecosystem, such as a wetland or meadow, into a monoculture of a single species, drastically reducing the overall plant richness of an area and limiting its ecological value (Swearingen et al. 2002). The decrease in plant biodiversity can, in turn, impact the mammals, birds, reptiles, amphibians and insects in an area, as the invasive plants do not provide the same food and cover value as the natural native plant species did (Swearingen et al., 2002).

Control methods for these invasive species can range from hand pulling to mechanical methods (e.g. mowing) to herbicides. A variety of tools have been developed for control of several of these species (e.g. the WeedWrench and the Honeysuckle Popper). Herbicide control should only be performed by individuals with proper training and licensing by the Pennsylvania Department of Agriculture. When working in sensitive habitats such as wetlands, a 'wetlandsafe' herbicide should be used to avoid indirect effects on other organisms. It should be noted that each different invasive species present on a site may require a different technique or suite of techniques for effective control. Generally speaking, control efforts should be concentrated before these species disperse their seed for the year. Specific control methods for these species can be found at: http://www.invasive.org/eastern/

Other invasive plants that pose fewer, but still significant, threats to native flora and fauna have been observed in the county. For example, periwinkle (*Vinca minor*), a widely planted ornamental plant, has been observed spreading along roadsides into natural areas in the county

Table 3 lists some of the significant invasive plant species potentially found in Snyder County:

Table 3. Significant invasive exotic plant species potentially found in Snyder County.

Species	Description and Threat					
tree-of-heaven (Ailanthus altissima)	Introduced to Philadelphia from China in the late 1700s, it is present along roadsides, old fields, and timber cuts throughout the county. This fast growing tree is a prolific seeder and can also proliferate through vegetative means, out-competing native vegetation.					
Norway maple (Acer platanoides)	Widely planted as a yard tree, Norway maple can spread rapidly throughout forests. Often found growing along riparian areas and woodlots in close proximity to landscaped homes, Norway maple aids soil erosion by shading out the native herbaceous layer that is critical for stabilizing the soil.					
Japanese stiltgrass (Microstegium vimineum)	A fast-spreading grass that is typically found along forest roads, streambanks, and other cool in habitats. It out competes native vegetation and may have an effect on animal species that use streamside microhabitats.					
Japanese knotweed (Polygonum cuspidatum) giant knotweed (Polygonum sachalinense)	These large fast-growing exotics displace natural vegetation and greatly alter natural ecosystems. Typically found along stream banks and other low-lying areas, as well as old home sites and waste areas.					
mile-a-minute (Polygonum perfoliatum)	A vine that invades open and disturbed areas and scrambles over native vegetation in open and disturbed areas, limiting their photosynthesis. This species is listed as a noxious weed in Pennsylvania.					
purple loosestrife (Lythrum salicaria)	An herbaceous wetland invasive that is present at scattered sites throughout the county. Once established in a wetland this species is difficult to eradicate and will displace native species.					
garlic mustard (Alliaria petiolata)	An increasingly common invasive biennial herb spreading through natural areas throughout the region. Recent scientific evidence has shown that this species can disrupt micorrhizal relationships that trees depend on for their growth.					
Japanese honeysuckle (Lonicera japonica) Oriental bittersweet (Celastrus orbiculatus)	These species of vines cover and out compete native vegetation as well as girdle trees by twining up them.					
bush honeysuckles (Lonicera tatarica, L. morrowii, L. maackii)	Found in a variety of environments from wetlands to uplands. Competes with native plants for moisture, nutrients, and pollinators. Fruits do not provide high energy food for migrating birds.					
Canada thistle (Cirsium arvense)	A Pennsylvania listed noxious weed. Invades a variety of dry to moist habitats displacing native plants and disrupting community processes.					
spotted knapweed (Centaurea stoebe ssp. micranthos)	Competes with native species by capturing moisture and nutrients. Poses a high threat to shale barrens and other dry habitats.					
autumn olive (Elaeagnus umbellata)	A drought-tolerant species that thrives in many soil conditions. It threatens native ecosystems through competition and alteration of natural succession patterns and nutrient cycling.					
Japanese barberry (Berberis thunbergii)	Commonly planted ornamental that escapes and forms dense stands in a variety of habitats, including forests and wetlands, displacing native vegetation.					
winged burning bush (Euonymus alatus)	A shrub that can form dense thickets that displace native woody and herbaceous plants.					
multiflora rose (Rosa multiflora)	Widely planted shrub that invades a variety of habitats excluding most native shrubs and herbs. May be detrimental to the nest of native birds.					
jetbead (Rhodotypos scandens)	A shrub that forms dense thickets that displace native woody plants and shades out herbaceous groundcover.					
privet (<i>Ligustrum</i> spp.)	These species can form dense thickets in floodplains, forests, wetlands, and fields that can out compete native vegetation.					

Invasive Animal Species

In addition to invasive plants, Pennsylvania is now home to several exotic species of animals including mammals, birds, fish, reptiles, and insects. These species can directly threaten populations of native animals through direct competition or predation. Other invasive exotic animals can alter habitats and ecosystems by changing plant cover or diversity. Some of these invasive animals such as the Norway Rat (*Rattus norvegicus*) and House Mouse (*Mus musculus*) are all too common encounters in built areas.

Arguably, the most significant threat from an invasive animal species to the biodiversity of Snyder County is the Hemlock Woolly Adelgid (Adelges tsugae). This is a small aphid-like insect that feeds on the leaves of eastern hemlock trees (*Tsuga canadensis*). Infestations of the woolly adelgid appear as whitish fluffy clumps of feeding adults and eggs along the underside of the branch tips of the hemlock. Hemlock decline and mortality typically occurs within four to ten years of initial infestation. The adelgid can cause up to 90% mortality in eastern hemlocks. which are important for shading trout streams, and provide habitat for about 90 species of birds and mammals. Several control options are currently being tested. This species was originally found in Japan and China and was introduced accidentally to North America around 1924 (McClure 2001). It is currently distributed from Maine to Georgia and can be found in over 2/3 of the counties in Pennsylvania (PA DCNR 2007).

Chestnut Blight (*Cryphonectria parasitica*), a fungus, was probably introduced to North America from infected nursery stock from China in the 1890s. First detected in New York City in 1904, it has all but wiped out the American chestnut (*Castanea dentata*) from Maine to Alabama. American chestnut once comprised one-fourth to one-half of eastern U.S. forests, and was prized as a food for humans, livestock, and wildlife and for its durable wood. Today, only stump sprouts from killed trees remain and the canopy composition has been filled by the chestnut's associate species, including species of oak and hickory.

The Gypsy Moth (*Lymantria dispar*) has caused extensive defoliation of forests in the northeast. This European moth was intentionally introduced to the U.S. in 1869 as part of a commercial silk production venture. Its main impact is that it defoliates trees, in particular oak species. This defoliation can result in a reduction in the growth rate of trees and eventual death of the tree.

The European Starling (*Sturnus vulgaris*) is an exotic bird species established to North America in the late 1890s as part of a plan to introduce all of the birds mentioned in the works of Shakespeare to Central Park in New York City. It has since spread throughout the US. In addition to competing with native bird species for food and space,

large flocks of this species can destroy fields of crops. The House Sparrow (*Passer domesticus*), introduced to several places in the United States in the late 1800's, has become widely distributed. In addition to causing crop damage, House Sparrows will sometimes kill native adult cavity nesters and their young or destroy their eggs. The House Sparrow is partially responsible for a decline of Eastern Bluebirds (*Sialia sialis*) in the United States.



Hemlock Woolly Adelgid infestation along a hemlock branch. This invasive species is currently causing a severe decline (>90%) of native hemlock stands, an important habitat type in Pennsylvania.

photo source: Connecticut Agricultural Experiment Station Archives

Several invasive animal species are spreading throughout the streams, rivers, and lakes of Pennsylvania, but in many cases the impact of these species remains unknown. The Zebra Mussel (*Dreissena polymorpha*) was accidentally introduced to the Great Lakes in the 1980's and has been spreading in Pennsylvania's waters. Not currently known to Snyder County, this mussel poses a great threat to industry, recreation, and native fish and mussel species and should be controlled wherever it occurs. Another nonnative bivalve, the Asian Clam (Corbicula fluminea), has spread throughout most of Pennsylvania's waterways. Of greatest concern to biodiversity is the capacity of the clam to alter the ecology of an aquatic system, making it less hospitable to the native assemblage of freshwater mussels, fish, invertebrates, and plants. Another aquatic species, the Rusty Crayfish (Orconectes rusticus), has been introduced from its native range in the Midwestern United States to many of Pennsylvania's watersheds. Rusty cravfish can reproduce in large numbers and reduce lake and stream vegetation, depriving native fish and their prey of cover and food. Their size and aggressive nature keeps many fish species from feeding on them. Rusty crayfish may also reduce native cravfish, freshwater mussels, and reptile and amphibian populations by out-competing them for food and habitat or by preying on young individuals.

Table 4 lists some of the significant invasive animal species potentially found in Snyder County:

Table 4. Significant invasive exotic animal species potentially found throughout Snyder County.

Species	Description and Threat
Hemlock Woolly Adelgid (Adelges tsugae)	Often called simply HWA, this species is causing severe damage to Eastern Hemlock (<i>Tsuga canadensis</i>) killing up to 90% of infected trees greatly modifying ecosystems.
Gypsy Moth (<i>Lymantria dispar</i>)	Feeding preferentially on oak trees (<i>Quercus spp.</i>) and their relatives this species will eat almost any plant when forced and can cause severe environmental and economic damage.
Common Pine Shoot Beetle (Tomicus piniperda)	A pest of pine trees (<i>Pinus spp.</i>) this species damages terminal shoots stunting the growth of trees thus weakening them and increasing their susceptibility to other pests.
Sirex Woodwasp (Sirex noctilio)	An up-and-coming pest, this species attacks living pines and is likely to cause great amounts of damage to pine plantations throughout the nation.
Multicolored Asian Ladybird Beetle (Harmonia axyridis)	Preying on native insects and invading our houses each winter, this species was likely introduced in an attempt to control non-native aphids.
Zebra Mussel (Dreissena polymorpha)	Introduced from dumped ballast water, this species is not yet know in Snyder County, but must be monitored for given its disastrous effects on ecosystems and economies.
Asian Clam (Corbicula fluminea)	Found in extremely high densities along major tributaries and rivers, this species is directly competing with native mussels for food and habitat.
Rusty Crayfish (Orconectes rusticus)	Found in many of our streams, this recent invader is displacing native crayfish, reducing fish populations by feeding on young fish, and generally disrupting aquatic systems.
Round and Tubenose Gobies (Neogobius melanostomus and Proterothinus marmoratus)	These predatory fish prefer cobbly bottoms in slow moving water. Introduced from dumped ballast water, they feeding on macroinvertebrates, small clams and mussels, and fish eggs and are a direct competitor with our many small native darters and minnows.
Grass Carp (Ctnopharyngodon idella)	A voracious herbivore, this species was introduced to control weeds in eutrophied lakes. However, it now causes significant damage to native wetland vegetation responsible for reducing nutrients in water-bodies.
Common Carp (Cyprinis carpio)	Introduced as a food fish, this species is now found anywhere with warm, slow-moving water. As a bottom feeder it greatly increase turbidity and mobilize large amounts of sediment.
Snakehead (Channa spp.)	Prized as a food species in Asia, this species was recently introduced to the East Coast and has quickly taken root. Currently not found in Snyder County, it should be monitored for.
House Sparrow (Passer domesticus)	Generally found any place humans are, this species can cause crop damage, but mainly competes with small, native cavity nesting birds.
European Starling (Sturnus vulgaris)	Competing directly with native cavity-nesting birds, this species also cause severe crop damage
Rock Dove (Pigeon) (Columba livia)	Generally found around human structures, this species can cause crop damage, is a known carrier for several serious human diseases, and causes a general mess where it nests and roosts.
Mute Swan (Cygus olor)	While considered pretty by some, this European invader causes significant damage to wetland vegetation that it "grubs" out during feeding. Additionally, it is fiercely competitive and will exclude all other native waterfowl from its nesting territory to the point of killing intruders.
House Mouse (Mus musculus)	Ubiquitous throughout the world, this species carries many diseases, competes directly with many native species, and can cause a significant damage to crops and structures.
Norway Rat (Rattus norvegicus)	Generally a pest of human infrastructure, the Norway Rat is also found around rivers and other water systems. Known as a carrier for many diseases, this species is a threat anywhere it occurs.
House Cat (Felis silvestris)	House Cats, both domestic and feral, can individually kill several small animals each day. Summed among the great number of House Cats out-of-doors this adds up to <i>billions</i> of small amphibians, reptiles, birds, and mammals each year in the United States.

Overall Invasive Recommendations

Although Snyder County has many sites that are free from non-native species, invasive species are an increasing threat to biodiversity harbored within the county. Successful control of invasive plant species is a time, labor, and resource-intensive process. Prevention or control during the early stages of invasion is the best strategy. In areas where invasive plants are well established, multiple control strategies and follow-up treatments may be necessary. Specific treatment depends on the target species' biological characteristics and population size. Invasive plants can be controlled using biological, mechanical, or chemical methods.

The following are presented as ways to deal with invasive species in the region:

- County Natural Heritage Inventory (CNHI) sites identified in this report can serve as useful high conservation value "focus areas" for the control of invasive species.
- Many education resources exist regarding invasive exotic species. Regional groups such as the Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) can help with funding opportunities and educational outreach on invasive species. A membership brochure is available as a pdf file at: http://www.ma-eppc.org.
- Cooperative Weed Management Areas (CWMAs), once largely confined to the western states, are increasingly forming in the east. A CWMA is a partnership of landowners, including federal, state, and local government agencies, individuals and various interested groups that work together to manage noxious weeds and invasive plants in a defined geographic area. An overview of CWMAs can be found online at:
 - http://www.weedcenter.org/weed_mgmt_areas/wma_overview.html.
- Several excellent web sites exist to provide information about invasive exotic species. The following sources provide individual species profiles for the most troublesome invaders, with information such as the species' country of origin, ecological impact, geographic distribution, as well as an evaluation of possible control techniques:
 - The Wild Resource Conservation Program funded The Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) to develop an Invasive Plant Tutorial. This tutorial is designed to help with identification, prioritizing, preventing, and managing invasive plant species through resources already available

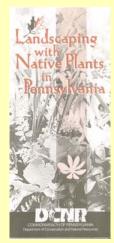
through the internet at: http://intraforestry/invasivetutorial/index.htm

- ➤ The Nature Conservancy's Weeds on the Web at: http://tncweeds.ucdavis.edu/
- The Virginia Natural Heritage Program's invasive plant page at: http://www.der.state.va.us/dnh/invinfo.htm
- ➤ The Missouri Department of Conservation's Missouri Vegetation Management Manual at: http://www.conservation.state.mo.us/nathis/exotic/vegman/
- The following site is a national invasive species information clearinghouse listing numerous other resources on a variety of related topics: http://www.invasivespecies.gov/

It is far more cost effective to prevent invasive species introductions and to control introductions while they are still small, than to control invasive species populations after they have become established. Some nurseries in Pennsylvania now carry a selection of tree, shrub, and herbaceous species that are native to Pennsylvania, and these are recommended where plantings are necessary in, or adjacent to, natural areas. Additionally, these native plants are often hardier than non-native cultivars because they are already adapted to Pennsylvania's climate. The Vascular Flora of Pennsylvania (Rhoads & Klein 1993), The Plants of Pennsylvania: an illustrated manual (Rhoads & Block 2000), and The Trees of Pennsylvania: a complete reference guide (Rhoads & Block 2004) area all helpful references for determining whether a plant species is native to the state

Additional references on invasive plant species and using native plant species in plantings include two PA Department of Conservation and Natural Resources publications:





http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx http://www.dcnr.state.pa.us/forestry/wildplant/native.aspx The variety of landscaping plants available to Pennsylvanians from nurseries and home centers has increased in recent years. Unfortunately, many species sold are non natives, and in some cases, they are considered aggressive invasives that threaten the integrity of natural systems by displacing native plant species. "Seedling Sales" and "Plant Sales" held by numerous organizations frequently include undesirable, or even aggressive invasive species in their catalogs. Organizers of these sales should promote the sale of native plant species, preferably from native seed stock. There are a number of native plant nurseries throughout Pennsylvania that can provide homeowners with many options for attractive, native plant species for use in landscaping applications. A quick web-search for "Pennsylvania Native Plant Nurseries" can connect interested citizens to local native plant distributors.



Norway Spruce (*Picea abies*) is a large coniferous tree that is commonly planted as a shade tree in residential settings, and is used in pine plantation crops for its use as a pulpwood. Unfortunately this species can escape from cultivation and spread throughout natural systems. Native alternatives to Norway Spruce include Red Spruce (*Picea rubens*) or White Pine (*Pinus strobus*). photo source: http://bio.bd.psu.edu/plant_web/



Common Periwinkle (*Vinca minor*) is an attractive flowering plant frequently sold at plant sales for use as a ground cover. Unfortunately, this species is considered an aggressive invasive species, which displaces native herbaceous vegetation.

photo source: Dan Tenaglia, Missouriplants.com, Bugwood.org

After intensive removal of invasive species, restoration of natural habitats through replanting with native species is often needed. Nurseries, landscape architects, and horticultural professionals can assist with native plant restoration. Complete eradication of invasive non-native plants from a site may not be completely achieved, but it is possible to reduce infestations within native plant communities to a level which can be routinely maintained. Control of invasive plants is critical to the long-term protection of Pennsylvania's natural areas and rare species.

Pennsylvania has a Noxious Weed law that prevents the propagation, sale, or transport of several weed species within the Commonwealth. Most of the 13 species that are currently listed are agricultural weeds that rarely threaten natural areas; but purple loosestrife (*Lythrum* salicaria), giant hogweed (Heracleum mantegazzianum), kudzu (Pueraria lobata), mile-aminute (*Polygonum perfoliatum*), Canadian thistle (Cirsium arvense), and multiflora rose (Rosa multiflora) are on the list and these species are known to invade natural areas. The Pennsylvania Fish and Boat Commission maintains a list of aquatic nuisance species that are prohibited from possession, sale, barter, or distribution within the Commonwealth (PA Code 58.71.6). This list includes the zebra mussel and the rusty crayfish among others.

A Selection of Invasive Plant Species known from Snyder County

Among the most aggressive introduced plant species in Pennsylvania are the following top offenders of natural areas. These species are not kept in check by natural predators, and out-compete native species. Once established, they can be very difficult and time consuming to remove. Natural Areas should be monitored regularly for pioneer populations of these species. Small populations, once encountered, should be eradicated to help ensure the continued viability of natural areas. photo sources: PA Department of Agriculture & PNHP



garlic mustard (*Alliaria petiolata*)



multiflora rose (Rosa multiflora)



tree-of-heaven (Ailanthus altissima)

Below: Edge habitat that has been invaded by aggressive species of plants including tree-of-heaven, Japanese honeysuckle, multiflora rose, and Oriental bittersweet becomes a snarled, poor quality forest.



purple loosestrife (Lythrum salicaria)





Japanese knotweed (*Polygonum cuspidatum*)



Japanese honeysuckle (Lonicera japonica)



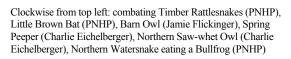


A Review of Snyder County's Animal Biodiversity











MAMMALS AND MAMMALIAN HABITATS OF SNYDER COUNTY

Approximately a fourth of the land area in Snyder County is contained within public lands including 3 State Gamelands and Bald Eagle State Forest. While the mountainous areas of the county are very important to the hunting economy of the county, the mixture of topography has created many types of habitats important to a large number of mammal species, some of which are very rare or even endangered at the state level. The proximity of the county to developed areas such as Sunbury, Selinsgrove, and Harrisburg suggests that future development within the county may affect the persistence of many of these species.

Hunting remains one of the county's more important nonagricultural industries. As mentioned, approximately a quarter of the county is public lands, which provide many areas for deer hunting. Although not as popular a White-Tailed Deer (*Odocoileus virginianus*) hunting destination as the northern tier counties, Snyder County accounts for over 2,500 deer harvested annually. Opportunities for a successful hunt will remain into the future as long as development does not create a landscape that is detrimental to traditional hunting methods. While Black Bear (Ursus americanus) are harvested annually in Snyder County, the numbers remain low ranging from 3 to less than 20 annually even though in several areas nuisance bears have been trapped and translocated to the mountainous areas of the county. These two species will continue to contribute to the economy of Snyder County well into the future. While deer and bear appear to be the more popular game species within the county, other mammal species are also of importance to local economies during the various hunting seasons. These include the Gray and Fox Squirrels (Sciurus carolinensis and S. niger). Eastern Cottontail rabbits (Sylvilagus floridanus) and fur-bearer species such



Woodland Jumping Mouse (Napaeozapus insignis) photo source: PNHP



White-tailed Deer (*Odocoileus virginianus*)
photo source: Charlie Eichelberger

as the Mink (*Mustela vison*) and other weasels. What is less well known is the fact that these same habitats support a diverse and important non-game mammal fauna as well.

Many of the species occurring throughout the county possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout Pennsylvania. These species are termed "generalists" and include the Northern Short-tailed Shrew (*Blarina brevicauda*) and several other shrew and mole species, White-footed Mouse (*Peromyscus leucopus*) and several

other rodent species, as well as Striped Skunks (*Mephitis mephitis*), Virginia Opossums (*Didelphis virginiana*), Coyote (*Canis latrans*) and the ubiquitous Eastern Chipmunk (*Tamias striatus*). All of these species occur throughout the many diverse habitats within Snyder County and are in no jeopardy of disappearing from the landscape.

Other species have fairly restricted habitat needs and are termed "habitat specialists". They may be restricted to grassland- and meadow-type habitats, the forest interior, upper elevation ridgelines, wetlands, and streams or, during part of their life cycle, to specific habitats such as caves and mines. Examples of these species include the Meadow Vole (*Microtus pennsylvanicus*; grasslands and meadows), Allegheny Woodrat (*Neotoma magister*; upper elevation ridges), Muskrat (*Ondatra zibethicus*) and Beaver (*Castor canadensis*; wetlands and streams) and most of the bat species (caves and mines).



Muskrat (Ondatra zibethicus) photo source: Army Corps of Engineers, New Hampshire

Habitat availability is just one of a number of factors that determine whether a species of mammal is going to persist within certain areas. Food resources are an extremely important factor as reproductive females and dispersing individuals require consistent and substantial amounts in order to bear young, nurse, and travel between nesting and foraging areas or to find new nest sites. Species such as the Allegheny Woodrat, have possibly declined due to a lack of food resources as their primary foodstuff of historic times. the American chestnut (Castanea dentata), was lost to the chestnut blight during the early part of the previous century. Forced now to rely on more ephemeral food resources like the mast of oaks and other forest trees and a diverse array of greens, they become energy-stressed when food resources become limited or food caches created during the fall decay in mild and damp winter periods. Competition for these resources with other, more numerous mammal species also reduces the survival chances for these populations, especially when they are isolated from others of their own kind.

Wetlands and streams play a major role in providing habitat for mammals as well as serving as corridors for dispersal throughout the county. Whenever biologists research mammals, one of the first environs investigated are marshes, bogs, and streams, as they are often sites where the number of species of mammals, or diversity, is highest. It is not uncommon to find 6 species of shrews, 9-10 species of rodents including the beaver, 4-5 species of weasels, 7-8 species of bats as well as sign of various medium-sized carnivores, squirrels, bear, and deer along these habitats. One species not reported from Snyder County is the Northern Water Shrew (Sorex palustris albibarbis), a species rarely observed in Pennsylvania. This species was once thought to be extremely rare but recent evidence seems to indicate that it is much more widespread in the northern tier counties of Pennsylvania than previously thought. One of the larger shrew species,

the northern water shrew swims and dives in pools along the smaller tributaries that empty into moderate to larger sized streams. Since its diet consists primarily of macroinvertebrates such as caddisflies, stoneflies, mayflies and other aquatic insect species, it most likely depends on clean, un-degraded streams and wetlands. The shrew thus may serve in the future as an "indicator species," a species that may alert us to arising environmental problems such as abandoned mine drainage or acid rain. Although not currently known to occur within the county, the closeness to sites where this species has been captured in Snyder County leads biologists to believe that it may occur at higher elevations along streams within the Bald Eagle State Forest.

Open land in the form of meadows and reverting grasslands are habitat types commonly found along the valleys of Snyder County. The most well known mammal occurring in these grasslands is the Meadow Vole. The runways formed by this medium-sized rodent can be spotted under dense vegetation during the summer months and under the icy crust forming on snow during the winter months. Meadow Voles are so successful at dispersing throughout the county that they are sometimes found in grassy forest clearings within large tracts of forest having made their way there along the forest roads, pipelines, and power right-of-ways. Several other species of mammal are known to occur within open lands, including the Eastern Cottontail rabbit, Woodchuck (Marmota monax) and Red Fox (Vulpes vulpes). Bats are a common component of the forests of Snyder County, most often encountered during the summer months along the streams and open bodies of water that occur throughout the county. During the summer, rocky ridges may provide roost sites for the Eastern Small-footed Bat (Myotis leibii) as it raises its young. Presently, in Snyder County, the small-footed bat is known to hibernate at a single small cave. The Silver-haired Bat (Lasionycteris noctivagans), a rarely encountered bat species in Pennsylvania, may occur within Snyder County during the early spring or late fall months as it migrates through the



Northern Water Shrew (Sorex palustris albibarbis)
photo source: PNHP



Eastern Small-footed Bat (Myotis leibii) photo source: PNHP

state on its way to and from its summer habitat in the northern portion of the United States and Canada. Hibernating bat species such as the Little Brown Bat (Myotis lucifugus) and Big Brown Bat (Eptesicus fuscus) are common bats found throughout the caves of the county. Several species such as the Hoary Bat (Lasiurus cinereus) and Red Bat (Lasiurus borealis) don't over-winter in the state at all and migrate further south to states like the Carolinas and Florida where they are thought to spend their winter months in hibernation under deep patches of leaf litter.

Historically, several species have either disappeared from Snyder County or their populations had become so low that they were thought to be extirpated from the county. Two of these species, the Fisher (*Martes pennanti*) and the River



Red Bat (Lasiurus borealis)

photo source: PNHP

Otter (*Lontra canadensis*) have been re-introduced by the Pennsylvania Game Commission in portions of their range in Pennsylvania where habitat necessary to their existence still occurs. These populations have expanded into other portions of the state and recently, River Otter have been spotted in the creeks and streams of Snyder County. While not documented in Snyder County yet, Fisher have been spotted in the adjacent counties and they will likely be documented in Snyder County in the near future.

As outlined here, Snyder County is very diverse in terms of the habitats available to the mammal fauna of Pennsylvania. In many portions of the state, most habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix of inhospitable habitat. Large blocks of forested land and vegetated stream and river corridors serve as avenues of dispersal to the diverse list of mammals noted to occur in the county. Development of land, splitting of habitats by uncrossable barriers such as major highways, drainage of



Northern Myotis (Myotis septentrionalis)
photo source: PNHP

wetland areas and environmental degradation have all served to confine many mammal species to very localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction". If enough of these populations disappear from the landscape, these species' existence in Pennsylvania may be in jeopardy. Continued vigilance as well as enlightened management will ensure that this list will not be shortened and may grow in the future providing opportunities to all Pennsylvanians for viewing the state's mammalian wildlife. This, in turn, will enhance the county's wealth as the ecotourism industry begins to flourish in Pennsylvania.

• Important Mammal Areas *

The Important Mammal Areas Project (IMAP) is being carried out by a broad-based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Nominated sites are reviewed by IMAP personnel and local scientists with final site selection managed by the Mammal Technical Committee of the Pennsylvania Biological Survey. The primary concern of the project is to help ensure the future of Pennsylvania's wild mammals, both game and non-game species. Precedence is given to sites with species of special concern but the project is also interested in habitats that have high mammalian diversity or those that offer exceptional educational value.

Snyder County includes portions of three Important Mammal Areas (IMAs): Central Mountains; Blacklog Mountain; and Central Susquehanna Valley (Figure 3). Features described below pertain to the entire IMA and are not necessarily confined to the county.

- Central Mountains IMA

This site includes a large area in central Pennsylvania, including a series of ridges between Nittany Mountain to the north and part of Shade Mountain to the south. Habitats vary from mature forests to old fields, and include seeps and wetlands of various types. Sections contain large expanses of unfragmented forest habitat, as well as virgin old-growth (white pine, eastern hemlock, pitch pine). Located within the area are seven caves of great significance to mammals and groundwater.

The area encompassed by this IMA is under continual assault from development in the valleys, as well as from road construction through higher elevations (e.g. I-99 corridor). Portions of the area are State Forest Lands (Bald Eagle, Tuscarora, and Rothrock). Of the cave sites, some are protected, while others are commercially exploited.

- Blacklog Mountain IMA

This large IMA extends over five counties in central Pennsylvania, with approximately 65% located in SGL 81 and SGL 107. It is bisected by SR 522 at Shade Gap. Dominated by deciduous forest, it includes coniferous and mixed woodlands, as well as some grasslands. Although this large site is home to an array of mammal species, its designation is due to the recognition that it

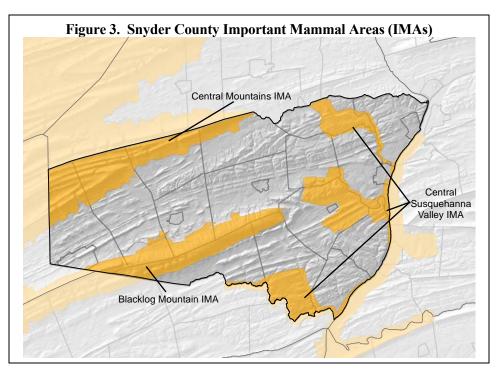
represents a stronghold for Allegheny Woodrats. Populations at Blue Springs Cave and Lewistown Narrows have been monitored since 1986 and 1987, respectively.

The multiplicity of public and private owners suggests that this long ridge is protected to some degree, but is likely to be under continual threat from development based in the surrounding valleys.

- Central Susquehanna Valley IMA

The Central Susquehanna Valley IMA extends over six counties between Sunbury and Duncannon along the Susquehanna River and its major tributaries. It includes three important focal areas: Whites Island, Hoover island bat condo, and Haldeman Island (SGL 290). Dominated by deciduous forests, streams, and the open waters of the Susquehanna, it has a variety of other habitats ranging from grasslands to swamps and marshes. It includes SGLs 194, 212, 233, 254, 258, 281, and 290. This area includes a diverse community of mammals, including those of both aquatic and terrestrial habitats. Northern River Otters inhabit the river and its tributaries, and there is a barn located in the floodplain at Mahantango Creek that houses approximately 30,000 bats (Little Brown Myotis, Big Brown Bat). The barn site should be acquired for protection and is a potential site for "watchable wildlife" interpretive displays.

Major threats to habitat include commercial and residential development, and exotic plant species. Management plans are in place for SGLs within this IMA.



^{*} This information is adapted from the Important Mammal Areas Assessment Reports, 2005.

BIRDS OF SNYDER COUNTY

The large-scale forested blocks of Pennsylvania make it a critical component to the continued success of many eastern deciduous forest birds (Gross 1999). Pennsylvania is home to a high percentage of the nesting population of Scarlet Tanager and Wood Thrush, among others. Dense populations of these birds are found even within forests defoliated by the gypsy moth (Gross 1999). Many of the forest interior birds found in the county are area-sensitive, requiring large forest tracts for successful breeding (Gross 1999).



Scarlet Tanager (*Pairanga olivacea*) photo source: Ron Austing

The ridge lines of the Ridge and Valley province in Pennsylvania offer relatively continuous forest habitat along the central Appalachian Mountains. This creates a connective corridor from north to south that provides a migration pathway for birds and mammals. Data collected on bird migrations through the years have highlighted the Appalachian ridgelines as particularly important to bird migration (Goodrich 1999).

Snyder County has much undeveloped land, forest interior, and a myriad of wetland communities that provide some of the finest bird habitats in Pennsylvania. The forests of the county provide outstanding habitat for bird species that rely on large unfragmented forested tracts, including the Northern Goshawk, Barred Owl, and Scarlet Tanager. Pennsylvania's bird diversity is a critical component of the integrity and character of Penn's Woods and Snyder County accounts for a high proportion of the state's forests. Birds provide numerous benefits to humans including insect and pest control, plant seed

dispersal, tremendous aesthetic value, and in some cases hunting opportunities. Bird watching is a major source of revenue for Snyder County and Pennsylvania birders spend hundreds of millions of dollars in bird watching activities and equipment purchases every year (PFBC & PGC 2005)!

Since European colonization, our diversity of bird life has been dramatically altered. Gone from the state are the Carolina Parakeet, the Heath Hen, and the Passenger Pigeon, a species which once stood as North America's most common bird. With the intense forestry practices of the 1800's, birds that relied on large forested tracts declined precipitously. During the past century, much of Pennsylvania's cleared forests have regenerated, restoring much of the lost habitat for forest birds that had been eliminated in years prior. Marsh birds have also been in decline across the U.S. from the draining and modification of natural marshlands. The intense mechanization of agriculture that has occurred over the past 40 years has been the main culprit in the decline of the grassland-dependent bird species.

Pennsylvania is an important state for breeding, migrating, and wintering birds (Brauning 1992). Snyder County, with its varied landscape, presents a wide range of habitats for birds. The habitat types include large, contiguous forest blocks, marsh and wetland areas, riparian corridors and floodplains, and the pastoral landscape. Several important habitat types for bird conservation are negatively affected by increasingly rapid land use change. Protection and responsible management of these ecosystems is necessary for the maintenance of healthy bird populations.

The Ridge and Valley province of Pennsylvania, in which Snyder County resides, is a significant ornithological region as a result of the distinctive geology and topography. The forested ridges of the Allegheny Front rise 2,700 feet (823m) above sea level, providing habitat for northern bird species, while the ridges drop into riverine valleys that southern species frequent. This region, part of the Appalachian Flyway, is also an important area for migrating birds (Brauning 1992). On fall days observers often count thousands of migrating birds passing overhead. Protected natural areas such as the Snyder Middleswarth and Tall Timbers Natural Areas, state and national parks, forests, and nature preserves provide habitat for all wildlife including birds.

Forest Interior Species

Large contiguous tracts of forests, necessary for forest interior species, are declining in most regions. Forest interior, or core forest, is defined as contiguous forest that is 300 feet (91m) or greater from a road or edge (Whitcomb et al. 1981). This critical habitat is declining, with seventy percent of Pennsylvania's core forest land found in patches of 5,000 acres or less; this indicates a highly fragmented landscape. As an example, a square, unbroken 40-acre patch of forest contains only 12 acres of forest interior while a similar 640-acre patch contains 503 acres of interior. Fragmentation and smaller interior area negatively affect the nesting success of these bird species (Whitcomb et al. 1981). Increased forest edges, created by forest management practices such as logging and utility development, exposes nesting birds to greater dangers such as brood parasitism and nest predation (Robinson 1994). Forest interior birds nesting near edges are more often parasitized by Brown-headed Cowbirds (Molothrus ater), which lay their eggs in other bird nests where they are raised at the owner's expense.



Hooded Warbler (Wilsonia citrina)

photo source: Ron Austing

The ridgetop forests of the Ridge and Valley province retain the greatest amount of core forests in Snyder County. Forest interiors have high bird diversity. These communities include a variety of warblers, tanagers, vireos, owls, woodpeckers, and hawks. Additionally, there is a high concentration of high-priority species in the Northern Ridge and Valley region, as identified by the multi-agency avian conservation program, Partners In Flight (PIF). In addition to conservation efforts for rare species, maintaining viable populations of common birds is increasingly important as formerly common forest interior species have shown a persistent population decline over time (Sauer et al. 2000).



Cerulean Warbler (Dendroica caerulea)

photo source: Ron Austing

Common Fo	orest Interior Bird Species
Broad-winged Hawk	Buteo platypteru

Black-throated Green Warbler Dendroica virens Pileated Woodpecker Dryocopus pileatus Acadian Flycatcher Empidonax virescens Black and White Warbler Mniotilta varia Scarlet Tanager Piranga olivacea Hairy Woodpecker Picoides villosus Ovenbird Seiurus aurocapillus Barred Owl Strix varia

Partners In Flight (PIF) Priority Forest Interior Birds

Olive-sided Flycatcher Contopus cooperi Cerulean Warbler Dendroica caerulea Worm-eating Warbler Helmitheros vermivorus Wood Thrush Hylocichla mustelina Kentucky Warbler Oporornis formosus Louisiana Waterthrush Seiurus motacilla Golden-winged Warbler Vermivora chrysoptera Canada Warbler Wilsonia canadensis

Pennsylvania State Listed Forest Interior Specialist Birds

Protonotaria citrea

Northern Goshawk Accipiter gentilis
Long-eared Owl Asio otus
Swainson's Thrush Catharus ustulatus
Yellow-bellied Flycatcher Empidonax flavescens

Prothonotary Warbler

To sustain viable populations, the forest structure must remain intact. The structural diversity of the forest, such as natural openings (not caused by tree removal or management) and complex vertical layering of trees provides more types of feeding, perching, and nesting habitats. Maintaining structural diversity is accomplished by maximizing the size of contiguous forest tracts, keeping larger forest patches closely grouped, harvesting around forest edges, and establishing corridors between contiguous blocks (Pashley et al. 2000).

Marsh, Wetland, and Riparian-Dependent Birds

Wetlands and riparian zones are an imperiled habitat across the state (Myers et al. 2000). From 1956-1979, 38% of Pennsylvania's wetlands with emergent vegetation were drained, filled, or succumbed to succession (Tiner 1990). Of the 1,900 species of breeding birds in North America, 138 require wetlands.



Least Bittern (Ixobrychus exilis)

photo source: Ron Austing

Wetlands are transitional lands between terrestrial and aquatic systems and have high species diversity and exceptional environmental value. Saturation by water determines the soil development, which in turn influences the type of plants and animals using that habitat. Wetlands range in size from very small vernal pools to massive complexes; the associated plants and animals are just as varied. Common wetland bird

species include waterfowl, shorebirds, herons, rails, bitterns, swallows, and sparrows. Many wetland-dependent birds are of special concern for the Pennsylvania Natural Heritage Program (PNHP). These birds can be secretive, cryptic, and hard to flush, making marshes difficult areas to survey. Some of these species are also very habitat specific and unknown from other habitats.

Wetlands and riparian zones also provide breeding and foraging habitat for various raptors and wading birds. Raptors, such as the Osprey and Bald Eagle, prefer nesting on top of tall trees with a good view of the surrounding land. The Broad-winged Hawk forages and nests almost exclusively in wooded

Common Wetland Dependent Birds in Snyder County

Great Blue Heron Ardea herodias
Red-winged Blackbird Agelaius phoeniceus
Swamp Sparrow Melospiza georgiana
Song Sparrow Melospiza melodia
Great Egret Ardea alba
Red-shouldered Hawk Buteo lineatus

PNHP bird species of special concern found in wetlands

Osprey Pandion haliaetus American Bittern Botaurus lentiginosus Least Bittern Ixobrychus exilis Sedge Wren Cistothorus platensis Marsh Wren Cistothorus palustris) Virginia Rail Rallus limicola King Rail Rallus elegans Sora Porzana carolina Common Moorhen Gallinula chloropus American Coot Fulica americana Bald Eagle Haliaeetus leucocephalus

wetlands and streams, a feature common in Snyder County. Wading birds, such as Great Blue Herons and Great Egrets, prefer clumps of dead, water-surrounded trees for their rookeries. Both of these species often occur around rivers and wetlands.

Conservation and management programs for marsh birds are critical to sustain healthy populations of breeding birds as well as general ecosystem viability. Immediate needs include the preservation of emergent wetlands that provide nesting, feeding, and wintering habitats. Primary management needs include the protection of wetlands from draining and filling, pollution, siltation, and invasion by exotic plant species.



Sora (Porzana carolina)

photo source: Ron Austing

Grassland Birds

Grasslands, open fields, and old farm fields create a unique habitat for a variety of bird species of special concern. Historically, grasslands were not a dominant part of the northeastern United States landscape, but were present and extensive in some areas.



Eastern Meadowlark (Sturnella magna)

photo source: Ron Austing

Historically, Snyder County would have had several grasslands present on certain ridge and hilltops along with many wet meadow grasslands. Although more grassland has been created in this historically forested area, a large number of grassland birds appear to be declining throughout the East as documented in the American Breeding Bird Survey (BBS). Most grassland birds, including common species, show a decline of around 40 to 60 percent (Sauer et al. 2000). Their decline has resulted from changes in agricultural practices, habitat fragmentation, pesticide application, natural fire suppression, and human development. Grassland birds are often found in the rich valleys of Snyder County with their mix of agricultural fields, pastures, and old fields.

Grassland Bird Species					
swallows	Family: Hirundinidae				
Grasshopper Sparrow	Ammodramus savannarum				
Short-eared Owl	Asio flammeus				
Upland Sandpiper	Bartramia longicauda				
Killdeer	Charadrius vociferous				
Northern Harrier	Circus cyanus				
American Kestrel	Falco sparverius				
Loggerhead Shrike	Lanius ludovicianus				
Savannah Sparrow	Passerculus sandwichensis				
Dickcissel	Spiza americana				
Eastern Meadowlark	Sturnella magna				

A species of special concern found in Snyder County's pastoral areas is the Barn Owl (*Tyto alba*). Historically nesting in large tree cavities and small caves, the Barn Own now nests almost exclusively in man-made structures such as old barns and silos. Hunting at night over open fields and wet meadows, the Barn Owl is rarely seen except by the lucky individuals who house them on their land. Specific threats to the Barn Owl include the development and conversion of open fields to row crops, demolition of old farm structures, and vehicular collisions during nocturnal hunting (Marti et al. 2005).

Grassland maintenance is difficult due to the natural succession of forests, the timing of agricultural practices, and conflicting views of land managers. Programs like the Conservation Reserve Enhancement Program (CREP) through the U.S. Department of Agriculture provide incentive to farmers to restore habitats to healthy conditions. Additional practices, such as restricting mowing fields until late July, can allow most young birds to fledge. For more information about incentive programs for grassland management, contact the Snyder County Farm Service Agency in Middleburg.



Barn Owl (Tyto alba)

photo source: Jamie Flickinger



Barred Owl (Strix varia)

photo source: Ron Austing

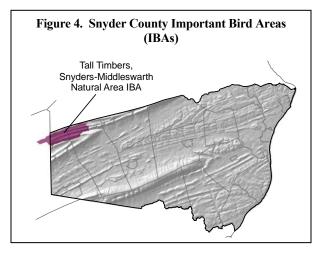
Important Bird Areas*

In an effort to conserve the Commonwealth's avifauna, the Pennsylvania chapter of the National Audubon Society, along with the Pennsylvania Ornithological Technical Committee of the Pennsylvania Biological Survey, has identified 81 areas within the state that they consider to be a part of a global network of places recognized for their outstanding value to bird conservation. Termed Important Bird Areas, or IBAs, one of these areas, Tall Timbers, Snyder Middleswarth Natural Areas occurs within Snyder County (Figure 4). Snyder County's IBA highlights what is considered to be the County's critical bird habitat for both common and rare forest interior birds. More information about the Important Bird Area Program can be found at Audubon PA's website (http://pa.audubon.org/).

Tall Timbers, Snyder Middleswarth Natural Areas (IBA #38)

This IBA consists of a rugged valley drained by Swift Run, with Snyder-Middleswarth Natural Area and Tall Timbers State Forest Natural Area extending about 5 miles up the drainage. The deep valley is about 0.5 to 0.75 miles wide and continuously forested. Snyder-Middleswarth is a virgin old-growth forest dominated by White Pine and Eastern

Hemlock, with Pitch Pine. Tall Timbers is a mixed forest of second-growth oak, White Pine, Eastern Hemlock, and other pines. This area is within a large contiguous block of the Bald Eagle State Forest.



Prothonotary Warbler

A large diversity of species depend on this IBA as a stopover during spring migration, with a total of 176 species recorded since 1959.

Major threats to this area are forest insect pests, notably the Hemlock Woolly



Magnolia warbler (*Dendroica magnolia*)
photo source: Ron Austing

Adelgid, which is threatening to kill a large proportion of the hemlocks on the site. This area is currently protected as a State

Forest Natural Area. Management of this area will allow it to continue natural succession.

Protonotaria citrea

A selection of birds recorded from Tall Timbers, Snyder-Middleswarth Natural Areas IBA since 1959 Connecticut Warbler Oporornis agilis American Redstart Setophaga ruticilla Mourning Warbler Oporornis philadelphia Worm-eating Warbler Helmitheros vermivorus Cerulean Warbler Dendroica cerulea Golden-winged Warbler Vermivora chrysoptera Yellow-breasted Chat Icteria virens Nashville Warbler Vermivora ruficapilla Hooded Warbler Louisiana Waterthrush Seiurus motacilla Wilsonia citrina Wilson's Warbler Wilsonia pusilla Winter Wren Troglodytes troglodytes Canada Warbler Wilsonia canadensis Brown Creeper Certhia familiaris Magnolia Warbler Chimney Swift Dendroica magnolia Chaetura pelagica Black-and-White Warbler Barred Owl Strix varia Mniotilta varia

^{*} This information is adapted from the Important Bird Areas site conservation plans, 2005.

REPTILES AND AMPHIBIANS OF SNYDER COUNTY

Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptile and amphibian species. Pennsylvania's reptile and amphibian makeup, known as the herpetofauna, is quite unique. The ranges of most Pennsylvania reptiles and amphibians are restricted to certain regions of the state, a testament to the varied topography and physiographic provinces within the region. Today, the Commonwealth is home to 72 native herptile species, including those common in the glaciated regions of the Canadian Shield, many of the southern species from the lower regions of the Appalachians, several associated with western prairies, and a few connected with the coastal plain.



Common Snapping Turtle (Chelydra serpentina) photo source: Charlie Eichelberger

Snyder County is home to many common, generalist species, such as the Eastern Garter Snake (*Thamnophis sirtalis*), the Red-spotted Newt (*Notophthalmus viridescens*), the Bull and Green Frogs (*Rana catesbeiana, R. clamitans*), and the Painted and Snapping Turtles (*Chrysemys picta, Chelydra serpentina*). These species occur in many different habitats, exist throughout the entire state, and are the most commonly encountered reptiles and amphibians in the Commonwealth. Along with these common reptiles and amphibians, Snyder County includes several less common herptiles. Many of these species have restricted ranges or are considered specialists, meaning their life histories have more specific habitat requirements.

Much of Pennsylvania has succumbed to a large amount of habitat degradation, destruction, and fragmentation due to land development. However, a number of large forested tracts remain in Snyder County, providing a good amount of contiguous habitat for the reptiles and amphibians of the state. The array of habitats within these large forested blocks serves both the generalist and specialist species.

Terrestrial woodland salamanders depend on canopied forests with adequate amounts of leaf litter. These salamanders are voracious predators of the forest floor. Their role in limiting the numbers of leaf decomposing invertebrates has been shown to be significant in maintaining a rich layer of organic matter on the forest floor. The Red-backed, Slimy, and Valley and Ridge Salamanders (*Plethodon cinereus*, *P. glutinosus*, *and P. hoffmani*) are the most common woodland species throughout Snyder County's forests.

The numerous woodland waterways and small mountain streams of Snyder County provide habitat for the brook salamanders, including the Northern and Mountain Dusky Salamanders (*Desmognathus fuscus*, *D. ochrophaeus*), the Northern Two-lined and Long-tailed Salamanders (*Eurycea bislineata*, *E. longicauda*) and the Northern Spring Salamander (*Gyrinophilus porphyriticus*). In the cold-water waterways of the county, the brilliant Northern Red Salamander (*Pseudotriton ruber*) can be found under the litter and rocks in seeps and springheads. All of the streamside salamanders require high water quality and forested stream edges.



Northern Green Frog (Rana clamitans)
photo source: Charlie Eichelberger

The largest salamander on the continent, the Hellbender (*Cryptobranchus alleganiensis*), may still be found in the moderately sized creeks where suitable habitat exists. Able to reach over two feet (0.6m) in length, this bizarrelooking harmless salamander is rarely seen, as it spends

the majority of the time under large flat rocks in swift moving, high quality waters. Hellbender populations have been declining very rapidly due to decreases in water quality and introductions of aggressive nonnative crayfish. Amphibians as a whole are particularly sensitive to toxins. Consequently, abandoned mine drainage is detrimental to the salamanders that inhabit affected streams. While there have been no directed Hellbender surveys in Snyder County in recent years, reports of their continued presence in the lower Susquehanna drainage are few.

Portions of the county support complexes of Ephemeral/fluctuating Natural Pools, more commonly known as vernal pools. These wetlands are critical to a group of amphibians that rely on the wet/dry annual cycle that eliminates the possibility of fish populations being established. The Wood Frog (*Rana sylvatica*), and the Jefferson, Marbled and Spotted Salamanders (*Ambystoma jeffersonianum*, *A. opacum*, and *A. maculatum*), all of which are vernal pool obligates, are known from Snyder County. These species cannot reproduce without the presence of vernal pools. Therefore, the health of these species' populations relies upon the integrity of vernal pools in the county.



Jefferson Salamander (Ambystoma jeffersonianum) migrating over snow to a vernal pool photo source: Charlie Eichelberger

The Four-toed Salamander (*Hemidactylium scutatum*) is not a vernal pool obligate but is often found in association with these habitats. This diminutive salamander lays its eggs in peat mosses (*Sphagnum* spp.) and can be found in the margins of seeps, springs, and streamsides where Sphagnum moss is found above cool, clear water. The Four-toed Salamander tends its clutch, which is laid in vertical mats of Sphagnum, until the young hatch. In addition to the Four-toed Salamander, many frogs and toads that are not vernal pool obligates can also be found using these habitats. The American Toad (*Bufo americanus*), Spring Peeper (*Pseudacris crucifer*), Grey Tree Frog (*Hyla*)



Hellbender (*Cryptobranchus alleganiensis*)
photo source: Tim Maret

versicolor), Northern Cricket Frog (*Acris crepitans*), and Spotted Turtle (*Clemmys guttata*) are regular visitors to vernal pools and may use these wetlands to breed and forage. Though the Northern Cricket Frog was once widespread across Pennsylvania, numbers have dropped off rapidly, and there are currently only two sites in the state where cricket frogs are still known to breed. Spotted Turtles are also becoming increasingly rare in the state because of habitat loss, predation, and illegal collection.

The Fowler's Toad (*Bufo fowleri*) is generally less common than the related American Toad, with the former typically inhabiting areas of sandy soils and the latter being far more general in its habitat requirements. The Upland Chorus Frog (*Pseudacris feriarum*) can be found using herbaceous marshes, riparian backwaters, and ephemeral wetlands where there is plenty of cover among the grasses and sedges. This species has declined precipitously in the past few decades for unknown reasons. Likewise, the Pickerel Frog (*Rana palustris*) and Northern Leopard Frog (*Rana pipiens*) require heavily vegetated streams and creeks. Once one of North



Four-toed Salamander (*Hemidactylium scutatum*) tending her clutch of eggs

photo source: Charlie Eichelberger



Eastern Box Turtle (*Terrapene carolina*) photo source: Charlie Eichelberger

America's most common species of frog, the Northern Leopard Frog has rapidly disappeared from much of its range for mysterious reasons. Many herpetologists are now concerned with the future of this species.

The Stinkpot Turtle (Sternotherus odoratus) inhabits most moderate-to-large wetlands, though it is infrequently encountered because of its secretive nature. The Map Turtle (Graptemys geographica) is a common occurrence in the larger tributaries of the Susquehanna River. The semi-aquatic Wood Turtle (Glyptemys insculpta) relies on wooded creeks and rivers, and can be locally common in areas. Riverine turtle nests are generally laid in suitable substrates along waterways. These sites are frequently used by many nesting females and are easily targeted by overpopulations of raccoons, skunks, and opossums. The Eastern Box Turtle (Terrapene carolina) is an easily recognized, generalist species found throughout the county. While this species is still considered common, with a lifespan that may reach beyond a century, many biologists believe that Box Turtle populations have been in a steady decline due to road mortality and predation on nests and juveniles. There is growing concern for many of Pennsylvania's turtles, because numerous populations are nearly void of juvenile turtles, indicating that there is little successful reproduction occurring.

The Northern Fence Lizard (*Sceloporus undulatus*), and the Five-lined Skink (*Eumeces fasciatus*) are the only lizard species known from Snyder County. Both of these species occur in relatively small, isolated populations in dry habitats with an abundance of cover objects and basking areas. These habitats often include many sun-exposed rocks and dead woody debris. These species are particularly susceptible to localized

extinction because of their populations' small sizes and isolation from other lizard populations.

The Northern Black Racer (Coluber constrictor) and the Black Rat Snake (Elaphe allegheniensis), two fairly common species in the state, can be found in many different habitats across the county. These two species prey upon small mammals including mice and squirrels. The brilliantly patterned Milk Snake (Lampropeltis triangulatum) can be found in a variety of habitats and though it is common, this species is rather secretive and is rarely seen. A more frequently observed snake, Northern Water Snake (*Nerodia sipedon*) is a widespread resident of Snyder County. This species hunts along open waterways, searching for amphibians and small fish. The Eastern Hognose Snake (Heterodon platirhinos) is known from a few locales in the county. This harmless, toadeating snake is known to flare its neck into a hood, and strike at predators while hissing loudly. If the performance doesn't work, this snake will feign death and roll on its back while becoming limp and gaping its mouth.



Black Rat Snake (*Elaphe allegheniensis*)
photo source: Charlie Eichelberger

The Smooth Green Snake (*Liochlorophis vernalis*) is likely common in grassy areas but is difficult to locate because its camouflage allows it to virtually disappear into vegetation. Though this snake is rarely seen, the species is thought to be secure in the state. The Eastern Ribbon Snake (*Thamnophis sauritus*) depends on the sedge and grass covered edges of wetlands. This species is thought to be declining due to wetland destruction. Several small and secretive snake species in the county include the Red-bellied Snake (*Storeria occipitomaculata*), the Northern Brown Snake (*Storeria dekayi*), the Ring-necked Snake (*Diadophis punctatus*), and the Eastern Worm Snake (*Carphophis amoenus*). With the exception of the Worm Snake, these species are fairly common residents and can be found beneath rocks

and decaying wood and bark. Worm Snakes are exclusively fossorial, meaning they spend their lives underground. Consequently, little is known about the Worm Snake in Pennsylvania.

The Timber Rattlesnake (Crotalus horridus) and Northern Copperhead (Agkistrodon contortrix) have long been persecuted due to their venomous nature. Although these snakes may deliver a serious bite if threatened, the danger they pose has been dramatically over-exaggerated. In fact, there has never been a documented human fatality in Pennsylvania from a Rattlesnake or Copperhead bite. The forested ridges of Snyder County provide wonderful habitat for these species and there are records of both of these species in the county. Rattlesnakes and Copperheads are able to use a wide range of habitats and may be encountered throughout the forested regions of the county. Rattlesnakes primarily occur on rocky slopes where they can find refuge in spaces between the boulders as well as thermoregulate in the sunny openings. Copperheads can be found from mountaintops to valley floors in dry settings as well as wetland edges. Both species forage in a variety of habitats, but favor forested areas with healthy small mammal populations. Hibernacula, or dens, often are found under canopy cover but are usually located within several hundred, or more, feet of an open basking site. Persistence of these sites relies on forestry practices that maintain a diversity of open areas adjacent to forested foraging habitat.



black and yellow color phases of the Timber Rattlesnake (Crotalus horridus)

photo source: Charlie Eichelberger

Timber Rattlesnakes are still considered a game species by the Pennsylvania Fish and Boat Commission and can be collected with an appropriate PFBC permit. Despite the allowance of rattlesnake hunting, the Timber Rattlesnake is considered a species of special concern because it is declining from human persecution. The American Society of Ichthyologists and Herpetologists (2006) has stated that rattlesnake roundups and hunts cannot co-exist with rattlesnake conservation and should be ended if we are to maintain Timber Rattlesnake populations in the Commonwealth Timber Rattlesnakes are a protected species in every surrounding state where the snake occurs and are considered during environmental review in Pennsylvania. The wooded habitats along the ridges of Snyder County provide a tempting location for housing development; however, housing locations at these sites are not recommended based on the risk of human-snake encounters.

Snyder County is a significant spot in the state for the Commonwealth's reptiles and amphibians. The large, unfragmented forested tracts with numerous waterways provide critical habitat for the reptiles and amphibians. Of utmost importance to the conservation of the county's herpetofauna is the protection of the region's forests and wetlands, including the communities of vernal pools. The rich and diverse herpetofauna of Snyder County is unique to Pennsylvania and should be considered in the long-term plan of the region.

This summary is based on review of the range maps for Pennsylvania herptile species and examining records found in museums, databases, and various monographs. While this information has been based on decades of scientific research and inventories, the secretive nature of herptiles make them difficult to survey. Therefore, there could be other herptile species that occur in the county that have not yet been recorded.

Pennsylvania Fish and Boat Commission Regulations

In Pennsylvania, the Fish and Boat Commission has jurisdiction over the reptiles and amphibians. Recently, regulations concerning the herptiles were reviewed and there have been considerable changes in how this group is managed. The regulations now include a list of "no-take" species that are thought to be declining. More information on the amphibian and reptile regulations can be found on the Fish and Boat Commission's website at:

http://sites.state.pa.us/PA Exec/Fish Boat/regs nongame.htm.

Pennsylvania Herpetological Atlas

The Pennsylvania Herpetological Atlas, begun in 1997, serves to fill some of the gaps in our knowledge of herptile distributions in the state. The atlas is a volunteer based project and citizens are encouraged to submit records for species of conservation concern to the atlas. Submissions may be made online at:

http://webspace.ship.edu/tjmare/herp.htm .

DRAGONFLIES AND DAMSELFLIES: THE ODONATES

Damselflies and dragonflies are grouped together in the scientific order Odonata (or informally, the odonates). Odonata comes from the Greek word 'odon,' which means 'tooth'. Both adult and larval (immature) odonates possess mouthparts armed with serrated, tooth-like edges and grasping hooks that help them catch and eat their prey.

LIFE HISTORY AND HABITATS

Adult odonates lay their eggs (oviposit) in or near water. There are two common methods of oviposition. Some species lay their eggs inside the stems or leaves of living or dead plant material. Other species lay their eggs in the water, singly or in a mass. Odonate eggs develop at different rates depending on the species, but in general development quickens as temperature increases (Brooks 2003). In temperate regions like Pennsylvania, eggs develop over a period of several weeks to several months.

As larvae, odonates are found in a wide variety of aquatic habitats, such as seeps, vernal pools, streams, rivers, ponds, lakes, and other wetlands. Within each habitat, larvae seek out favorable microhabitats with the right combination of water flow, vegetation, substrate texture, etc. They feed on the other insect larvae that share their aquatic habitat, such as mosquitoes, midges, gnats, and other flies. During larval development, odonates undergo 5-15 molts over a period of a few months for some species and up to several years for others (Westfall and May 1996). The number of molts depends upon the species and also on environmental conditions.

When a larva is fully developed, it undergoes metamorphosis inside its larval skin. Then it crawls out of the water for its final molt. This movement of the larva out of the aquatic habitat to shed its larval skin is called



A damselfly, the Lilypad Forktail (Ischnura kellicotti)
photo source: PNHP



A dragonfly, the Calico Pennant (*Celithemis elisa*) photo source: PNHP

emergence. Once properly positioned, the larval skin is shed one last time and a winged adult emerges.

Odonates emerge from the water, transforming from camouflaged stalkers into jeweled fighter planes. Adult odonates continue to feed on the community of insects with whom they shared an underwater life. They also add to their diet additional insects they encounter for the first time as adults, such as butterflies.

Adult odonates are closely associated with the larval habitat during mating and subsequent oviposition when the eggs are laid in suitable habitat. However, it is important to recognize the additional habitat requirements of the adults. For example, some species have specific perching preferences, and will not use a habitat that lacks proper perches, even when suitable larval habitat is present (Westfall and May 1996). Feeding areas are also very important for odonates. After the process of metamorphosis and emergence, a fresh adult has very little energy in reserve and must begin feeding as soon as possible. Young adult females in particular avoid breeding areas for a period of time while they build up mass, mostly in growth of their ovaries. Males and females can frequently be found feeding far away from breeding habitat, along roadsides, in wooded glades, in open meadows, and other upland and aquatic habitats. Some males and females disperse long distances from their natal aquatic habitat to find new breeding areas, an important process that strengthens populations by diversifying the gene pool.

SPECIES DIVERSITY IN PENNSYLVANIA In North America, there are an estimated 350 species of dragonflies (Needham et. al. 2000) and 161 species of damselflies (Westfall and May 1996). In Pennsylvania, we currently have 121 species of dragonflies and 55 species of damselflies (PNHP, 2006).

Families of Damselflies in Pennsylvania:

Calopterygidae – Broad-winged Damselflies Coenagrionidae – Pond Damsels Lestidae - Spreadwings

Families of Dragonflies in Pennsylvania:

Aeshnidae - Darners

Cordulegastridae - Spiketails Corduliidae - Emeralds

Gomphidae - Clubtails

Libellulidae - Skimmers

Macromiidae - Cruisers

Petaluridae - Petaltails



photo source: Sally Ray



the Mottled Darner (Aeshna clepsydra)

photo source: Rick Koval An adult dragonfly, newly emerged from its nymphal exoskeleton

photo source: PNHP



photo source: Rick Koval

BUTTERFLIES AND MOTHS: THE LEPIDOPTERA

Butterflies and moths are grouped together in the scientific order called Lepidoptera. Lepidoptera comes from the Greek words 'lepido,' which means scale, and 'ptera,' which means wing. A butterfly or moth has two forewings and two hindwings. When inspected closely with a hand lens, each wing will reveal thousands of neatly arranged scales of different colors, which form patterns on the wings. Lepidoptera are also characterized by a coiled, tubular mouthpart called the proboscis, which is used to drink nectar. This group of insects undergoes complete metamorphosis in a life cycle that includes eggs, caterpillars, pupae, and adults.



Great Spangled Fritillary (Speyeria cybele) photo source: Sally Ray

LIFE HISTORY AND HABITATS

The Lepidoptera cycle of life starts with an egg laid on a specific plant. The egg hatches and a tiny caterpillar (the larva) emerges. The caterpillar feeds and grows larger, and will shed its skin several times to allow for growth. After the caterpillar has grown through several molts, typically 4-6, it is ready to pupate. The pupa emerges when a fully-grown caterpillar sheds its skin and exposes a protective shell. Inside this shell the transformation from caterpillar to adult takes place. After a period of time that varies from species to species,



Common Least Skipper (*Ancyloxypha numitor*) photo source: Sally Ray

the adult emerges with a plump abdomen and withered wings and immediately begins pumping fluids from the abdomen into the wing veins until they are fully expanded. Then the fluids are withdrawn from the wing veins, the wings harden, and the moth or butterfly takes off on its maiden flight.

Butterflies and moths are closely related insects, and they share many features. They have similar life histories and utilize a similar suite of habitats. Butterfly adults have thread-like antennae with a small rounded club at the end. Moths can have plumose (feather-like) or thread-like antennae, but they will not have a small club at the end. Some moths have very plump and fuzzy bodies, while butterflies tend to have sleeker and smoother bodies. Moths typically land and spread their wings open flat, while butterflies will often land and close their wings together over their back, or at 45degree angles (the skippers). Moths are mostly active at night and butterflies fly during the day, but there are also many day-flying moths. The pupae of butterflies have a smooth exterior called a chrysalis, while moth pupae form a cocoon, which is typically wrapped in silky

Many Lepidoptera depend not only on a specific habitat, but also a specific plant within that habitat. The larvae of many species will often use only a single host plant. The monarch (*Danaus plexippus*) uses only milkweed (*Asclepias* spp.) or closely related plants. The spicebush swallowtail caterpillar (*Papilio troilus*) prefers to feed on spicebush (*Lindera benzoin*). The same type of relationship exists with many moths.



Question Mark (Polygonia interrogationis)

photo source: Sally Ray

LEPIDOPTERAN SPECIES DIVERSITY IN PENNSYLVANIA

In North America north of the Mexican border, there are an estimated 13,000 species of Lepidoptera (Wagner 2005). Pennsylvania's varied habitats support a large range of butterflies. Altogether, the state has about 156 species of butterflies and the closely related skippers (Wright 2007), as well as an unmeasured number of species of moths. No state agency is directly responsible for managing Lepidoptera, and scientists suspect the population trends for many species are headed down. This group is understudied, but the PNHP tracks several species of butterflies, skippers, and moths are rare in Pennsylvania and targets them in surveys during the county inventory projects.

In Snyder County, PNHP, has documented 384 species of Lepidoptera, including 14 species of special concern, and several invasive exotic species. The most visible of the invasive exotic lepidopteran species in Pennsylvania, the Gypsy Moth, is responsible for the defoliation of millions of acres of forest each year, killing many of the trees they attack.



While it appears that this photograph was taken in the dead of winter, it was actually taken during the beginning of June 2007. These oaks have been hit particularly hard by the Gypsy Moth outbreak. Surprisingly, many of these trees will survive, and those that die will serve as wildlife habitat for birds, bats, and many others. As dead snags fall to the ground, they serve as critical habitat for many reptiles, amphibians, and mammals.

photo source: PNHP

Conservation Recommendations for Insects

The specific habitat requirements of many odonates and Lepidoptera and other insects are not well known. Protecting habitats where species of special concern currently occur is a first step towards ensuring their long-term survival. Alteration or destruction of habitat is the greatest threat to populations of Odonata and Lepidoptera and other insects.



Open wetlands, like this marsh, serve as excellent odonate habitat photo source: PNHP

CONSERVATION RECOMMENDATIONS

There are a few important pieces of information needed when developing conservation and management plans for Odonata and Lepidoptera that are unique to these taxa:

1) Research and define the specific habitat requirements of each life stage of the species of concern.

Most research on the habitats of Odonata and Lepidoptera has focused on the larval habitat and foodplants. This makes sense because of the more sedentary nature of the larvae compared to the adults and the subsequently tighter association of larvae to habitat. The adults are also associated with the larval habitat during mating and oviposition when the eggs must be placed in suitable habitat. However, it is important not to lose sight of the additional habitat requirements of the adults such as perching/puddling and upland feeding areas.

2) Acknowledge and maintain the balance that is necessary between predators and their prey.

Larval and adult odonates feed on the other insects that share their environment such as mosquitoes, midges, gnats, and other flies. Odonates help control insect species that are considered pests. However, when housing developments encroach upon wetland habitats,

municipalities and homeowners often take pest control into their own hands. The pesticides used to control mosquitoes and other nuisance insects have many negative effects on non-target species. Direct mortality of all insect species occurs when broad-based killing agents are used. More specific killing agents are available that only harm black flies or mosquitoes, but indirectly this still affects predators such as fish and insects, which experience a decrease in food availability when their formerly abundant previtems are eliminated. Additionally, the application of pesticides can raise pest populations in the long run by disrupting the intricate natural food webs in these wetland systems. Pesticides may eliminate odonates which are slower to rebound from die offs, causing a population explosion of the pest species in subsequent years.

Indirect effects of pest control can also severely reduce populations of butterflies and moths. These species are vulnerable to changes in the distribution and abundance of their foodplants. Applications of herbicides or vegetation removal (e.g., mowing) while the eggs or larvae are on the plants can cause declines in Lepidoptera and interrupt stages of the life cycle of these animals. In an effort to slow the spread of gypsy moth and to protect timber resources, various insecticides including lead arsenate, DDT, and carbaryl (Sevin), have been sprayed over the years. Presently, the biological insecticide *Bacillus thuringiensis* (*Bt*) and the insect growth regulator diflubenzuron (Dimilin) are considered more environmentally safe than other sprays and are the primary means of gypsy moth control. However, both chemicals affect species of insects beyond the target gypsy moth. The Bt variety used against gypsy moth (Bt kurstaki) is toxic primarily to caterpillars, or larvae of Lepidoptera. Species with 1st and 2nd instars at the time of spraying and that feed on foliage are most at risk. Butterflies seem to be particularly susceptible to Bt, though there have not been studies to evaluate the effect on all butterflies. In order to protect rare or small populations of non-target organisms, the size of the spray blocks and the timing of spraying for gypsy moths can be adjusted on a site-by-site basis.

3) Protect the species and habitats within a healthy, functioning ecosystem.

Landscape-scale conservation of wetland, meadow, and forested habitats and the supporting upland habitat is needed for long term survival of healthy odonate and Lepidoptera populations.

AQUATIC COMMUNITY CLASSIFICATION

A statewide project of the PA Natural Heritage Program, the Pennsylvania Aquatic Classification Project, collected aquatic datasets from state and federal agencies, interstate basin commissions, and universities, analyzed information with standard statistical methods, and identified community types and habitat associations (Walsh et al. 2007a, 2007b). The most common community type per watershed was chosen to represent typical watershed organisms and habitats. Although other community types may exist in a particular watershed, the major community type is described.

What is an aquatic community?

An aquatic community represents a group of organisms that occur together in a particular habitat. The organisms require similar habitat features, may be dependent on each other for food or other resources, and/or may be dependent on similar processes in their environment.

The aquatic communities in this report refer to three types of organisms: fish, macroinvertebrates, and mussels. Aquatic communities for each type of organism can be used to describe the aquatic resources, habitat types, and stream quality.

Where do aquatic communities occur?

Flowing water habitats, such as rivers and streams, and their community types are described. Aquatic community types of non-flowing waters like lakes, wetlands, and ponds, have not been identified to date.

Aquatic communities are identified within watersheds (Table 6). The term watershed describes an area of land that drains down slope to the lowest point. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves on downstream, eventually reaching an estuary and the ocean. Watersheds can be large or small. All of the land in the state is part of a watershed. Every stream, tributary, or river has an associated watershed, and small watersheds join to become larger watersheds. In this report, relatively small watersheds (hydrologic unit code 12 – huc12) are described by their community types (Figure 5, Table 6). (For more information on huc 12: http://water.usgs.gov/GIS/huc.html)

What do fish, macroinvertebrates, and mussels tell me about streams and watersheds?

All three types of organisms hold unique places in Pennsylvania's streams and rivers. Macroinvertebrates include aquatic insects, worms, and crustaceans, like crayfish and scuds, which occupy the lower levels of food webs in aquatic systems. The presence of certain macroinvertebrates reflects food availability, water quality, and habitats, and gives an overall picture of stream health.

Fish prey upon macroinvertebrates and other stream organisms. Food resources and spawning habitats can be specific for fish. They, too, are influenced by the stream quality and entire environment of the watershed. For example, sediment from erosion at a mismanaged construction site near a stream may cover gravel and cobble habitats where brook trout lay their eggs. Developing fish will be smothered by layers of fine particles.

As filter-feeders, which siphon water to extract particles of food, mussels also require relatively clean water to thrive. They are particularly sensitive to industrial discharge, acid mine drainage, and urban runoff pollution. Mussels require habitats where they can burrow into the stream bottom and typically occur in larger streams and in rivers that contain sufficient food particles

Many factors influence the occurrence of aquatic communities, including natural variations in stream habitats. Fast-flowing, cold streams flowing from ridges provide a different environment than slower and warmer rivers meandering through valleys, and aquatic communities reflect their environment. Geology also varies across Pennsylvania and flowing water may have a unique chemical composition based on the rock that it contacts.

Over any natural habitat, variations are caused by human alterations to aquatic environments. Many changes within a watershed can be detected within its streams and rivers. If implemented improperly, timber harvest, agriculture, urban development, and roads are among some alterations that may cause changes in water quality and stream habitats from non-point source pollution. A number of pollutants enter aquatic systems from point sources to flowing waters, such as discharges from sewage treatment plants, mines, and industrial sources.

Table 5. Pennsylvania aquatic life uses, special protection water designations and their occurrence with fish assemblages.

(EV = Exceptional Value Waters, HQ = High Quality waters, CWF= Cold Water Fishes, WWF= Warm Water Fishes, TSF= Trout Stocked Fishes, MF= Migratory Fishes)

Increasing watershed area	Aquatic Community Classification-Fish	EV	HQ	CWF	WWF	TSF	MF	
	rsh	Coldwater	X	X	X			
	Coolwater 1, Coolwater 2		х	х	х	х	х	
	easing	Warmwater 1, Warmwater 2			х	х	х	х
	Incr	River & Impoundment				х		х

How does this Classification relate to the DEP stream designations?

The purpose and meanings differ between the classes defined in Pennsylvania aquatic life use/special protection designations and aquatic fish assemblages from the Pennsylvania Aquatic Community Classification. The similar nomenclature of both classifications may be confusing, but in both cases it is meant to relatively define the organisms and aquatic habitats along a gradient of water temperatures (and associated stream size). The PA stream designations broadly encompass habitats occupied by several Aquatic Community Classification fish assemblages and are used in water quality regulation (Table 5).

How are communities described?

Fact sheets are provided for each Aquatic Community classified in Snyder County. The fish and macroinvertebrate communities are named by descriptive community habitat names and mussel communities are named by the commonly occurring animals in the community type. Other organisms that may be found in the community are also listed. While not every organism described in a community will occur in every community location, organisms listed by community types give a general account of what organisms to expect in a community habitat.

1) Community Description and Habitat - the environment of the stream where the community occurs is described by watershed and stream characteristics. Average values of the community characteristics across their entire range from a large dataset are presented, including size of the stream and watershed, gradient (slope), and/or elevation. Local conditions are also mentioned. Some water chemistry variables are also valuable in understanding the conditions of the community, including:

- pH is the measure of the concentration of hydrogen ions in a solution. The concentration of hydrogen ions determines the alkalinity (pH > 7) or acidity (pH < 7) of stream water.
- Water temperature is important to stream organisms because it influences metabolism and growth of stream organisms. Each aquatic animal species has a tolerance for specific temperature ranges and cannot survive at extremely high or low temperatures.
- Conductivity is defined as the ability of water to conduct an electrical current. It is expressed in microsiemens (μS) per centimeter at 25 °C.
 Conductivity is determined by the types and quantity of dissolved substances in water. In streams, conductivity can be elevated because of pollution or natural causes.
- Alkalinity is a measure of how well a
 waterbody resists or does not resist changes in
 acidity. If a stream has high alkalinity and can
 neutralize acids sufficiently, then it is subject to
 little change in pH. A low alkalinity stream is
 less resistant to changes in acidity and may be
 naturally acidic or may become acidic due to
 acid precipitation or other causes.
- 2) Stream quality rating- Communities are generally ranked as low, medium, or high quality based on habitat, water chemistry, and sensitivity of organisms to pollution.
- **3) Threats and Disturbances** potential pollution sources or other threats that may alter the natural state of the community are listed, where known.
- **4)** Conservation recommendations are described for the county natural resource managers and land planners to consider in protection and management of the watersheds and communities.

Figure 5. Watersheds of Snyder County, Pennsylvania (hydrologic unit code 12 - huc 12)

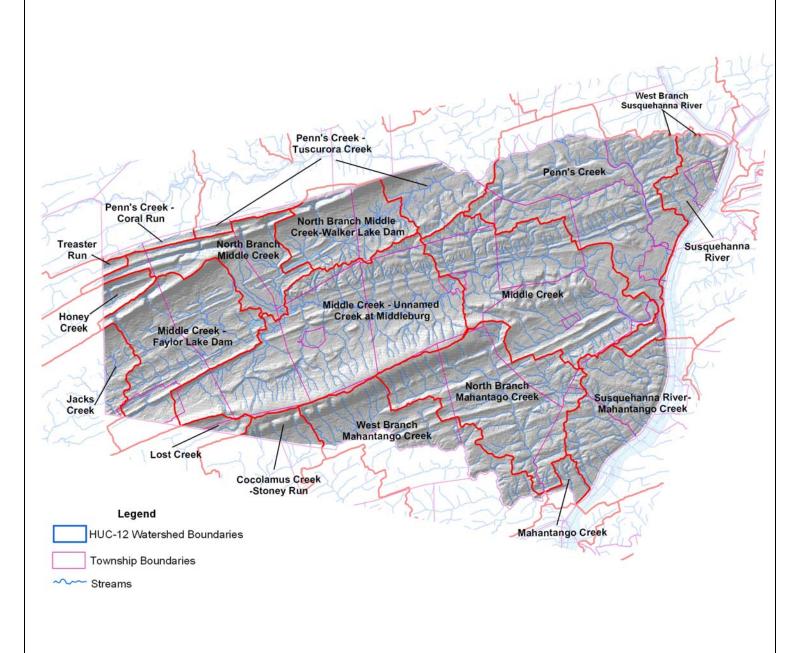


Table 6. Hydrologic unit code 12 (huc 12) watersheds in Snyder County and the results of the Aquatic Community Classification Project for fish, macroinvertebrate, and mussel community types identified within each. Fact sheets describing each community type can be found on the following pages.

Watershed Name	*Stocked Fish Present?	Atlantic Basin Fish Community	Macroinvertebrate Community	Susquehanna Basin Mussel Community	
Cocolamus Creek – Stony Run	Y	River and impoundment Community	Low Gradient Valley Stream Community	not assessed	
Honey Creek	Y	Coolwater Community 2	not assessed	not assessed	
Jack's Creek	Y	Warmwater Community 1	Low Gradient Valley Stream Community	not assessed	
Lost Creek	Y	Warmwater Community 1	not assessed	not assessed	
Mahantango Creek	N	Warmwater Community 2	not assessed	not assessed	
Middle Creek	Y	Warmwater Community 2	not assessed	Eastern Elliptio Community	
Middle Creek – Faylor Lake Dam	Y	Warmwater Community 1	not assessed	not assessed	
Middle Creek – Unnamed Creek a Middleburg	t Y	Warmwater Community 2	not assessed	Eastern Elliptio Community	
North Branch Mahantango Creek	Y	Warmwater Community 1	not assessed	not assessed	
North Branch Middle Creek	Y	Coolwater Community 2	not assessed	not assessed	
North Branch Middle Creek – Walker Lake Dam	N	Coolwater Community 1	not assessed	not assessed	
Penns Creek	N	Warmwater Community 1	not assessed	Eastern Elliptio Community	
Penns Creek – Coral Run	Y	Coldwater Community	not assessed	not assessed	
Penns Creek – Tuscarora Creek	Y	Warmwater Community 1	not assessed	Eastern Elliptio Community	
Susquehanna River	Y	Warmwater Community 2	High Quality Small Stream Community	not assessed	
Susquehanna River - Mahantango Creek	Y	not assessed	not assessed	Yellow Lampmussel	
Treaster Run	Y	Coolwater Community 1	not assessed	not assessed	
West Branch Mahantango Creek	Y	Warmwater Community 1	not assessed	not assessed	
West Branch Susquehanna River	Y	River and Impoundment Community	Low Gradient Valley Stream Community	Yellow Lampmussel	

^{*} Surveys by the Pennsylvania Fish and Boat Commission found one or more fish (trout or warmwater gamefish) present of hatchery origin. This suggests that this watershed or a nearby watershed is stocked. While prized by anglers, the introduction of non-native fish species disrupts the natural balance of the aquatic community and can decrease the overall quality of the waterway.

AQUATIC COMMUNTIY FACT SHEETS: FISH

Atlantic Coldwater Community - typified by:

Brook Trout (Salvelinus fontinalis), Brown Trout (Salmo trutta), Rainbow Trout (Oncorhynchus mykiss)

Community Description and Habitat: This headwater stream community occurs in small, swift streams running from ridge slopes. Streams are generally at high elevation with high gradient. Water temperatures are the coldest among the fish communities. The Coldwater Community represents headwater streams with brook trout and slightly larger streams with both brook trout and brown trout or brown trout only. At times, rainbow trout are also found in this community.



Brook Trout photo source: http://www.cnr.vt.edu/efish

The small streams that support the Coldwater Community tend to have fewer disturbances than larger waters flowing through valleys. These waters often flow from sandstone or shale ridges and have a unique water chemistry signature with few dissolved cations and low buffering capacity.

The community is known to occur in the headwaters of streams in Snyder County. Some examples of Coldwater

 $\begin{tabular}{llll} Average Water Chemistry \\ alkalinity & - & 27 mg/l \\ conductivity & - & 140 \ \mu S/cm \\ pH & - & 6.7 \\ H_20 \ temp. & - & cold \\ \end{tabular}$

Community habitat are Weikert Run and Cherry Run.

Other streams in the County may be designated as Cold Water Fisheries (CWF) and Trout Stocked Fisheries (TSF) by PA DEP. A community dominated by wild cold water species characterizes the assemblage, as determined by the PA Aquatic Community Classification. The TSF and CWF designations, occurring with other PA Aquatic Community fish classes, may include streams stocked with trout or those that may have marginal cold water habitats that also support other assemblages.

Stream Quality Rating: high

Threats and Disturbances: The streams supporting the Coldwater Community have fewer disturbances than other stream habitats. Forested, headwater streams have relatively little human influence in the watershed. However, streams may be acidified by atmospheric deposition in some locations. Acidic precipitation that falls on these watersheds can leach away the watershed's natural acid buffering capacity, resulting in low stream pH. The headwaters of streams like Kern Run, Luphers Run, and Beaver Creek are impaired by acid deposition and low pH (DEP 2006).

<u>Conservation Recommendations</u>: Protecting headwater streams flowing from forested ridges is necessary to ensure habitat for this community. Minimizing impacts from roads and timber harvest near headwater streams will maintain healthy waters. Addressing water pollution from acid deposition is critical for headwater, cold-water streams. Liming watersheds and/or streams is one option for minimizing the effects of acid deposition.

Coldwater Community streams in the county watersheds may have wild-reproducing populations of brook trout, a key fishery resource. Because cold, headwater streams often occur in terrain unsuitable for most types of human developments, they are subject to different types of water pollution issues than valley streams.

Trout streams in Pennsylvania are highly valued by fisherman, but have been greatly altered by the transplantation of European brown trout and rainbow trout. This has restricted habitats for native brook trout through competition with other trout species.



Small, high gradient streams with forested watersheds are typical of the Atlantic Coldwater Community habitat.

photo source: PNHP

Atlantic Coolwater Community 1 - typified by: Slimy Sculpin (*Cottus cognatus*), stocked Brown Trout (*Salmo trutta*), Fathead Minnow (*Pimephales promelas*), Pearl Dace (*Margariscus margarita*)

Community Description and Habitat:

This community generally occurs in high gradient streams, downstream of the watershed headwaters. The community typically is found in relatively small streams high in the watershed, but may also be found in valley streams. In contrast to the Coldwater Community, the Coolwater Community 1 stream habitats are modified by some human influenced conditions. Watersheds supporting the stream habitats of the Coolwater Community 1 may be influenced by agricultural practices and to a lesser extent by human settlements.

The community fish prefer cool, rocky streams and may occur in transitional areas between cold-water streams and warm-waters. The Atlantic Coolwater Community 1 may represent streams with put-and-take trout fisheries or cool streams with seasonally warm temperatures. Community fish may tolerate some acidic conditions, low dissolved oxygen, suspended sediments, or other water quality impairments. Examples of the Coolwater Community 1 habitats are Treaster Run, Swift Run, and parts of the North Branch of Mahantango Creek. The community habitat overlaps with some DEP-designated Cold Water Fishery and Trout Stocked Fishery streams. This indicates that Coolwater Community may coincide with some seasonally cool streams and streams where trout species occur, but that also support other fish assemblages.

Stream Quality Rating: low

Threats and Disturbances:

This community occurs downstream of headwaters and exists in streams not usually protected from human influences. The most common threats to water quality for Atlantic Coolwater Community 1 are pollution from poorly managed agricultural areas. Excess silt and nutrients are contributed from agricultural runoff. Removal of stream bank vegetation and livestock grazing in streams also contribute to poor conditions. Water temperatures may be warmer than natural temperatures in these altered streams. The community watersheds have agriculture in the valley lowlands that may negatively influence water quality and habitat, if not properly managed. Some streams in the Treaster Run watershed were classified as impaired by DEP as a result of siltation (DEP 2006).



Fathead Minnow photo source: http://www.cnr.vt.edu/efish

Conservation Recommendations:

Restoration of stream habitat and water quality to natural conditions is recommended. Re-vegetation of

stream banks and restoration of in-stream habitats will help restore natural conditions. Mitigating

 $\begin{array}{cccc} \underline{Average\ Water\ Chemistry} \\ alkalinity & - & 54\ mg/l \\ conductivity & - & 225\ \mu S/cm \\ pH & - & 7.0 \\ H_20\ temp. & - & cool \\ \end{array}$

runoff from crops and livestock pastures with measures to conserve soil, adding riparian buffers, stream bank fencing and stabilization, and other methods will improve water quality and reduce siltation.

Where stocking of non-native fish is occurring with the cool-water community, native fish are displaced. Restoration of the fish community to native fish is recommended. The habitat for the Atlantic Coolwater Community 1 represents an important transition between cold headwater streams and warm, larger streams; the habitat is distinct among other habitat types and should be protected and restored.



Medium size streams are typical of Coolwater Community 1.

photo source: PNHP

Atlantic Coolwater Community 2 - typified

by: Blacknose Dace (*Rhinichthys atratulus*), White Sucker (*Cato-stomus commersoni*), Golden Shiner (*Notemi-gonus crysoleucas*)

Community Description and Habitat:

This community type is similar to Atlantic Coolwater Community 1 since it occurs in small to medium size in valley streams. Streams may be low gradient and slow moving compared to streams of a similar size flowing from ridges. Examples of streams with Coolwater Community 2 habitat are Kreb Gap Run and parts of Middle Creek.

Fish found in this community type are habitat generalists and generally pollution tolerant. There are few fish species present in the Atlantic Coolwater Community 2. In some locations this community is coincident with PA DEP designated Cold Water Fishery streams, like in Kreb Gap Run, and Trout Stocked Fishery streams, such as Middle Creek. Some species like the blacknose dace and white sucker are also found with brown trout. Some DEP Cold Water Fishery streams may also be seasonally warm and can still support relatively tolerant brown trout, in some locations.

Stream Quality Rating: low



Coolwater Community 2 is found in a variety of habitats in medium-sized streams and small rivers. Habitat-generalist fish can tolerate slow and silty streams.

photo source: PNHP



Blacknose Dace photo source: http://www.ohiodnr.com/dnap

Threats and Disturbances:

Poorly managed agriculture is the most pressing threat to Atlantic Coolwater Community 2. Excess siltation and nutrients contributed from crop fields and livestock grazing lead to degraded stream conditions. Tributaries to Kreb Gap Run and Middle Creek are designated as impaired by PA DEP (2006) due to siltation from grazing-related agriculture. Streams in the Middle Creek watershed are impaired from acid deposition and low pH, as well as from municipal point sources contributing excess nutrients.

Conservation Recommendations:

Sedimentation and excess nutrient loading in some watersheds, where the Atlantic Coolwater Community 2 occurs, are the major threats to fish habitat. Restoration of stream temperatures may be particularly important to improving the habitats for this community

type. Re-vegetation of stream banks and restoration of in-stream habitats will help restore natural conditions. Mitigating runoff from crops and livestock pastures with measures to conserve soil, riparian buffers, stream bank fencing and stabilization, and other methods will improve water quality and habitat.

Addressing water pollution from acid deposition at headwater streams will improve valley streams. Liming watersheds and/or streams is one option for minimizing the effects of acid deposition.

Average Water Chemistry				
alkalinity	-	55.6 mg/l		
conductivity	-	213 μS/cm		
рН	-	7.2		
H_20 temp.	-	cool		

Atlantic Warmwater Community 1 - typified

by: Central Stoneroller (*Campostoma anomalum*), Northern Hogsucker (*Hypentelium nigricans*), River Chub (*Nocomis micropogon*), Longnose Dace (*Rhinichthys cataractae*), Cutlips Minnow (*Exoglossum maxilingua*), Mottled Sculpin (*Cottus bairdii*), Margined Madtom (*Noturus insignis*), Creek Chub (*Semotilus atromaculatus*), Rosyface Shiner (*Notropis rubellus*), Fantail Darter (*Etheostoma fabellare*), Greenside Darter (*Etheostoma blenniodes*)

Community Description and Habitat:

The Atlantic Warmwater Community 1 usually occurs in small to medium size watersheds) in valley streams. Streams have warmer waters and are slower moving than headwater, high gradient streams.



Northern Hogsucker

photo Source: http://www.ohiodnr.com/dnap

Thermal tolerances of fish in the community group are higher than fish from the cold- and cool-water communities. Habitat preferences of indicator taxa suggest this community occurs in warm-water streams with moderate to high gradients and currents and little silt.

The habitats for Warmwater Community 1 are typically associated with some human disturbance in the watershed. Agriculture and other valley land uses likely occur in the watershed with Warmwater 1 Communities. Many larger streams in the valleys of Snyder County are classified as Warmwater 1 Community habitats. The West Branch Mahantango, North Branch. Mahantango, South Branch Middle, and Penns Creeks are some examples of the community habitat in the county. Some valley streams with Warmwater 1 Communities may also be classified by PA DEP as Cold Water Fisheries or Trout Stocked Fisheries. Seasonally warm valley streams may have stocked or wild brown trout during some periods, but are primarily characterized by fish preferring warmer temperatures.

Stream Quality Rating: medium

Threats and Disturbances:

Water quality and habitat may be influenced by non-point source pollution from agriculture land uses. Poorly managed agriculture can be a threat to this community. Nutrient enrichment and excess sedimentation of streams from mismanaged agricultural practices impair many streams in watersheds with this community type. In several watersheds with Warmwater 1 Communities, aquatic life is designated as impaired by PA DEP due to

excess nutrients and siltation from agricultural sources (e.g., tributaries to the West Branch Mahantango Creek, to North Branch.

Mahantango Creek, to Penns Creek, and to Kreb Gap Run). Air pollution contributes mercury to streams in the county resulting in bioaccumulation of contaminants in fish; Penns Creek is impaired for fish consumption due to high concentrations of mercury (DEP 2006), likely distributed by air pollution.

Conservation Recommendations:

This community is a high conservation priority. Warmwater streams in good condition are not common. The fish associates of this community type are not especially rare individually; however, the community group occupies habitats in need of restoration in Pennsylvania.

This community is downstream of many human settlements and has been altered to some degree from its natural condition. Protection of the variety of habitats in small rivers is key to maintaining a diverse fish community. Shallow and deep pools (slow moving areas) and swift current habitats are examples of habitat types in a small river. Control of combined sewer overflows, residential and road runoff, and stream habitat improvements in populated areas would improve community quality. Alternatively, the restoration of riparian buffer zones, exclusion of livestock from streams, rotational grazing, and soil conservation are some mitigation techniques to control non-point source pollution in agricultural streams. Air pollution sources of mercury are difficult to address within the County and may need to be addressed through state and federal air pollution regulations.



Medium-sized streams without many groundwater inputs are typical of Atlantic Warmwater Community 1 streams. Stream sequences of pools (slow-moving habitats), riffles (swift current habitats), and runs (intermediate current habitats) provide a variety of habitats and support warmwater fish communities.

photo source: PNHP

Atlantic Warmwater Community 2 -

typified by: Redbreast Sunfish (*Lepomis auritus*), Rock Bass (*Ambloplites rupestris*), Spotfin Shiner (*Cyprinella spiloptera*), Smallmouth Bass (*Micropterus dolomieu*), Spottail Shiner (*Notropis hudsonius*), Common Shiner (*Luxilus cornutus*), Tessellated Darter (*Etheostoma olmstedi*), Pumpkinseed (*Lepomis gibbosus*), Bluntnose Minnow (*Pimephales notatus*), Bluegill (*Lepomis macrochirus*), Green Sunfish (*Lepomis cyanellus*), Satinfin Shiner (*Cyprinella analostana*), Swallowtail Shiner (*Notropis procne*), Shield Darter (*Percina peltata*), American Eel (*Anguilla rostrata*), Largemouth Bass (*Micropterus salmoides*), Common Carp (*Cyprinus carpio*)

Community Description and Habitat:

The Atlantic Warmwater Community 2 is found in many larger waterways. The habitat is low-gradient, medium-to-large sized streams at low elevations. Typical water chemistry values are moderate alkalinity and conductivity. The pH is neutral and water temperatures are warm.

Community fish prefer pools in warm streams or ponds. Some indicator fish are tolerant of low dissolved oxygen or turbid waters. Many community fish are habitat generalists. The community group also includes game fish, like smallmouth bass and bluegill, which were likely stocked in many locations and have since become naturalized

In Snyder County, Middle Creek and the lower reaches of Penns Creek are habitats of the Warmwater 2 Community. Fish communities are influenced by assemblages in the nearby Juniata River and support a variety of warm water fish species. Middle Creek is also designated as Cold Water Fishery by PA DEP and may support brown trout in some locations. However, coldwater fish species are not dominant in this community.



This community occurs in large streams and rivers with warm waters, because of variety of habitats supports a diverse fish community.

photo source: PNHP



Redbreast Sunfish
photo source: http://www.ohiodnr.com/dnap

Stream Quality Rating: medium

Threats and Disturbances:

Non-point source pollution is a threat to the community. The large amounts of watershed agricultural land cover leads to some degradation of habitat and water quality of valley streams in Juniata County. Tributaries to Middle Creek and Penns Creek designated as impaired by PA DEP (2006) because of excess sediment and nutrients from agricultural sources. Air pollution contributes mercury to streams in the county resulting in bioaccumulation of contaminants in fish; Penns Creek is impaired for fish consumption due to high concentrations of mercury, likely distributed by air pollution.

A shift in the native fish community because of introduced species is also a concern. Many fish in the community were not originally present in the Susquehanna River watershed. For instance, rock bass and smallmouth bass have been transplanted into the Susquehanna River basin.

Conservation Recommendations:

This community is downstream of many human settlements and has been altered to some degree from its natural condition. Protection of the variety of habitats in small rivers is important to maintaining a diverse fish community. Shallow and deep pools (slow moving areas) and swift current habitats are examples of habitat types in a small river. Since warmwater streams mainly occur in

valleys dominated by human modified landscapes, they are often subject to pollution from agriculture and

Average Water Chemistry
alkalinity - 47 mg/l
conductivity - 237 µS/cm
pH - neutral
H₂0 temp. - warm

urban runoff. Soil conservation measures, restoration of riparian buffer zones and exclusion of livestock from streams are some mitigation techniques for non-point source pollution. Air pollution sources of mercury are difficult to address within the County and may need to be addressed through state and federal air pollution regulations.

Atlantic River and Impoundment

Community - typified by: Walleye (Stizostedion vitreus), Yellow Perch (Perca flavescens), Black Crappie (Pomoxis nigromaculatus), Goldfish (Carassius auratus)

Community Description and Habitat:

The River and Impoundment Community habitat is typical of relatively low gradient large streams and rivers at low elevations. Dam impoundments along rivers create deep pools with soft-sediment stream bottoms. This environment occurs at moderate elevation in streams with low gradients. Streams are characterized by warm-waters with relatively high conductivity and alkalinity, and slightly alkaline pH.

The Susquehanna River is likely habitat for the community. The presence of game fish in larger streams and rivers, where there is diverse flowing water habitat, is indicative of this community type. Another example of the community habitat is sections of Cocolamus Creek inhabitated by some game species typical of the community. In some locations, like Cocolamus Creek, brown trout may also occur with the community, and community habitats are designated as a Cold Water Fishery by PA DEP. However, cold water species are not dominant where this community occurs.



Yellow Perch

photo source: http://www.cnr.vt.edu/ef

Stream Quality Rating: medium

Threats and Disturbances:

Large streams and rivers, downstream of many human settlements, are subject to many types of pollution. Large rivers, like the Susquehanna River, may receive effluents from industrial, sewage treatment plants, and storm water discharges. Non-point source pollution from agricultural contributes excessive silt and nutrients to the rivers. Tributaries to Cocolamus Creek are impaired for agricultural contributions of sediments and nutrients (PA DEP 2006). Crop and animal



Rivers, like the Susquehanna River, and impoundments are common habitats of this community type.

photo source: PNHP

feeding agriculture are cited as the causes of impairment in Cocolamus Creek tributaries. Runoff from impervious surfaces reaches the rivers and carrying along road contaminants.

This community is primarily composed of fish that are not native to the Susquehanna River watersheds. Walleye, Black Crappie, and Goldfish are introduced species to the Atlantic basins in eastern and central Pennsylvania. Many game fish have also been introduced and are actively stocked around Pennsylvania. These fish may have naturalized...

Conservation Recommendations:

Large stream and river habitats in good quality condition are rare. Although the potential sources of pollution to the river and impoundment community are many, solutions to pollution problems are possible by minimizing point source pollution and managing water quality in the smaller tributaries. Additionally, local watershed managers and municipal planners should address non-point source pollution especially from agricultural areas. Restoration of riparian buffer zones, exclusion of livestock from streams, rotational grazing, and soil conservation are some mitigation techniques to control non-point source pollution in agricultural streams.

AQUATIC COMMUNTIY FACT SHEETS: MACROINVEREBRATES

High Quality Small Stream Community -

typified by: Brushlegged Mayfly (Isonychiidae), Fingernet Caddisfly (Philopotam-idae), Dobsonfly (Corydalidae), Saddlecase Maker (Glossosomatidae), Watersnipe Fly (Ather-icidae), Common Burrower (Ephemeridae), Snail-case Maker Caddisfly (Helicopsychidae)

Community Description and Habitat:

This community is found in small to medium-size streams of moderate elevation and intermediate gradient. Moderate amounts of agricultural land cover may have some adverse influence on water quality. Small streams, like Hallowing Run and Boile Run, are examples of the community habitat. The stream watersheds have mixed land use. Water chemistry values of the streams that support this community type are usually typified by moderate alkalinity, moderate conductivity, and a neutral pH.

Stream Quality Rating: high

Threats and Disturbances:

Organisms in this community type are sensitive to organic pollution and habitat degradation. This community is tolerant of low levels of water quality degradation.



Typical community habitats are small to medium-sized streams with diverse stream-bottom habitats and high water quality.

photo source: PNHP



Brushlegged Mayfly photo source: www.dec.state.ny.us

High quality habitats and water quality are suggested for the streams that this community occupies. Although the community habitat may have fewer sources of degradation than that associated with other assemblages in Snyder County, degradation may result in a shift to a community indicative of poor water quality. Impairments resulting from poorly buffered agricultural land include excess nutrient and sediment input from cropland or livestock pastures.

Conservation Recommendations:

While some non-point source pollution occurs in

watersheds supporting the High Quality Small Stream Community, the pollution problems here are less severe than in other stream types. In areas where non-point source agricultural pollution is occurring, runoff and stream bank erosion can be controlled by installing riparian buffers of an adequate width along pastures and crop fields, excluding livestock from streams and riparian zones, rotational grazing, and soil conservation measures.

Average Water Chemistry
alkalinity - 53 mg/l
conductivity - 203 µS/cm
pH - neutral

Low Gradient Valley Stream Community

- typified by: Riffle Beetle (Elmidae), Waterpenny Beetle (Psephenidae) Netspinning Caddis-fly (Hydropsychidae), Asian Clam (*Corbicula fluminea*), Narrow-winged Damselfly (Coenagrion-idae), Rusty Dun Mayfly (Caenidae), Fingernail Clam (Sphaeriidae), Freshwater Limpet (Ancylidae), Broadwinged Damselfly (Calopterygidae)

Community Description and Habitat: This community generally occurs in medium-sized streams, intermediate- gradient valley streams. The water chemistry associated with this community is distinct from other macroinvertebrate communities because alkalinity and conductivity are relatively high, but pH is neutral. Moderately high amounts of urban and agricultural land cover in the watershed contribute to water quality issues in watersheds where this community occurs. Additionally, forest cover is relatively low in these watersheds. Valley streams with much watershed agriculture, like Jack's Creek, Turtle Creek, and Winfield Creek, characterized this community's habitat.

Stream Quality Rating: intermediate

<u>Threats and Disturbances</u>: The exotic Asian Clam (*Corbicula fluminea*) commonly occurs with this community type. The Asian clam is a threat to other bivalves due to competition for food resources and habitat.

The habitat for this community type may receive pollution from agricultural sources. In streams where this community is found, water quality may be



This community is typically found in low gradient valley streams with some influence from agricultural practices in the watershed.

photo source: PNHP



Riffle Beetle photo source: www.epa.gov

degraded from
excess nutrients,
habitat
modification,
and siltation due
to improper
agricultural
practices.
Community
habitat in
Winfield Creek

moderately

and Turtle Creek is impaired because of excess siltation from agricultural sources and/or channelization (PA DEP 2006). Jack's Creek is impaired for fish consumption because of high concentrations of PCBs (PA DEP 2006).

Conservation Recommendations:

Where this community is common, non-point source pollution from the surrounding watershed is contributing to moderately degraded water quality and habitat conditions. Although this community type does not signify extremely poor stream quality, some

stresses to stream condition are indicated.

Average Water Chemistry
alkalinity - 76 mg/l
conductivity - 318 μS/cm
pH - neutral

Areas with large amounts of agriculture

and roads have the potential for non-point source pollution. In agricultural environments, runoff and stream bank erosion can be controlled by rehabilitating riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. Practicing soil conservation and low impact crop agriculture is also recommended to maintain healthy valley streams.

As with other valley streams, management of storm water from roads and urban developments and mitigation of any stream effluents is recommended. Retention and treatment of storm water is ideal and would ameliorate water quality in streams receiving urban effluents. Keeping sewage treatment systems upto-date would also improve stream habitats that support aquatic communities. Management of storm water from roads and urban developments and mitigation of any direct stream discharges are recommended. Retention and treatment of storm water would ideally ameliorate water quality in streams receiving urban effluents. Keeping sewage treatment systems up-to-date would also improve stream habitats that support aquatic communities.

AQUATIC COMMUNTIY FACT SHEETS: MUSSELS

Eastern Elliptio Community - typified by:

Eastern Elliptio (*Elliptio complanata*)
The Rainbow Mussel (*Villosa iris*)*, Yellow
Lampmussel (*Lampsilis cariosa*)*, and Eastern
Lampmussel (*Lampsilis radiata*)* are not consistent
community members, but are often associated with
this community.

Species of Concern: Rainbow Mussel (G5 S1)*, Yellow Lampmussel (G3G4 S3S4)*, and Eastern Lampmussel (G5 S1)*.

Stream Quality Rating: medium

Community Description and Habitat: The Eastern Elliptio Community is widely distributed across the study area and is found in a variety of environments. The most common community member, Eastern Elliptio, tolerates many habitats. Stream bottom habitats can be variable, but this community requires some sand and silt mixed with larger cobble and gravel. In Snyder County, the community was found in Middle Creek and Penns Creek.

Water quality in the habitats of this community is typified by moderate alkalinity, and high conductivity. Water chemistry parameters may be influenced by non-point source pollution from agriculture and resource extraction. Agriculture in the watershed may contribute to non-point source pollution.

Additional study of the Eastern Elliptio Community is needed. The primary indicator species are statistically strong indicators of this community, and thus when found, strongly indicate that this community is present. However, they are also found in other community types.



The Eastern Elliptio Community can occupy diverse habitats from small, slow-moving rivers to large rivers like the Susquehanna.

photo source: PNHP



Eastern Elliptio

photo source: PNHP

<u>Threats and Disturbances</u>: Watershed disturbances including improperly managed agriculture may be detrimental to the Eastern Elliptio Community. The tributaries of Middle Creek and Penns Creek are impaired from nutrient enrichment and siltation from agricultural sources and from municipal point sources. Penns Creek has high concentrations of mercury, resulting in fish consumption impairment. The source of mercury is likely air pollution. The contaminant bioaccumulates in fish tissue and is also harmful to mussels.

<u>Conservation Recommendations</u>: Although the Eastern Elliptio is not rare in Pennsylvania, some of the associated species that may occur with this community are less common. Protection of current mussel habitats and high water quality will mean that communities will endure and potentially be reintroduced where they have been lost.

Zebra Mussels have been reported in the Susquehanna River basin. Monitoring of Zebra Mussel infestation will document the spread and effects of the non-native species on native mussel populations.

Reducing non-point source pollution and habitat degradation from agriculture is important for valley streams and rivers in Snyder County. Stream bank fencing, riparian restoration, rotational grazing, and soil conservation are some recommendations for improving streams and maintaining habitat to support mussels. Air pollution sources of mercury are difficult to address within the County and may need to be addressed through state and federal air pollution regulations.

Average Water Chemistry alkalinity - 63.6 mg/l conductivity - 199 μS/cm

^{*} Recognized as a species of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program.

Yellow Lampmussel Community -

typified by: Yellow Lampmussel (*Lampsilis cariosa*)* Additionally, the Eastern Floater (*Pyganodon cataracta*), Eastern Lampmussel (*Lampsilis radiata*)* and Triangle Floater (*Alasmidonta undulata*)* are all commonly associated with this community.

Species of Concern: Yellow Lampmussel* (G3G4 S3S4), Eastern Lampmussel* (G5 S1), and Triangle Floater* (G4 S3S4)



Yellow Lampmussel (Lampsilis cariosa) photo source: Andrew Strassman (PNHP)

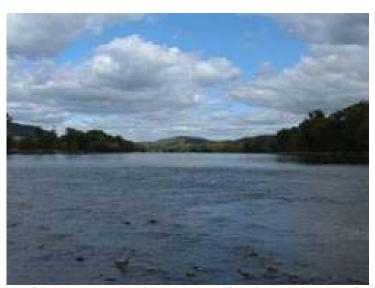
Community Description and Habitat: This community type is found in large river systems in the Susquehanna River watershed. Large streams and rivers with slow moving reaches and appropriate stream bottom habitats are good habitats for this community. The main indicator species, Yellow Lampmussel, is a habitat generalist and occurs in a variety of substrate types including sand, silt, cobble, and gravel (Connecticut DEP 2003, NatureServe www.natureserve.org/explorer). The Susquehanna River is one example of this community's habitat.

Sandstone and shale bedrock geology is common in watersheds containing this community. As is typical of larger rivers, watersheds of this community type may be influenced by much human disturbance. Much of the watershed is agriculture land cover in the valleys surrounding the Susquehanna River.

Stream Quality Rating: medium

Threats and Disturbances: Watershed disturbances include coal mining, which has impaired some tributaries to the Susquehanna River due to low pH and high metal concentrations (DEP 2006). Improperly managed agriculture may also be detrimental to the Yellow Lampmussel community. Upstream non-point source pollution from agriculture results in excess nutrients and silt contributed to tributaries of the Susquehanna River (DEP 2006). Habitat alteration and channelization of the Susquehanna River and its tributaries has created artificial flow variability, reduction in productive habitat, and the listing of tributary streams as impaired by PA DEP (DEP 2006).

Conservation Recommendations: Large river habitat conservation is a daunting task since river watersheds are very expansive and contain many potential pollution sources and habitat alteration problems. At the minimum, maintaining habitats where communities are currently residing and preventing further water pollution will ensure that current communities will continue to exist. However, restoring habitats and improving water quality in river tributaries may pave the way for mussel species in decline to rebound. Remediating toxic water pollution problems, such as abandoned mine drainage, in tributaries to the Susquehanna River where Yellow Lampmussel habitats are found, will increase mussel community health and may allow communities to expand their range into pollutant-free habitats.



The Susquehanna River is an example of habitat that is typical for this community.

photo source: PNHP

^{*} Recognized as a species of special concern in Pennsylvania by the Pennsylvania Natural Heritage Program.

Threats and Conservation of Freshwater Mussels

Freshwater mussel populations are rapidly declining in North America. For mussel species in the United States, nearly 25% have Federal Endangered or Threatened status and 75% are listed as Threatened, Endangered, or of Special Concern by individual states (Nedeau et al. 2005).

Mussel communities are generally indicative of habitat types that are rare in the Commonwealth and becoming increasingly rarer. Mussel species are generally found in watersheds at least 75 sq. km. in size that have medium or large sized streams. Mussel species richness tends to increase with increasing watershed size (Strayer and Jirka 1997), so the largest rivers in Pennsylvania, like the Ohio, Allegheny, Susquehanna, and Delaware Rivers tend to have the most diverse mussel communities. Water quality threats to mussels include toxic and organic compounds released from industrial and municipal point sources. Non-point source pollution contributed from large areas, like farms and cities, can also threaten water quality for mussels. Agricultural practices can vary greatly, as can their influences on mussel communities. In many instances, mussels are seemingly undisturbed, compared to other aquatic organisms, by agricultural pollution. But excessive sedimentation and habitat alteration from agricultural practices can also be detrimental to mussel communities. Runoff from urban and suburban developments appears to be more damaging to mussels, most likely due to combined effects of altered hydrology, excess sediment and nutrients, and warm water temperatures. In recent decades, regulations of gross point source discharges have sufficiently improved water quality and allowed mussels to recolonize some streams and rivers (Strayer and Jirka 1997).



PNHP staff surveying for freshwater mussels in the Susquehanna River using clear-bottomed buckets.

photo source: PNHP



Elktoe (Alasmidonta marginata)
photo source: PNHP

Hydrologic alteration, disrupted connectivity, habitat alteration, and changes in thermal properties are ways in which dams negatively influence mussel communities. Fish hosts have restricted movement from dams and parasitic mussels carried by their hosts are similarly restricted in their distribution. Alterations of the stream channel above and below the dam will potentially alter available habitat for mussel communities. Water quality and temperature can be largely altered in a reservoir. Impoundment management and drawdown plans can be important for maintaining mussel communities.

Invasive mussel species like the Zebra Mussel (*Dreissena polymorpha*) and the Asian Clam (*Corbicula fluminea*) may be damaging to populations of native mollusks. Non-native mussels may alter food resources and habitat (Hakenkamp et al. 2001) and may also smother endemic mussel populations, as is the case with the Zebra Mussel.

Mussel habitat requirements are not well known. Protecting habitats where mussels are currently occurring is a first step to ensuring the long-term mussel resource. Protection from major channel alteration by bridges, dams, and dredging is important for maintaining habitat. Preventing excessive amounts of sediments, nutrients, and toxins in streams and rivers will maintain good water quality to support healthy mussel communities. Adopting zoning, stormwater detention ordinances, and natural resource protection ordinances will help protect mussel resources. Reducing the effects of urbanization through control of quantity and quality of stormwater will also help protect these habitats.

Pennsylvania is fortunate to harbor many inland freshwater mussel taxa that are globally rare. By conserving the processes that support these species, we are better able to conserve the species. Thus, we believe that it is important to protect examples of each mussel community and protect watersheds that contain diverse mussel populations to effectively protect the biodiversity of the state, and the nation.

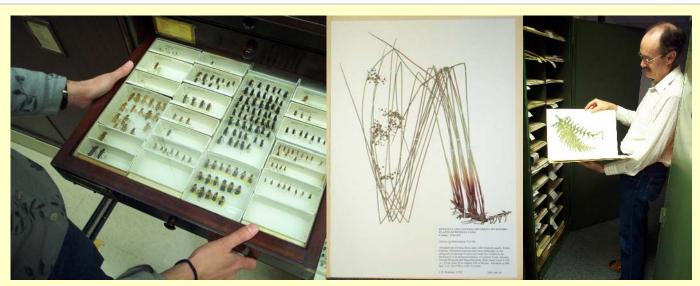
PENNSYLVANIA NATURAL HERITAGE PROGRAM DATA SYSTEM

The Pennsylvania Natural Heritage Program (PNHP) was established in 1982 as a joint venture between the PA Department of Environmental Resources (DER), The Nature Conservancy (TNC), and the Western Pennsylvania Conservancy (WPC). Today this partnership continues under the leadership of WPC, the Department of Conservation and Natural Resources (DCNR), the Pennsylvania Game Commission (PGC), the Pennsylvania Fish and Boat Commission (PFBC), and the US Fish and Wildlife Service (USFWS). Their database has become Pennsylvania's chief storehouse of information on outstanding natural habitat types (natural communities) and plant and animal species of special concern. Several other noteworthy natural features are also stored in the database, including DEP-designated Exceptional Value Streams (Shertzer 1992) and outstanding geologic features (based on recommendations from Geyer and Bolles 1979 and 1987).

The database includes existing data on occurrences of species and communities of special concern, gathered from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists. From this foundation, PNHP has focused its efforts on, and conducts systematic inventories for, the best occurrences of the priority species and natural communities.

PNHP has recorded nearly 18,000 detailed occurrences of species and communities of special concern, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps. Additional data are stored in extensive manual and digital files of over 200 natural community types, 1,400 animals, and 3,500 plants. These files are organized by each of Pennsylvania's 881 7½ USGS topographic quadrangle maps using a geographic information system (GIS).

In order to conduct an inventory of significant flora, fauna, and natural communities in the county, biologists from the Program first consulted the PNHP database. They then used a systematic inventory approach to identify the areas of highest natural integrity in Snyder County. The natural community and rare species data are the basis for judging the biological values of sites within the county. Protecting the sites with the best occurrences of the county's natural communities, and viable populations of sensitive plant and animal species can help to ensure that a full range of biological diversity in Snyder County is preserved for the future.



The Pennsylvania Natural Heritage Program database is a collection of data on occurrences of species and communities (elements) of special concern, drawing from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists.

photo source: PNHP

NATURAL HERITAGE INVENTORY METHODS

Methods used in the Snyder County Natural Heritage Inventory followed Pennsylvania Natural Heritage Program procedures, and those developed in Illinois (White 1978) and Indiana (Anonymous 1985). The inventory proceeds in three stages: 1) information is gathered from the PNHP database files, local experts, and map and air photo interpretation; 2) ground surveys conducted (preceded by one low-altitude flight over the county); and 3) data are analyzed and mapped.

Information Gathering

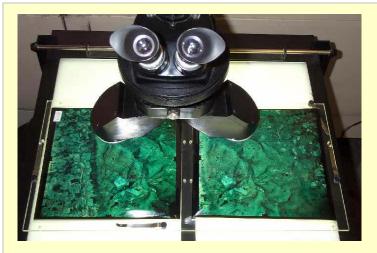
A list of natural features found in the county was prepared from the PNHP database and supplemented with information volunteered by local individuals and organizations familiar with Snyder County. In October of 2004 a public meeting was held and recommended Natural Area Survey Forms (Appendix I) were distributed to facilitate public input. PNHP staff solicited information about potential natural communities, plant species of special concern and important wildlife breeding areas from knowledgeable individuals and local conservation groups. A number of potential natural areas were identified by audience members and scheduled for field surveys.

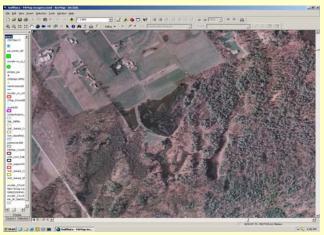
Map and Air Photo Interpretation

PNHP ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented (Appendix II). Additional data from vegetation maps, soil survey maps, field survey

records and other sources were consulted to gain familiarity with Snyder County's natural systems. This information, along with references on physiography, geology, and soils, was used to interpret photos and designate probable vegetation types and potential locations for exemplary communities and rare species. In many instances, vegetation was classified at an ecosystem level, and it was therefore critical that an ecologist or person with similar training interpret the maps and aerial photos.

Work progressed systematically within the area encompassed by each USGS topographic map. The natural area potential of all parcels of land was assessed using aerial photographs. Areas continuing into adjacent counties were examined in their entirety. Topographic maps used during field surveys were marked to indicate locations and types of potential natural areas based on characteristics observed on the photos. For example, an uneven canopy with tall canopy trees could indicate an older forest; a forest opening, combined with information from geology and soils maps, could indicate a seepage swamp community with potential for several rare plant species. Baseline information on sites appearing to have good quality communities or potential for rare species was compiled to help prioritize fieldwork.





Using aerial photography, skilled PNHP staff are able to identify areas with characteristic signatures that potentially indicate areas with high biological significance. Aerial photography interpretation can give a quick overview of the condition of particular areas in the county and is a first stop for identifying areas that will be targeted for field surveys.

After an initial round of photo interpretation, field surveys were conducted to evaluate the potential natural areas. Locations with minimally disturbed natural communities or with species of special concern were outlined on topographic quadrangle maps. The photo signatures (characteristic patterns, texture, tone of vegetation, and other features on the photos) of these sites were then used as a guide for continued photo interpretation and future field surveys. Photo signatures of poor quality sites led to the elimination of further fieldwork on other sites with similar signatures.

Field Work

Experienced PNHP biologists and contractors conducted numerous field surveys throughout Snyder County from 2004 through 2007. Biologists evaluated the degree of naturalness of habitats (including assessment of percent of native vs. non-native plant species, degree of human disturbance, age of trees, etc.) and searched for plant and animal species of special concern. Workers also categorized the vegetation of each potential natural area visited. An evaluation of quality was made for each potential natural community element, with care being taken to give reasons for the quality rank. Boundaries of the community types were redrawn, if needed, based on new field information. Community information recorded included the dominant, common, and other species, as well as disturbances to the community. Field forms were completed for all occurrences of plant and animal species of special concern and natural communities (see sample Field Survey Form, Appendix III), the quality of each population or community was assessed, and locations were marked on USGS topographic quadrangle maps.

In March of 2005, two low altitude reconnaissance flights were flown over the county to provide a more



Small Mammal Surveys

accurate overview of the current condition and extent of known natural areas and to assess the potential of any additional areas.

Data Analysis

To organize the natural features data and set conservation priorities, each natural community or species (element) is ranked using factors of rarity and threat on a state-wide (state element ranking) and range-wide (global element ranking) basis (see Appendix IV). Each location of a species (an element occurrence) is ranked according to naturalness, its potential for future survival or recovery, its extent or population size, and any threats to it. An explanation of the five element occurrence quality ranks is given in Appendix V. The element-ranking and element occurrenceranking systems help PNHP personnel to simultaneously gauge the singular importance of each occurrence of, for example, an Ephemeral/fluctuating Natural Pool community or yellow-fringed orchid occurrence in Snyder County, as well as the statewide or world-wide importance of these natural features. Obviously, sites with a greater number of highly ranked elements merit more immediate attention than sites with a smaller number of lower ranked elements

Field data for natural communities and plant and animal species of concern found, were combined with existing data and summarized in PNHP Element Occurrence Records for mapping and computerization. Mapped locations of natural features, including approximate watershed or subwatershed boundaries, were then created and added electronically to PNHP's Geographic Information System (GIS).



Invertebrate Surveys

photo source: PNHP



Experienced PNHP staff conduct botanical surveys and habitat assessments for species of special concern. All sites are evaluated for their natural condition. Associated disturbances and threats are noted and recommendations are made to minimize negative impacts.

photo source: PNHP

Information on the needs of the rare species in this report has come from a variety of sources, including field guides and research publications. For reptiles and amphibians, the major sources are Hulse et al. (2001); for birds, Brauning (1992) and McWilliams and Brauning (2000); for moths, Covell (1984); for butterflies, Opler and Krizek (1984) and Opler and Malikul (1992); Schweitzer (1981) provided much of the information on rare moth and butterfly species in Pennsylvania. A list of Plant and Animals of Special Concern in Snyder County is provided in Appendix VI.

Landscape Analysis

Background: Fragmentation of the landscape by roads, utility lines, and other human disturbances can impact the surrounding landscape significantly. A road or utility line cut through a forested block cleaves the large block into two smaller blocks and significantly increases the amount of edge habitat within the forest. When a forest with a closed canopy is disturbed by road building activities, the newly disturbed soil and open canopy favor the establishment of invasive species of plants and animals. Many of these will out-compete and displace

native species in this disturbed habitat. These smaller forest fragments will have significantly more edge habitat and less forest interior than the original forest block. Furthermore, fragmentation of large forest blocks decreases the ability of many species to migrate across manmade barriers such as roads. Migration corridors, once severed, isolate populations of species from one another, limit the gene flow between populations and create islands of suitable habitat surrounded by human activity. Much of the native biological diversity of an area can be preserved by avoiding further fragmentation of these large forested areas. Historically, edge habitat was created to provide habitat for organisms. namely game species, which often thrive in disturbed areas. Today, we realize that by fragmenting forests we are eliminating habitats for the forest interior species. Those species that utilize edge habitats are typically considered generalists, capable of utilizing many different habitats and are usually not of immediate conservation concern.

The larger forested blocks in the County (those of at least 250 acres) have been highlighted in an effort to

draw attention to the significance of large forested blocks within the County. Besides being habitat suitable for many native species, large unfragmented forest blocks in close proximity to each other become natural corridors for species movement within and through the county. In many cases, by highlighting the larger forested blocks, the most natural landscape corridors become evident.

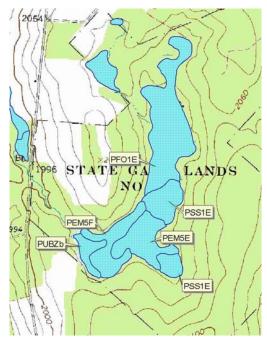
GIS Methodology: Creating Forest Block Layers

Forested areas in Snyder County were identified though a classification of 2000 Penn State Land Cover Data, compiled from Landsat TM (thematic mapping) satellite imagery with a resolution of 30 meters (~100 feet) and downloaded from Pennsylvania Spatial Data Access (http://pasda.psu.edu/).

Land cover types used in the creation of forest blocks were transitional, deciduous, coniferous, and mixed forest; woody wetlands, and emergent herbaceous wetlands. Interstates, U.S. and state highways, state,

county and township roads, active railroads, and utility right-of-way locations digitized from aerial photos were considered fragmenting features. The forest block layer was overlain by the Penn DOT road layer to identify forest blocks fragmented by roads. The Pennsylvania Department of Transportation (Penn DOT) right-of-way (ROW) distance was applied as a buffer to roads: interstates have a 500-foot ROW, PA and US designated roads have a 150-foot ROW, and local roads have a 100foot ROW. Analysis to identify contiguous blocks of forest was conducted using the map calculator function of the Spatial Analyst Extension in ArcView 3.2. The results were then compared against aerial photos and any apparent non-forested areas were removed. Forest blocks less than 1 acre were then removed and the remaining blocks were grouped into four size classes: 0-250 acres; 250-1,000 acres; 1,000-5,000 acres; and greater than 5,000 acres. A detailed description of the GIS analysis is available upon request.





Wetlands are frequently a combination of several types of natural communities. National Wetland Inventory (NWI) maps provide distinctions among these types. The lines that occur within wetlands on the township maps in this report represent these distinctions. A wetland is represented in the aerial photo and the topographic map above. Distinct zones of open water and types of vegetation are clearly visible in the aerial photo and roughly correspond to the lines on the topographic map. This helps illustrate the complex diversity of habitats found in many wetlands. For a definition of wetland codes visit the National Wetland Inventory web site at: http://wetlandsfws.er.usgs.gov/tips.html

Species Ranking

Each year biologists representing various taxonomic groups of the Pennsylvania Biological Survey meet to discuss and rank the most important species for the protection of biodiversity in Pennsylvania. The various Biological Technical Committees include the Bryophyte and Lichen Technical Committee, the Fish Technical Committee, the Fungi Technical Committee, the Herpetological Technical Committee, the Invertebrate Technical Committee (with subcommittees of aquatic invertebrates, terrestrial invertebrates, arachnids and mollusks), the Mammal Technical Committee, the Ornithological Technical Committee, and the Vascular Plant Technical Committee with a subcommittee for natural communities. These meetings consist of a review and ranking of species of concern within the state, in terms of the rarity and quality of the species or habitats of concern, potential threats, and protection needs. The results of these meetings provide a baseline for evaluating the statewide significance of the species recognized in the Natural Heritage Inventory.

Site Ranking

The Pennsylvania Natural Heritage Program considers several criteria when ranking Natural Heritage Inventory sites to ensure that all sites, regardless of ecological differences, are evaluated systematically. Each criterion is considered independently and then all are examined collectively to ensure that no one criterion receives more emphasis than another. First, the commonness/rareness of the species at a site, defined by the global and state ranks (G & S ranks Appendix IV), is considered in the site ranking process. Those sites which include rarer species with higher ranks (i.e. G3 or S1) are given precedence over sites with more common, lower ranked species (i.e. G5 or S3). Next, the number of different species occurring at a site is also considered in the ranking process. Sites with multiple tracked (Rare, Threatened, or Endangered species monitored by PNHP) species are considered to be higher conservation priorities than sites with fewer tracked species. The ecological characteristics of the species at each site are also considered in the ranking process. For example, species that have highly specialized habitat requirements and are not known to readily disperse during periods of disturbance are under greater ecological pressure than species that have more general habitat requirements and have a greater capacity for dispersion. Finally, the site ranking process examines the landscape context of each site. For example, a site that is entirely isolated due to fragmentation, with little chance of restoration of connectedness, is a lower conservation priority than a

site that remains connected to other suitable patches of habitat. Site connectedness is critical because the potential for connected populations to remain viable is far greater than small isolated populations. By considering these criteria, the conservation priorities within Snyder County are highlighted to promote appropriate use of conservation dollars and efforts.

The four significance ranks are: *exceptional*, *high*, *notable*, and *local significance*. These ranks have been used to prioritize all identified sites and suggest the relative attention that sites should receive for protection.

exceptional significance*

- Sites that are of exceptional importance

for the biological diversity and ecological integrity of the county or region. Sites in this category contain one or more occurrences of state or national species of special concern or a rare natural community type that are of a good size and extent and are in a relatively undisturbed condition. Sites of exceptional significance merit quick, strong, and complete protection.

high significance*

- Sites that are of high importance for the biological

diversity and ecological integrity of the county or region. These sites contain species of special concern or natural communities that are highly ranked, and because of their size or extent, relatively undisturbed setting, or a combination of these factors, rate as areas with high potential for protecting ecological resources in the county. Sites of high significance merit strong protection in the future.

notable significance*

- Sites that are important for the biological diversity and ecological integrity of the

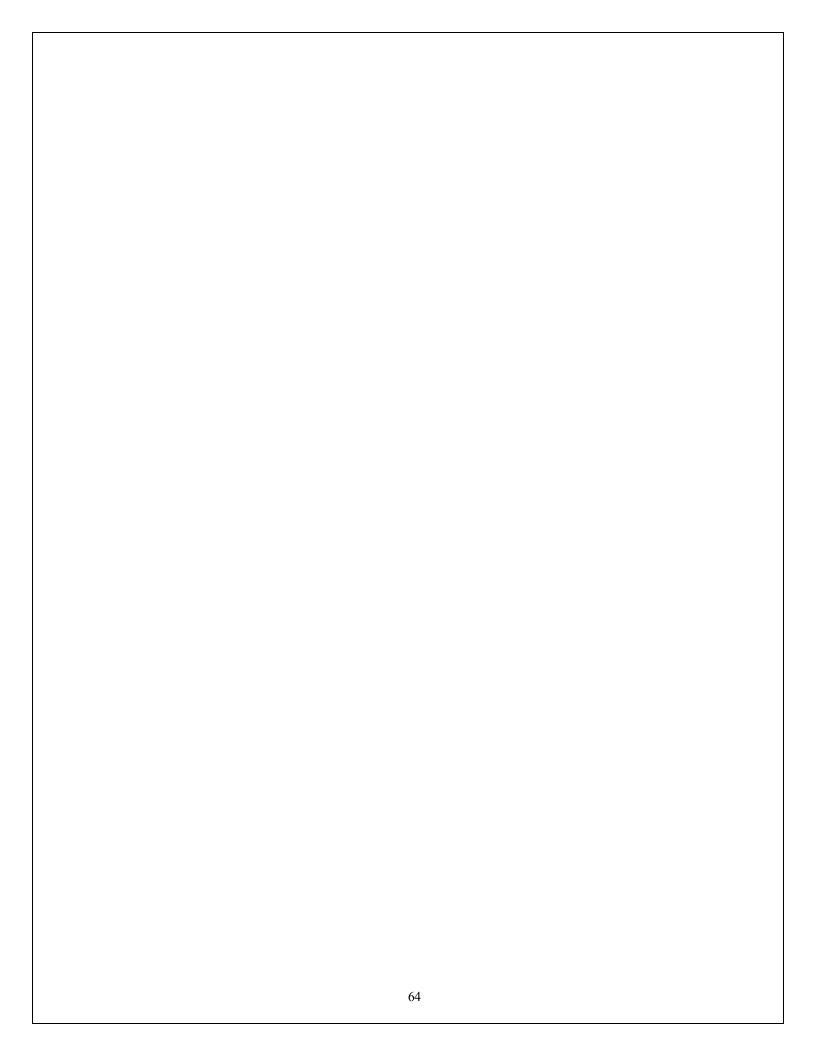
county or region. Sites in this category contain occurrences of species of special concern or natural communities that are either of lower rank (G and S rank) or smaller size and extent than exceptional or high ranked areas, or are compromised in quality by activity or disturbance. Sites of notable significance merit protection within the context of their quality and degree of disturbance.

local significance*

- Sites that have great potential for protecting biodiversity in the

county but are not, as yet, known to contain species of special concern or state significant natural communities. Often recognized because of their size, undisturbed character, or proximity to areas of known significance, these sites invite further survey and investigation. In some cases, these sites could be revealed as high or exceptional sites.

^{*} note that the shades of red, orange, yellow, and blue are used consistently throughout the document to refer to the significance rank.



RESULTS AND DISCUSSION

Forest Block Analysis--Landscape-scale Conservation

Forest blocks were identified in Snyder County and grouped into four size classes: 0-250 acres; 250-1,000 acres; 1,000-5,000 acres; and greater than 5,000 acres (Figure 5). The largest blocks were concentrated in the Bald Eagle State Forest of Armagh Township in the northeast corner of the county, the length of Jacks Mountain across the county, and the Blue Mountain corridor along the southeast edge of the county. A discussion of the importance of considering these large remaining forested areas in conservation follows.

Prior to European settlement, forest covered more than 90% of Pennsylvania (Goodrich et al. 2003). Today, 62% of the state is forested, comprising an area of over 17 million acres (Goodrich et al. 2003, Myers et al. 2000). However, much of this forest exists as relatively small islands isolated by surrounding linear features such as roads, utility right-of-ways, all-terrain vehicle and snowmobile trails, and railroads, as well as non-forest lands. Figure 6 shows forested areas greater than 250 acres that remain after fragmentation by interstate, US, and state highways; state and local roads; public forest roads; utility right-of ways; and active railroads. The forest blocks represent potential contiguous habitat for animals sensitive to all scales of fragmenting features, such as amphibians and interior forest birds. The acreage size classes shown in this figure roughly correspond to area-sensitive species requirements.

A number of studies have looked at the effects of roads and other linear features on the landscape. Ecological impacts of these fragmenting features include: (1) direct mortality of wildlife from vehicles; (2) disruption of wildlife dispersal; (3) habitat fragmentation and loss; (4) imposition of edge effects; (5) spread of exotic species; (6) alteration of the chemical environment.

Roads can be a significant source of mortality for a variety of animals. Amphibians may be especially vulnerable to road-kill, because their life histories often involve migration between wetland and upland habitats, and individuals are inconspicuous. One study conducted in southeastern Pennsylvania documented over 100 road-killed salamanders and frogs in one rainy night on a one-mile stretch of road in the spring breeding season (Goodrich et al. 2003). Large and mid-sized mammals are particularly

susceptible to vehicle collisions on secondary roads, while birds and small mammals are most vulnerable on wider, high-speed highways (Forman and Alexander 1998). In Upper St. Clair Township, Allegheny County, Pennsylvania, over the last four vears, white-tailed deer (*Odocoileus virginianus*) mortality due to road-kills was approximately four times higher than mortality due to hunting (Upper St. Clair Township Department of Deer Management). Six hundred thirty seven bobcats (*Lynx rufus*) were reported as road-kills in Pennsylvania from 1985 to 2000 (Goodrich et al. 2003). A 10-year study of road mortality in New Jersey recorded 250 raptors representing 12 species along a 90-mile section of road (Loos and Kerlinger 1993, cited in Goodrich et al. 2003).

Animals may alter their behavior in the presence of a road. One study found that small forest mammals (e.g., eastern chipmunk, eastern gray squirrel, and deer mouse) were reluctant to venture onto road surfaces where the distance between forest margins exceeded 20 m. The same study concluded that a four-lane divided highway might be as effective a barrier to the dispersal of small forest mammals as a body of fresh water twice as wide (Oxlev et al. 1974). A study conducted in North Carolina found that black bears shift their home ranges away from areas with high road densities (Brody and Pelton 1989). Traffic noise has been shown to interfere with songbird vocal communication thus affecting their territorial behavior and mating success (Seiler 2001). Roads, wide trails, and grassy corridors can also function as barriers restricting the movement of invertebrates and amphibians. Populations of microhabitat-specific species like land snails and salamanders, that generally require moist habitats, may be isolated by inhospitable, xeric corridors (Williams 1995, Blaustein et al. 1994). Some forest butterflies, like the West Virginia white (*Pieris virginiensis*), will not cross open habitats and its current rarity may be a function of habitat fragmentation and isolation (Williams 1995). Consequences of the isolation of populations include reduced genetic diversity and low recruitment rates that can, in turn, result in local extinctions (Seiler 2001).

Fragmentation of contiguous forested landscapes into smaller, isolated tracts has an effect on plant and

animal distribution and community composition. When an extensive forest tract is fragmented, the resulting forest islands may lack the full range of microhabitats that existed in the original tract or may be smaller than the minimum area required by a given species (Lynch and Whigham 1984). For example, the Louisiana Waterthrush (Seirus motacilla) is rarely found in small woodlots, because they require upland forest streams within their territory, and most small woodlots lack this necessary component (Robbins 1980, Robinson 1995). Area-sensitive species such as Northern Goshawk (Accipiter gentilis), Barred Owl (Strix varia), Bobcat, and Timber Rattlesnake (Crotalus horridus) require interior forest areas in excess of 6.000 acres to accommodate breeding and foraging territories (Squires and Reynolds 1997, Mazur and James 2000, Ciszek 2002, NatureServe 2005).

Along with a reduction in total forested area, forest fragmentation creates a suite of "edge effects" which can extend more than 300 meters into the remaining fragment (Forman and Deblinger 2000). Edge forest is composed of a zone of altered microclimate and contrasting community structure distinct from the interior, or core forest (Matlack 1993). Edges experience increased light intensity, altered insect and plant abundance, a depressed abundance and species richness in macroinvertebrate soil fauna, and a reduced depth of the leaf-litter layer (Yahner 1995, Haskell 2000, Watkins et al. 2003). The macroinvertebrate fauna of the leaf litter is significant for the pivotal role it plays in energy and nutrient cycling: these macroinvertebrates also provide prey for salamanders and ground-feeding birds. A number of studies have shown that the nesting success of forestinterior songbirds is lower near forest edges than in the interior because of increased densities of nest predators and brood parasites (reviewed in Murcia 1995).

Roads can act as corridors for plant dispersal, and exotic species increase their range by spreading along roadsides (Watkins et al. 2003). Vehicles and road-fill operations transport exotic plant seeds into uninfested areas, and road construction and maintenance operations provide safe sites for seed germination and seedling establishment (Schmidt 1989; Greenberg et al. 1997; Trombulak and Frissell 2000). Road traffic and maintenance of right-of-ways contribute at least six different classes of chemicals to the environment: heavy metals, salt, organic pollutants, ozone, nutrients, and herbicides (Forman and Alexander 1998, Trombulak and Frissell 2000). Heavy metals such as lead and iron contaminate soils, plants, and invertebrates up to 200 meters from roads, as well as vertebrate fauna foraging within the affected zone (Trombulak and Frissell 2000). Deicing salts contribute ions to the soil, altering pH and



Even a moderately sized gravel road can act as a fragmenting feature in a large tract of forest.

photo source: PNHP

soil chemical composition, which affects plant growth (Forman and Alexander 1998, Trombulak and Frissell 2000). Airborne sodium chloride from road salt may cause leaf injury to trees up to 120 meters from a road (Forman and Alexander 1998). Organic pollutants such as dioxins and polychlorinated biphenyls (PCBs) are present in higher concentrations along roads, and hydrocarbons may accumulate in aquatic ecosystems near roads (Trombulak and Frissell 2000). Storm runoff from roads, particularly where roads abut or cross water bodies, results in the transport of nutrients and sediments into aquatic ecosystems (Trombulak and Frissell 2000). Drifting or misapplied herbicides applied to roadsides and utility right-of-ways to control woody plant growth may damage forest edge and interior plant species (Williams 1995).

Humans are an integral part of natural history, where we function as ecosystem engineers, altering the landscape around us to suit our needs. Some species benefit from human-induced changes, such as birds that inhabit the early Successional and edge habitats provided by utility corridors or disturbance-adapted plants that colonize roadsides. But as is more often the case, species with specific habitat requirements tend to suffer declining numbers when faced with human encroachment. Given the pervasiveness of human influence throughout the northeastern United States, the ecological importance of large areas of relatively pristine habitat cannot be overstated. Not only are they potential habitat for a number of area-sensitive species, they are also important for the maintenance of vital ecosystem processes such as nutrient cycling, pollination, predator-prey interactions, and natural disturbance regimes (Heilman et al. 2002). In addition, large forested areas also serve to filter and regulate the flows of streams within watersheds and store large quantities of carbon as biomass.

Recommendations for all Forest Blocks

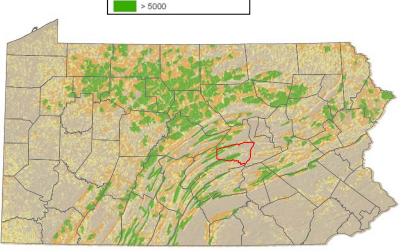
A significant portion of the land encompassed by these forest blocks is under public ownership, which presents land managers with the opportunity to coordinate sustainable management as well as biodiversity conservation. The Bureau of Forestry, responsible for managing a significant portion of land within these forest blocks, recognizes sustainability as the overarching goal of the management of state forests. The Pennsylvania Game Commission, which manages a small portion of the lands contained within these forest blocks, focuses on management practices aimed at enhancing habitat for wildlife. It is recommended that both of these agencies take into consideration the uniqueness of the contiguous forest contained within these areas, managing for older forests through longer rotations and silvicultural practices that enhance structure.

Forest fragmentation can be minimized by utilizing existing disturbed areas for new projects (e.g., wind farms) rather than clearing additional forest, by consolidating roads and right-of-ways where multiple routes exist, and by restoring unused cleared areas such as abandoned roads or railroad tracks to forest. When planning development, it is preferable to avoid complete division of the forest block to minimize impacts. Contiguity could be improved by establishing forested corridors at least 300 meters (1000 feet) wide between forest blocks that are separate. The impact of individual features such as wells, roads, right-of-ways, or other clearings can also be minimized by the use of ecologically informed best management practices in construction and maintenance.

A number of resources, listed in Appendix VII (page 185), are available to private landowners interested in sustainably managing their forestlands for biodiversity conservation, forest health, and forest products including timber. mushrooms, and high-value medicinal herbs. A good place to start is the Forest Stewardship Program, which assists landowners in developing a forest management plan based on their envisioned goals for their land. Landowners interested in bringing deer numbers back into balance with their habitat may want to consider enrolling in the Pennsylvania Game Commission's

Figure 6. Forested blocks greater than 250 acres in Snyder County Forested Blocks in Acres 1001 - 5000

Deer Management Program.



250 - 1000

These large forested blocks are critical habitat for plants and animals that are dependent on forest interior conditions such as many migrating bird species, fishers, bobcats, Northern Goshawks and Barred Owls. These forest blocks and their adjacent streams should be considered the backbone of wildlife habitat in the county. Conservation efforts in the county should concentrate on maintaining these large forest blocks by avoiding further fragmentation with additional roads, development, and utility rights-of-ways.

Riparian Buffer Recommendations

Riparian areas are lands directly adjacent to streams, creeks and rivers. Land adjacent to waterways and wetlands has an immediate influence on the quality of the water and the habitat it supports.

The literature varies with regard to buffer distances. From a strictly water quality standpoint, wetland buffers of 35-100 feet (10.7-30.5m) are thought to be sufficient for water quality maintenance. However, many of these buffer recommendations do not take wildlife habitat into account. Unfortunately, many states still refer to older literature with regard to wetland buffers and many of these studies are now considered to be rather obsolete. Newer scientific techniques have allowed researchers to conduct better studies with regard to habitat buffers. For example, wetland buffers of 48-98 feet (15-30 m) were once thought to be sufficient to protect vernal pool amphibians, while a more recent publication from the EPA, which reviewed dozens of peer reviewed journal articles on the subject, concludes that buffers of this size are inadequate to protect terrestrial habitats for vernal pool amphibians and reptiles. Many species of mammals and birds require much larger buffers to persist. Some bird species require forested buffers to be closer to 1640 feet (500 m)!



PNHP recommends an undisturbed (no-cut) riparian buffer of 328 feet (100 m) from rivers, streams, and floodplains to maintain the water quality of the wetland as well as to support many of the species of wildlife found in these sites. The riparian buffers recommended in this report also include wetlands, excluding created farm ponds and diked and impounded wetlands. These artificial wetlands have been excluded from this riparian buffer, since created and highly modified wetlands are generally poorer in biological quality. These buffers were not created for any one particular species but are thought to overlap the habitats used by both common and rare species found at these sites. Certainly, expanding these buffers will still provide water quality protection while increasing habitat for species that require larger blocks of contiguous forest. It is our professional belief, based on much scientific literature that a minimum buffer of 328 feet (100 m) should be implemented around the wetland, floodplain and riparian areas identified in the report to continue to support the species, both common and rare, found at these locations as well as minimize the catastrophic effects of floods on human land use.

The township maps graphically symbolize these recommended riparian buffers in an olive-green shade. Where these buffers coincide with large forested blocks (yellow, orange or green) the riparian buffer is a priority for conservation. Where the buffers are outside of large forested blocks (gray areas) these are riparian buffers that should be considered priorities for restoration.



Riparian buffers through large forest blocks should be considered a priority for conservation (left)

Riparian buffer through non-forested areas should be considered a priority for restoration (above).

Priorities for Protection – Inventory Results

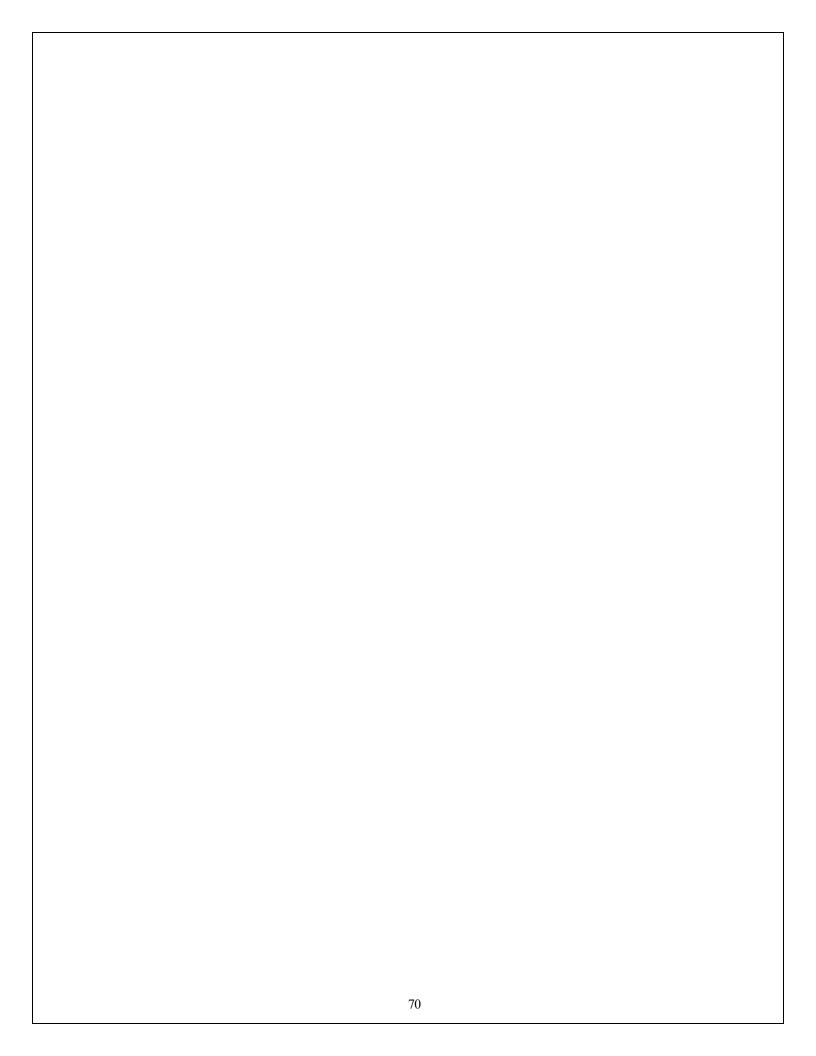
Fifty Natural Heritage Sites were identified in the Snyder County Natural Heritage Inventory (see the foldout Site Index that follows). Detailed maps and description of each site follows, organized by township. For each township, a map, summary table, and full report are provided. Townships are arranged alphabetically; boroughs are included with the appropriate township due to their small size. Township sections include:

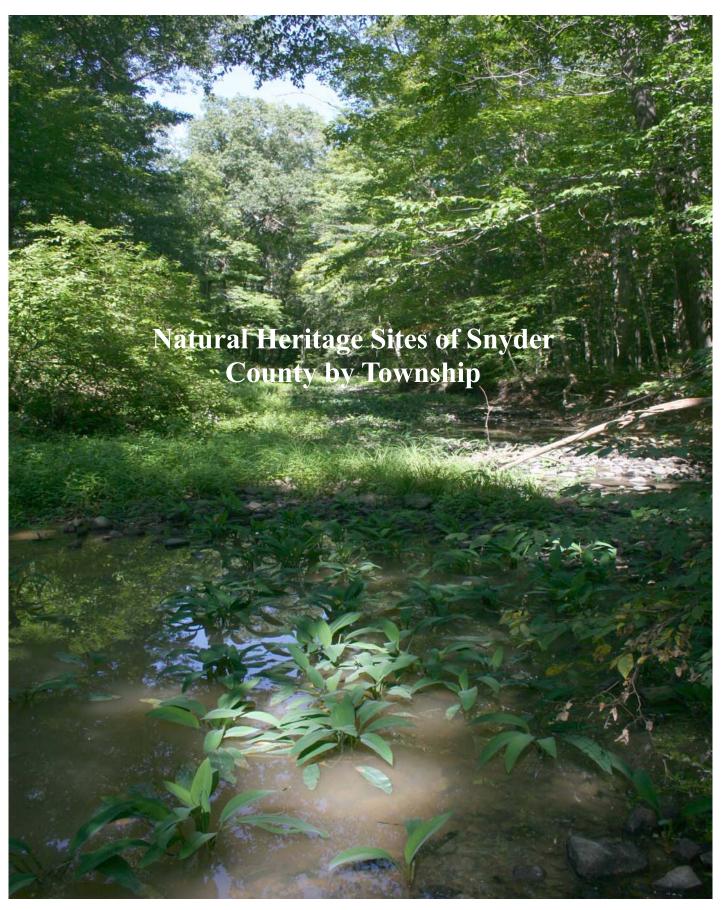
- A categorical designation of a site's relative significance is listed after the site name. Table 1 (pg. xv) has a summary of sites by significance category. Definitions of the significance categories are outlined in the Methods section (pg. 59).
- Listed under each site name are any statesignificant natural communities and species of special concern that have been documented within the area.
 - O See Appendix II (pg. 174) for a list of Natural Communities recognized in Pennsylvania.
 - Some species perceived to be highly vulnerable to intentional disturbance are referred to as "species of concern" rather than by their species name, and no ranks are revealed.
 - O The PNHP rarity ranks and current legal status (detailed in Appendix III, pg. 177) are listed for each community and species.
 - The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for protection.

Table 1 prioritizes sites with natural communities and species of concern documented in Snyder County. These sites are displayed in UPPER CASE letters throughout the report. This table ranks sites from the most important and threatened to the least, with "Exceptional" representing the higher priority sites and "Notable" representing the lower priority sites for the conservation of biodiversity in the county. Table 1 lists the site name, local jurisdiction, and pertinent information about the site. A more detailed description for each site is included in the text for each township in which it occurs.

Sites of "Local" significance are indicated in Title Case letters throughout the document, and are briefly discussed in the text accompanying each map. These are sites at which species of special concern or high-quality natural communities could not be documented during the survey period. These areas are not exemplary at the state level, but may be important at the county level. Examples would include relatively intact forested areas, caves, large wetlands, and other areas significant for maintaining local biodiversity.

Each of the primary sites identified in this report has associated with it areas mapped as Core Habitat and Supporting Natural Landscape. Core Habitat areas are intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance without substantial impact to the natural features. The Supporting Natural Landscape identifies areas surrounding or adjacent to Core Habitat that are not considered the primary habitat of the species of concern or natural community, but may serve as secondary habitat. These areas provide support by maintaining vital ecological processes as well as isolation from potential environmental degradation. Supporting Natural Landscape areas may be able to accommodate some types of activities without detriment to natural resources of concern. Each should be considered on a site-by-site and speciesby-species basis.





A view of the State Gamelands #188 Floodplain in Beaver Township. Note that the plant in the foreground is the state watchlist species, Golden club (*Orontium aquaticum*).

Adams Township

NATURAL HERITAGE SITES:		PNHP Rank ¹		State	Last Seen	Ovality ²
		Global	State	Status	(m/d/y)	Quality ²
DOLLAR WOODS MACROSITE		exceptional significance				
species of special concern ³		-	-	PE	8/2/2006	E
species of special concern ³		-	-	-	6/28/2006	E
species of special concern ³		G5	S3	-	6/13/2006	E
Ĥarlequin Darner (Gomphaeschna furcillata)		G5	S2	-	6/13/2006	E
Praeclara Underwing (Catocala p	praeclara)	G5	S3S4	-	7/19/2006	E
Ephemeral/fluctuating Natural Pool		GNR	S3	-	4/18/2006	BC
Acidic Broadleaf Swamp		G5	S3	-	6/2/1987	BC
GRASS MOUNTAIN VERNAL	POOL S		h	igh signific	nanaa	
				ign signiju		
Ephemeral/fluctuating Natural Poo	I	GNR	S3	-	4/15/2003	BC
Brown sedge (Carex buxbaumii)		G5	S3	TU	8/31/1995	D
PORT ANN VERNAL POOLS	N VERNAL POOLS		high significance			
Ephemeral/fluctuating Natural Poo	1	GNR	S3	-	8/21/1992	Е
PUBLICLY MANAGED LANDS:	Bald Eagle State Forest, State Game Lands #188	site signif	icance rank:	exceptional	high notable	local

OTHER CONSERVATION AREAS: Central Mountains IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: Swift Run (HQ-CWF)

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Middle Creek-Unnamed Creek at Middleburg
- North Branch Middle Creek
- North Branch Middle Creek-Walker Lake Dam
- Penns Creek-Tuscarora Creek

- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community
- Warmwater Community 2; High Quality Small Stream Community
- Coolwater Community 1; High Quality Small Stream Community
- Warmwater Community 1; Eastern Elliptio Community

Adams Township is located in northern Snyder County, bordered by Union County. Jacks Mountain forms the northern boundary. The bedrock geology is mostly shale with small areas of sandstone and limestone. Forests make up 60% of the total landcover in Adams Township.

Large forested blocks occur in the northern part of the township, but the rest of the forested areas in Adams Township exist as smaller fragmented patches. Trees should be planted wherever possible in these areas to connect the

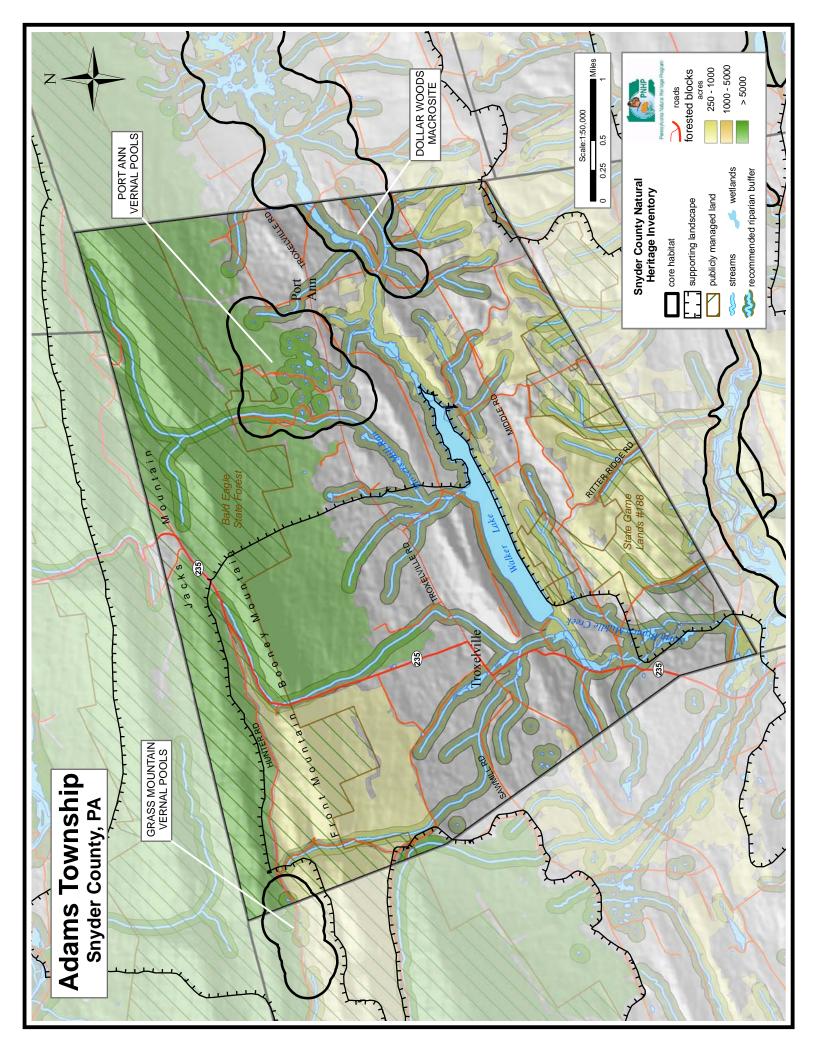
patches. Trees should be planted wherever possible in these areas to connect the forested habitat. Bald Eagle State Forest is located in the mountainous areas in northern Adams Township. Part of State Game Lands #188 is located in the southern part of the township. Agriculture makes up 34% of the total landcover in the township.

North Branch Middle Creek is the major stream flowing through the township, and a dam along this stream created Walker Lake. Most of the streams are flowing through the agricultural areas and fragmented forests, which do not filter out the sediments and chemicals as well as the large forested blocks. Trees should be planted in the open areas to provide a buffer and connect habitat patches. The Central Mountains Important Mammal Area (IMA) is located in northern Adams Township.

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection



ADAMS TOWNSHIP



One of the wetlands in the Dollar Woods Macrosite photo source: PNHP

DOLLAR WOODS MACROSITE (Center & Adams Townships)

This massive wetland complex is the largest in all of Snyder County, and is one of the most extensive wetland systems in the central portion of the state. The Dollar Woods Macrosite is really a conglomeration of several different wetland community types including an Acidic Broadleaf Swamp, a G5 S3 tracked community, with a portion of the site being a community of Ephemeral/fluctuating Natural Pools, a GNR S3 tracked community. The sheer size of the wetland complex, coupled with the varied types of wetlands within the site, provides excellent habitat for several species of concern. Several populations of **two globally** secure, state vulnerable animals of special concern were located at this site in 2006. Both of these species are semi-aquatic species that rely on shallow wetlands with emergent vegetation. The 2006 surveys also uncovered a population of the G5 S2 Harlequin

Darner (Gomphaeschna furcillata). This dragonfly relies on wetlands with high water quality for breeding. Also found at the Dollar Woods Macrosite was a population of the G5 S3S4 Praeclara Underwing (Catocala praeclara), a moth species of special concern in the state. In addition to the animal species of concern, two populations of a global and state vulnerable Pennsylvania endangered plant were also found at this site.

Threats and Disturbances

This site has become surrounded by agriculture and rural housing. Zerbe Road and Bucksey Road travel through the Dollar Woods Macrosite. Currently, much of the site is being developed, with homes being built where dry patches of ground can be found between the small wetlands. The site also receives runoff from agricultural land, which decreases the water quality of the site and may threaten the entirety of the community.

Conservation Recommendations

Further development of the Dollar Woods Macrosite is not compatible with the species of special concern that occur at this site and the site should be zoned to deter further development. Landowners at this site should be approached about conservation easements to ensure that the remaining wetlands can continue to function ecologically.

Forested regions within the site are critical to the overall health of the system and should be preserved in their current state. A no-cut forested buffer should be established around the site to minimize the influx of agricultural runoff from the surrounding lands. Agricultural practices close to the macrosite should be conducted with extreme care so that unnecessary



One of the wetlands, a former beaver pond, in the Dollar Woods Macrosite

photo source: PNHP

ADAMS TOWNSHIP



Harlequin Darner (Gomphaeschna furcillata)

photo source: Rick Koval

amounts of contaminants do not drain into the wetlands at the Dollar Woods Macrosite. Around the vernal pool communities at this site, a minimum 1000-foot (305-m) no-cut forested buffer should be established to protect the unique suite of vernal pool amphibians that use these pools.

GRASS MOUNTAIN VERNAL POOLS (Adams & Spring Townships)

This GNR S3 Ephemeral/fluctuating Natural Pool community contains a group of 30 vernal pools at the headwaters of Coral Run. The surrounding forest is mixed hardwoods, including red maple (*Acer rubrum*), northern red oak (*Quercus rubra*), and white oak (*Quercus alba*), with scattered eastern white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*). A thick heath shrub layer coats the ground around the pools at this site. In one of the pools is a population of the G5 S3 species of concern, brown sedge (*Carex buxbaumii*). This sedge species is not typically found growing in vernal pools, but the conditions in this particular pool are unique and provide suitable growing conditions for this rare plant.

Threats and Disturbances

This site lies on Bald Eagle State Forest land and while this affords the pools some degree of protection, the forest around the pools could be slated for future timbering practices. Additionally, this vernal pool community has been bisected by Hunter Road. Inappropriate road maintenance has led to siltation and runoff from the road surface during heavy rains. These contaminants not only serve to decrease the water quality, but also may slowly fill in the affected pools over time. Several of the pools in this community have had artificial channels dug between them to connect the pools.

Conservation Recommendations

Road maintenance should be conducted with the vernal pool community water quality in mind. Efforts should be made to minimize the silt input from the road surface into the pools. The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5-m) of no-cut, and 100 feet (30.5-m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool

amphibians are to be conserved. A minimum 1000-foot (305-m) no-cut forested buffer should be established around the pools at this site to protect the unique suite of vernal pool amphibians and the population of the Brown sedge that inhabit this vernal pool community.



Brown Sedge (*Carex buxbaumii*)
photo source: John Kunsman (PNHP)

ADAMS TOWNSHIP

PORT ANN VERNAL POOLS

(Adams Township)

This site contains a community of **Ephemeral/ fluctuating Natural Pools**, a GNR S3 tracked community in the state. This pool community is very large, containing several dozen pools along the base of Jack's Mountain on private property.

Threats and Disturbances

The wetlands are under significant threats, including imprudent timbering practices. At the western side of the pool community, a trailer park has been set up well within the area used by the vernal pool amphibians that inhabit these pools. The many ATV and jeep trails that crisscross this pool complex should not be used during the seasons when vernal pool amphibians are migrating to the pools for breeding.



The early spring rains initiate the migration of the Jefferson Salamander (Ambystoma jeffersonianum) to vernal pool waters, where the species will breed over the next few weeks. Soon after the arrival of the Jefferson Salamanders, the Spotted Salamanders (Ambystoma maculatum) will arrive at the pools to breed. These migrations often take place early enough in the spring that snow still falls. Even though ice may still be on the pools, small gaps in the ice allow for the salamanders to begin the breeding activity. The ice on the pools in the above photograph make these oft overlooked natural communities pop out from the landscape.



Just south of Bald Eagle State Forest on Booney Mountain, lies the Port Ann Vernal Pools complex. This vernal pool complex contains over 30 pools which are critical breeding habitat for a number of specialized amphibians. These small wetland complexes are also known to be used by some reptiles, dragonflies and damselflies, as well as unique habitat for a diversity of plants. The whole of organisms that use these vernal pools, and the rarity of pools, make them a natural community of special concern in the state. photo source: PA Map

Both of these aerial photgraphs are of the Port Ann Vernal Pools site. Take note of the many jeep and ATV trails throughout this vernal pool complex.

Conservation Recommendations
A no-cut forested buffer of at least 1000 feet (305 m) should be established around this community of vernal pools to protect the suite of vernal pool animals that use the site. The septic systems of the residences should also be well maintained to limit the amount of nutrient runoff that is likely occurring. The landowner should also be approached about a conservation easement on this site.

Beaver Township & Beavertown Borough

NATURAL HERITAGE SITES:	PNHP Rank ¹		State	Last Seen	Quality ²
	Global	State	Status	(m/d/y)	Quality
BEAVERTOWN VERNAL POOLS		ио	table signi	ificanco	
Ephemeral/fluctuating Natural Pool	GNR	S3	uvie signi	7/20/2006	С
Epitemetal/Indetdating Natural 1 001	ONK	33	_	7/20/2000	C
MIDDLE CREEK	high significance				
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	5/12/2005	E
MISSIONARY GLADE AND CAVE	exceptional significance				
Hoary Puccoon (Lithospermum canescens)	G5	S2	NR	7/11/2006	Е
Bladder Fern (Cystopteris tennesseensis)	G5	S1	NR	7/11/2006	E
Tall Gramma (Bouteloua curtipendula)	G5	S2	PT	7/11/2006	В
Side-oats gramma calcareous grassland	GNR	S1	-	7/11/2006	C
SHADE MOUNTIAN BARRENS	high significance				
Ridgetop dwarf-tree forest	G4	S3	-	4/12/2005	Е
A Zale Moth (Zale submediana)	G4	S2	-	5/3/2001	E
A Noctuid Moth (<i>Apharetra purpurea</i>)	G4	S2	-	6/23/2000	E
A Noctuid Moth (Aplectoides condita)	G4	S2S3	-	5/27/1998	E
Southern Pine Looper Moth (Caripeta aretaria)	G4	S 1	-	8/8/1997	E
A moth (Cerastis fishii)	G4G5	SNR	-	4/14/1998	E
Pine Devil Moth (Citheronia sepulcralis)	G4	S2S4	-	7/6/1999	E
A Midget Moth (Elaphria georgei)	G4	SNR	-	5/4/2006	E
Attentive Dart (Eueretagrotis attenta)	G4	SNR	-	7/6/1999	E
Footpath Sallow Moth (Metaxaglaea semitaria)	G5	S2	-	10/8/1997	E
A Moth (Sideridis maryx)	G4	S1S3	-	7/1/2000	E
Gordian Sphinx (Sphinx gordius)	G4	S1S3	-	5/24/1998	E
Broad Sallow Moth (<i>Xylotype capax</i>)	G4	S3	-	9/25/1997	E
Oblique Zale moth (Zale obliqua)	G4	S3	_	6/13/2001	Е
Pine Barrens Zanclognatha (Zanclognatha martha)	G4	S1S2	-	7/6/1999	E
STATE GAME LANDS #188 FLOODPLAIN	notable significance				
Cattail Sedge (Carex typhina)	G5	S2	PE	8/10/2000	D
WETZEL RUN HILL			high sign	ificance	
Hoary Puccoon (Lithospermum canescens)	G5	S2	NR	7/11/2006	Е
Tall Gramma (Bouteloua curtipendula)	G5	S2	PT	7/11/2006	Ē
Side-oats gramma calcareous grassland	GNR	S1	-	7/11/2006	E
Beavertown Cave		local significance			
Bald Eagle State Forest			g ·		

PUBLICLY MANAGED LANDS:

Bald Eagle State Forest, State Game Lands #188

site significance rank: exceptional high notable local

OTHER CONSERVATION AREAS:

Blacklog Mountain IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: Swift Run (HQ-CWF)

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

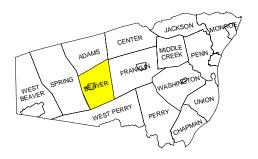
- Middle Creek-Unnamed Creek at Middleburg
- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community

• North Branch Middle Creek

- Warmwater Community 2; High Quality Small Stream Community

² Please refer to Appendix V for an explanation of quality ranks

Beaver Township is located in the center of Snyder County. Shade Mountain creates the southern boundary of the township. The bedrock geology is comprised mostly of shale with some smaller areas of sandstone and limestone. Forests make up 60% of the landcover in Beaver Township, most of which is in one contiguous forest block along Shade Mountain. Bald Eagle State Forest is located along this large forest block and should help to keep this forest intact for use by interior forest species. State Game Lands #188 is also located in Beaver Township. Agriculture makes up 35% of the total landcover in Beaver Township, most of which is in the center of the township.



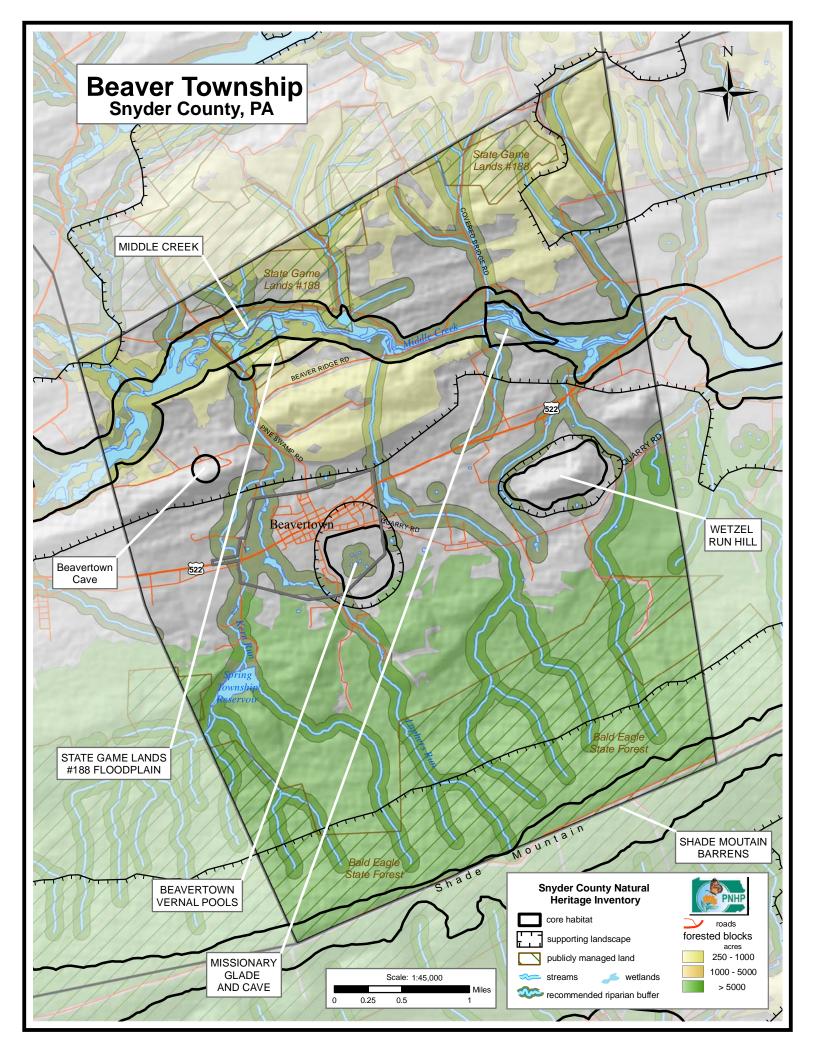
Middle Creek is the major stream flowing through Beaver Township. The streams originating in southern Beaver Township flow through the large forest blocks that provide an excellent buffer. The other streams in the township flow through the open agricultural areas, which provide a poor buffer to filter out sediments and chemicals before they enter into the streams. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. Blacklog Mountain Important Mammal Area (IMA) is located along Shade Mountain in the southern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. Beavertown Borough is located within Beaver Township. Fifty-five percent of the total landcover in the borough is agriculture, and residential areas make up 30% of the total landcover.



An aerial view of the Beavertown Vernal Pools site. This vernal pool community, just southeast of Beavertown supports some species of vernal pool amphibians, however, the landscape context is rather poor at this site. The vernal pool species that rely on these unique natural communities require forests in which to retreat at the close of the breeding season. Surrounded by agriculture and expanding development, the biological integrity of this unique natural community is under increasing stress.

photo source: PNHP

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status



BEAVERTOWN VERNAL POOLS (Beaver Township)

This vernal pool community is within the borough limits of Beavertown. The landscape context of the pool community has been greatly altered. While most of the pools are forested, the surrounding landscape is cleared land

Threats and Disturbances

One of these pools has been used as a trash dump, and the water quality is severely degraded because of the refuse in and around the pool. Another vernal pool at the site has been ditched, to attempt to divert the water under a culvert. As a result, the hydrology of this particular pool has likely suffered, causing it to prematurely dry. Agriculture and housing developments abut the forest containing the vernal pool community.

Conservation Recommendations

The dump at this site should be targeted for cleanup, and the channel cut at the ditched pool be plugged. Further



A vernal pool at the Beavertown Vernal Pools site. Note the thin forested buffer around the pool margin, and the roof of a house just beyond the pool edge. photo source: PNHP



A vernal pool at the Beavertown Vernal Pools site. The edge on the left side of the pool has been used as a garbage dump, and the right edge of the pool has very little forested buffer.

photo source: PNHP

development around the pools will only further degrade the vernal pool community. Seepage from septic systems and runoff from manicured yards, roofs, and driveways, flush contaminants into the pools, decreasing water quality and affecting the reproductive success of the vernal pool amphibians. If the land use surrounding the vernal pool community is to change, efforts should be made to reforest these areas to maintain, and hopefully restore some of the ecology of the system.

MIDDLE CREEK (Beaver, Franklin, Middle Creek, Penn, Spring, Union, & Washington Townships)

Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but

decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek, primarily in Penn, Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.



The northern slope of Missionary Glade overlooking Middle Creek. Note the healthy population of American yew covering much of the ground.

photo source: PNHP

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County. general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

MISSIONARY GLADE AND CAVE (Beaver Township)

This site consists of a small hill of Helderberg Limestone, with the top of the hill being covered by small patches of grasslands within a Red cedar-redbud shrubland, and the north slope of the hill dominated by a Rich hemlock-mesic hardwoods forest. The site is adjacent to Middle Creek, which has eroded some of the soft limestone bedrock of the hill, creating a natural cave at the hill base near the creek. Additionally, there is a small quarry at the base of the western slope that has created some cave openings above a successional meadow. These hollowed-out openings, along with the natural cave opening towards the creek are typical of karst topography, caused by eroding limestone. This site supports a population of Hoary Puccoon (Lithospermum canescens), ranked G5 S2, a population of Bladder fern (Cystopteris tennesseensis), ranked G5 S1, and the G5 S2 PA-threatened Tall gramma (Bouteloua curtipendula). Tall gramma and Hoary puccoon are components of Pennsylvania's prairie remnants. These species are characteristic of Side-oats gramma calcareous grasslands, a G5 S1 tracked community found at this site. The rich hemlock-mesic hardwoods forest on the north side of the hill contains a healthy patch of American yew (Taxus canadensis). While this species is not listed in the state, it is declining due to overbrowsing by deer and is considered vulnerable. Its presence at this site indicates that the deer are being successfully managed to support a healthy forest, with regenerating trees and a robust shrub layer. The surrounding land use includes rural housing and agriculture.

Threats and Disturbances

A small, inactive quarry was found on the western side of the glade and this area has been used to dispose of derelict farm machinery and other refuse. The quarrying operation created several openings in the limestone bedrock. While these openings were not explored, there is a good possibility that they open to more extensive underground openings and could provide habitat for cave specialists. The top of the hill is covered in lightly used ATV trails. A number of exotic plant species were noted from this site, primarily Japanese honeysuckle (Lonicera japonica), Amur honeysuckle (Lonicera maackii), Autumn olive (Elaeagnus umbellata), Oriental bittersweet (Celastrus orbiculatus), Garlic mustard (Alliaria petiolata), and Japanese barberry (Berberis thunbergii). There is also evidence that the site has been grazed by cattle in the past.

Conservation Recommendations

The ATV use at this site is relatively light and does not appear to be disturbing the rare species at this site. Efforts should be made to remove some of the exotic species at the site, particularly the shrub invasives that may crowd out the species of special concern. Pennsylvania's prairie remnants are jeopardized by invasions of exotic species as well as natural succession. These communities rely on disturbance to maintain the integrity of the habitat. The site would benefit from removal of some of the woody vegetation.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree forest**, ranked G4 S3, composed of pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*), and mixed hardwoods. Within this Ridgetop dwarf-tree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy, acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3
- Southern Pine Looper Moth (Caripeta aretaria) G4 S1
- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (Elaphria georgei) G4 SNR
- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site.

Threats and Disturbances

A dirt forestry road and some hiking trails and a singletrack dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force; however natural fires have historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the site.

STATE GAME LANDS #188 FLOODPLAIN (Beaver Township)

This wooded floodplain is along Middle Creek where the creek is flanked on either side by wet areas and seasonal wetlands. Recently, a population of the state endangered **Cattail sedge** (*Carex typhina*), a G5 S2

species, was located at this site. Also located at this site is a healthy population of Golden club (*Orontium aquaticum*), a G5 S4 species. This species was tracked by PNHP until recently; however, the species remains on the PNHP's "watch list". Healthy populations of this species are still of interest to PNHP and this location represents the only known extant locale for this species in Snyder County. The bottomland hardwood forest likely contains standing water at times. This site was much more open years ago but now has some mature trees, providing a dense canopy in areas.



Golden club (Orontium aquaticum)
photo source: PNHP

Threats and Disturbances

This site is along Pine Swamp Road and portions of the floodplain are on private property and could be threatened by future alterations. Exotic species invasions also threaten the site. Clearing of the trees and brush by the Pennsylvania Game Commission, who manages the site, could threaten the Cattail sedge population.

Conservation Recommendations

A forested buffer of at least 328 feet (100-m) should be established around the wetlands at this site to maintain the water quality of the wetlands containing the Cattail sedge.

WETZEL RUN HILL (Beaver Township)

Wetzel Run Hill is a limestone summit that juts out of the valley as a seemingly out of place feature. Recent surveys of the site uncovered a population of **Hoary puccoon** (*Lithospermum canescens*), a G5 S2 species of concern, and a population of **Tall gramma** (*Bouteloua curtipendula*), a G5 S2 Pennsylvania threatened species. These two species have highly restricted ranges in the state, and in this portion of Pennsylvania are the remaining components of prairies

Dominant Vegetation at State Game Lands #188 Floodplain

	11663.
red maple	Acer rubrum
musclewood	Carpinus caroliniana
pignut hickory	Carya glabra
American beech	Fagus grandifolia
black ash	Fraxinus nigra
winterberry	Ilex verticillata
black gum	Nyssa sylvatica
pin oak	Quercus palustris

swamp dewberry Rubus hispidus

poison ivy Toxicodendron radicans
arrow-wood Viburnum recognitum

Herbaceous and Non-vascular vegetation:

Shrubs and Vines:

Carex albolutescens a sedge a sedge Carex debilis a sedge Carex intumescens cattail sedge Carex typhina spotted cowbane Cicuta maculata wood reedgrass Cinna arundinacea spike-rush Eleocharis sp marsh bedstraw Galium obtusum fowl mannagrass Glyceria striata various bryophytes

that once stretched throughout the valleys. A GNR S1 tracked community, the **Side-oats gramma calcareous grassland** was also identified at Wetzel Run Hill.

Threats and Disturbances

A small jeep trail follows along the south side of the hill, and continues towards the summit. Along this jeep trail, some soil has been scraped away from the hillside, creating a disturbed patch of soil. Numerous invasive plant species were noted at this site during the recent surveys.

Conservation Recommendations

Quite often, maintaining natural areas requires that aggressive disturbance be avoided. Ironically, the Sideoats gramma calcareous grassland that provides habitat for the rare species at this site is a result of mechanical scraping. This moderate disturbance has allowed the grassland to reestablish, either through natural seedbank release or from migrating seeds from other patches of prairie that once dominated portions of the valley. Any future scraping must be conducted with extreme care and be done in concert with invasive species management to ensure that the site does not revert to a poor quality exotic shrubland. These exotic-dominated communities frequently occur on limestone summits unless the sites are properly managed.

The invasive plant species must be controlled at this site if the prairie opening is to persist. The Russian olive (*Elaeagnus umbellata*) poses the greatest threat, as it is



The prairie remnant at Wetzel Run Hill

photo source: PNHP

excluding native shrubs and aggressively shading out the wide array of herbaceous species at this site. Along the east side of the slope, Garlic mustard (*Alliaria petiolata*) creates monocultures in the herbaceous layer, excluding other herbaceous vegetation. Removal of these two invasive exotic species would greatly improve the quality of Wetzel Run Hill.

Beavertown Cave (Beaver Township)

This cave is rather small, though the large opening gives the impression that the cave would open up. This cave has not been extensively explored, but may harbor species of concern.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes

changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats that potentially use this site.

Vernal Pools

Vernal pools rely soley on precipitation, groundwater and runoff for sources of water input. These pools are void of fish species because of the cyclic pattern of alternating wet/dry periods. For this reason, vernal pools support a wide array of organisms that are specially adapted to the varying hydroperiod, particularly several species of amphibians. Per square foot, vernal pools are by far the largest source of vertbrate biomass anywhere in the Northeastern United States. The role of these amphibians in the ecology of the surrounding landscape is critical to the health of our forest systems.



A marbled salamander migrating to a vernal pool photo source: Charlie Eichelberger





A Gray Treefrog calling at a vernal pool photo source: Charlie Eichelberger



Vernal ponds are essential breeding habitat for amphibians. In this photograph, Wood Frog tadpoles can be seen over a carpet of Spotted Salamander egg masses.

Center Township

NATURAL HERITAGE SITES:		Rank ¹	State	Last Seen	Quality ²
IVATORAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quanty
DOLLAR WOODS MACROSITE			eptional siį	gnificance	
species of special concern ³	G3	S3	PE	8/2/2006	E
species of special concern ³	G5	S3	-	6/28/2006	E
species of special concern ³	G5	S3	-	6/13/2006	E
Harlequin Darner (Gomphaeschna furcillata)	G5	S2	-	6/13/2006	E
Praeclara Underwing (Catocala praeclara)	G5	S3S4	-	7/19/2006	E
Ephemeral/fluctuating Natural Pool	GNR	S3	-	4/18/2006	BC
Acidic Broadleaf Swamp	G5	S3	-	6/2/1987	BC
PENNS CREEK		exce	eptional si	gnificance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/18/2006	D
Elktoe (Alasmidonta marginata)	G4	S4	-	7/18/2006	D
species of special concern ³	G3	S2	-	7/27/1994	D
Centerville Cave		local significance			

PUBLICLY MANAGED LANDS: Bald Eagle State Forest

OTHER CONSERVATION AREAS: Central Mountains IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Middle Creek
- Middle Creek-Unnamed Creek at Middleburg
- · ·
- North Branch Middle Creek-Walker Lake Dam
- Penns Creek
- Penns Creek-Tuscarora Creek

- Warmwater Community 2; Eastern Elliptio Community
- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community

site significance rank: *exceptional*

- Coolwater Community 1; High Quality Small Stream Community
- Warmwater Community 1; Eastern Elliptio Community
- Warmwater Community 1; Eastern Elliptio Community

Center Township is located in northern Snyder County, bordered by Union County. The bedrock geology is mostly shale with some small areas of sandstone and limestone. Forests make up 41% of the total landcover in Center Township. One large forest block is located in the northern edge of the township, but much of the rest of the township has smaller fragmented forest blocks. Trees should be planted to connect smaller forest blocks wherever possible to improve habitat for forest species. Bald Eagle State Forest is located in the large forest blocks in northern Center Township. Agriculture makes up 51% of the total landcover in the township.

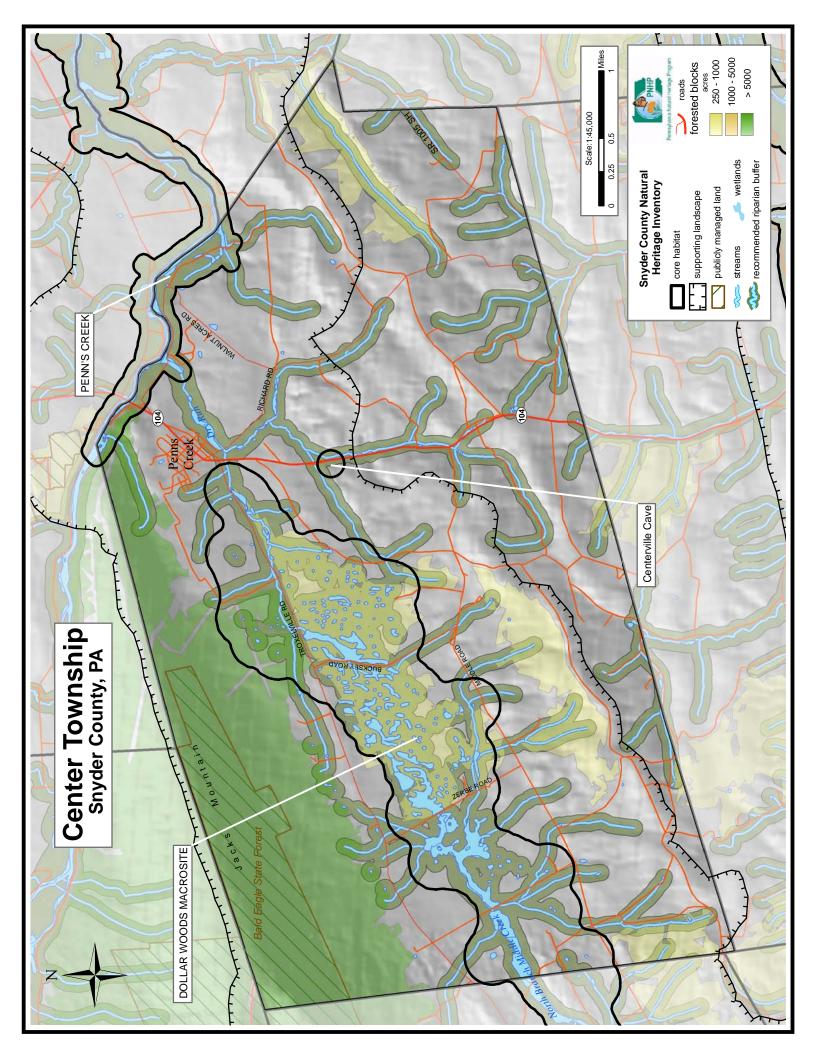


Penns Creek is the major stream flowing through Center Township, which runs along the northeastern boundary. Most of the streams in the township are running through the open agricultural areas and small, fragmented forests. Trees should be planted along streams to filter out the agricultural runoff and prevent sediments and chemicals from entering into the streams. The Central Mountains Important Mammal Area (IMA) is located in northern Center Township.

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection



CENTER TOWNSHIP

DOLLAR WOODS MACROSITE (Center & Adams Townships)

This massive wetland complex is the largest in all of Snyder County, and is one of the most extensive wetland systems in the central portion of the state. The Dollar Woods Macrosite is really a conglomeration of several different wetland community types including an Acidic Broadleaf Swamp, a G5 S3 tracked community, with a portion of the site being a community of Ephemeral/fluctuating Natural Pools, a GNR S3 tracked community. The sheer size of the wetland complex, coupled with the varied types of wetlands within the site, provides excellent habitat for several species of concern. Several populations of **two** globally secure, state vulnerable animals of special concern were located at this site in 2006. Both of these species are semi-aquatic species that rely on shallow wetlands with emergent vegetation. The 2006 surveys also uncovered a population of the G5 S2 Harlequin Darner (Gomphaeschna furcillata). This dragonfly relies on wetlands with high water quality for breeding. Also found at the Dollar Woods Macrosite was a population of the G5 S3S4 Praeclara Underwing (Catocala praeclara), a moth species of special concern in the state. In addition to the animal species of concern, two populations of a global and state vulnerable Pennsylvania endangered plant were also found at this site.

Threats and Disturbances

This site has become surrounded by agriculture and rural housing. Zerbe Road and Bucksey Road travel through the Dollar Woods Macrosite.

Currently, much of the site is being developed, with homes being built where

developed, with homes being built where dry patches of ground can be found between the small wetlands. The site also receives runoff from agricultural land, which decreases the water quality of the site and may threaten the entirety of the community.

Conservation Recommendations

Further development of the Dollar Woods Macrosite is not compatible with the species of special concern that occur at this site and the site should be zoned to deter further development. Landowners at this site should be approached about conservation easements to ensure that the remaining wetlands can continue to function ecologically.

Forested regions within the site are critical to the overall health of the system and should be preserved in their current state. A no-cut forested buffer should be established around the site to minimize the influx of agricultural runoff from the surrounding lands. Agricultural practices close to the macrosite should be conducted with extreme care so that unnecessary amounts of contaminants do not drain into the wetlands at the Dollar Woods Macrosite. Around the vernal pool communities at this site, a minimum 1000-foot (305-m) no-cut forested buffer should be established to protect the unique suite of vernal pool amphibians that use these pools.

PENNS CREEK (Center, Jackson, Monroe, Penn, & Union Townships, and Union County)

Penns Creek and Middle Creek are the two major creeks in Snyder County, draining eastward to the Susquehanna. Recent surveys along Penns Creek revealed a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern and a population of the Elktoe (Alasmidonta marginata), a G4 S4 species of special concern. Additionally, surveys in 1994 uncovered a population of a globally vulnerable, state imperiled species of special concern in Penns Creek. The similarity of the "G" and "S" ranks on all of these species shows that Pennsylvania is host to a large percentage of the populations of these mussels in North America: therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.



In this aerial view of the Dollar Woods Macrosite, we can see the diversity of wetlands found in this complex wetland system.

CENTER TOWNSHIP

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Penns Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Portions of Penns Creek above the Snyder County line are listed as impaired by DEP, because of elevated levels of mercury in fish tissues. Additionally, many of the tributaries, especially throughout Penn Township, are listed as impaired due to siltation from agriculture and residential runoff. Several sewage treatment plants are located along Penns Creek, a likely source of nutrient enrichment.

Conservation Recommendations

Since the waters of Penns Creek at this site are drained from most of the acreage in northern Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

Centerville Cave (Center Township)

This site lies just to the south of the town of Penns Creek. The cave is not natural and has been created as a mining prospect. Nevertheless, the conditions of the cavity may be suitable for use by caveadapted species and the opening certainly provides a close connection with the groundwater table.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves. bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for



The shallows along Penn's Creek, with its cobble bottom, serve as ideal freshwater mussel habitat.

photo source: PNHP

trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

Chapman Township

NATURAL HERITAGE SITES:		HP Rank ¹ Sta		Last Seen	Quality ²
NATURAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quanty
SUSQUEHANNA RIVER AT STATE GAME LANDS #233 S	SOUTH	h	iigh signij	ficance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/31/2001	BC
SUSQUEHANNA RIVER AT STATE GAME LANDS #258		ove	contional	significance	
	G.#			0 0	.
species of special concern ³	G5	S2B	PT	2000	В
Elktoe (Alasmidonta marginata)	G4	S4	-	7/28/1998	E
species of special concern ³	G3	S2	-	7/28/1998	C
Triangle Floater (Alasmidonta undulata)	G4	S3S4	-	7/28/1998	E
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/28/1998	E
PUBLICLY MANAGED LANDS: none	site signifi	cance rank	: exception	al <mark>high notab</mark>	<mark>le</mark> local

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

Mahantango Creek
 North Branch Mahantango Creek
 Susquehanna River-Mahantango Creek
 Warmwater Community 1
 Yellow Lampmussel

² Please refer to Appendix V for an explanation of quality ranks

Chapman Township, the smallest township in the county, is located in southeastern Snyder County, bordered by Northumberland County to the east and Juniata County to the south. North Branch Mahantango Creek forms the southern boundary, Chapman Creek forms the northern boundary, and the Susquehanna River forms the eastern boundary.

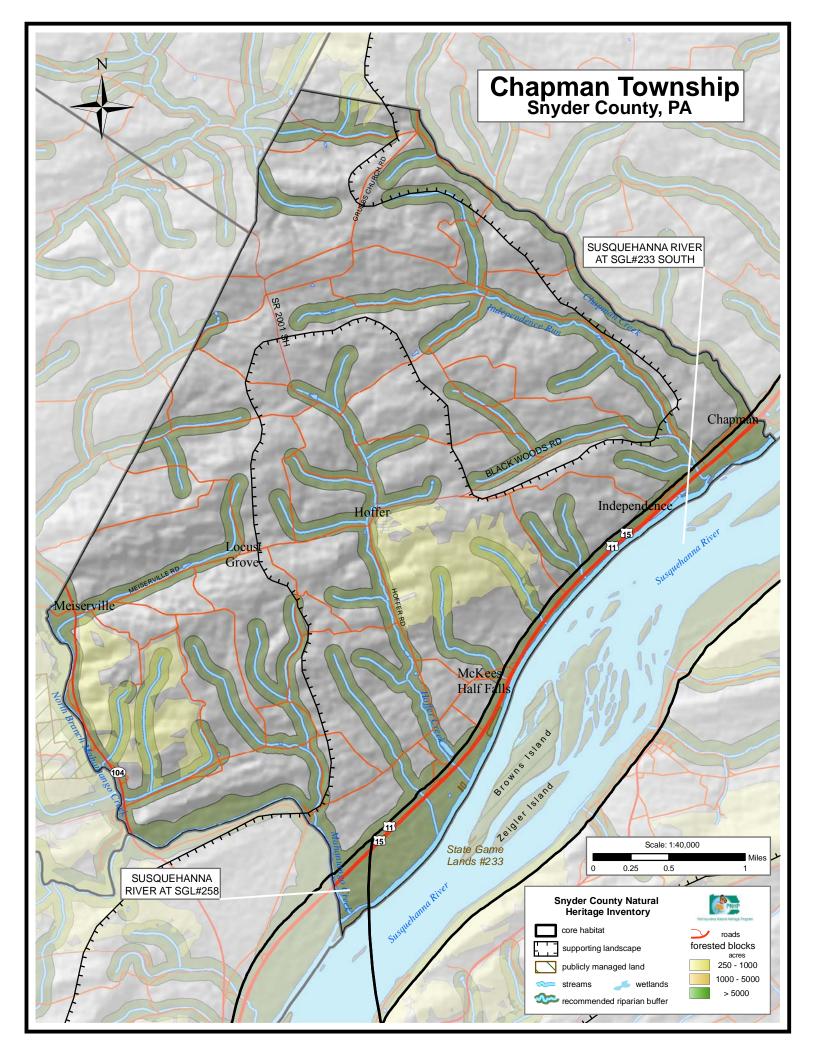


The bedrock geology is composed almost entirely of shale with smaller areas of sandstone and limestone. Forests make up 35% of the landcover in Chapman Township, which are made up of small, scattered forest blocks. Portions of State Game Lands #233 are located in Chapman Township, as a boat launch for access to the Susquehanna River islands which are also owned by the Pennsylvania Game Commission. Agriculture makes up 57% of the total landcover in the township.

West Branch Mahantango Creek, Chapman Creek, and Independence Run are the major streams flowing through the township. The streams in Chapman Township are flowing through the open agricultural areas that do little to filter out the sediments and chemicals before they enter into the stream. Planting trees along streams would create a buffer to filter out pollutants and connect forested habitat patches. The Central Susquehanna Valley Important Mammal Area (IMA) is located along eastern and southern Chapman Township. This IMA was chosen due to the available habitat for beavers, otters, bats, and other mammal species.

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

³ This species is not named at the request of the agency overseeing its protection



CHAPMAN TOWNSHIP

SUSQUEHANNA AT STATE GAME LANDS #233

SOUTH (Chapman & Union Townships and Northumberland County)

This site consists of a cluster of islands in the Susquehanna River including Browns, Herrold, and Zeigler Islands. Browns Island is owned and managed by the Pennsylvania Game Commission. The channels between the islands tend to have shallow, quickflowing water over a substrate of gravel, cobbles and sand, with a few bedrock ridges. A population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was documented at this site. The shoals around the islands at this site are critical habitat for numerous freshwater mussels, both common and rare, and are crucial for the maintenance of the water quality through this stretch of the Susquehanna River.

Deeper waters throughout the river may contain populations of freshwater mussels, but surveying for

these species under these conditions requires a tremendous amount of effort. It is likely that these mussel species occur at greater depths throughout the site but have simply not yet been recorded. The river habitats further from the shallows around the islands are of equal importance to the species of concern at this site as the shallows where the mussels have been recorded.

Threats and Disturbances

Disruption of the substrates around these islands would likely have impacts on the freshwater mussel populations. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban, suburban, and agricultural lands that drain into the river. In Snyder

County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, a likely source of nutrient inputs. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs.

Conservation Recommendations

The species of concern at this site is dependent on maintaining the fish populations and the water quality of the Susquehanna River. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.



The Susquehanna River at the State Game Lands #233 South site. The shoals around these islands provide critical habitat for freshwater mussels.

CHAPMAN TOWNSHIP

SUSQUEHANNA AT STATE GAME LANDS #258

(Chapman Township and Dauphin, Northumberland, Juniata, & Perry Counties)

This site consists of an archipelago of islands in the Susquehanna River near the junction of Dauphin, Juniata, Northumberland, Perry and Snyder Counties. Islands included in this site are Crafts, and Sweigart's Islands as well as many unnamed islands. The majority of the islands at this site are owned and managed by the Pennsylvania Game Commission. These islands are largely dominated by silver maple (Acer saccharinum) and spicebush (Lindera benzoin) and support breeding for a globally secure, state imperiled Pennsylvania threatened species. The channels between the islands tend to have shallow, quick-flowing water over a substrate of gravel, cobbles and sand, with a few bedrock ridges. Four animal species of concern were found in this habitat including a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern, a population of the Triangle Floater (Alasmidonta undulata) a G4 S3S4 species of concern, a population of the Elktoe (Alasmidonta marginata), a G3S2 species of concern and a population of a globally vulnerable, state imperiled species of concern. The shoals around the islands at this site are critical habitat for numerous freshwater mussels, both common and rare, and are crucial for the maintenance of the water quality through this stretch of the Susquehanna River.

Deeper waters throughout the river may contain populations of freshwater mussels, but surveying for these species under these conditions requires a tremendous amount of effort. It is highly likely that these mussel species occur at greater depths throughout the site but have simply not yet been recorded. The river habitats further from the shallows around the islands are of equal importance to the species of concern at this site as the shallows where the mussels have been recorded.

Threats and Disturbances

Disruption of the substrates around these islands would likely have impacts on the freshwater mussel populations. In addition, camping or other recreational visits to the islands during the breeding season could disturb the species of concern at this site.

Conservation Recommendations

The animal species of concern at this site are primarily dependent on maintaining the fish populations and the water quality of the Susquehanna River. Since the

Freshwater Mussels – the River's Filters The Susquehanna River provides habitat for a diverse community of freshwater mussels, a group of animals considered the most imperiled in North America. Almost half of the species of freshwater mussels in Pennsylvania are extirpated or considered rare, threatened, or endangered, due to more than a century of modification and destruction of aquatic habitats by dams, dredging, and pollution (Williams and Neves 1995). Mussels play important ecological roles. filtering algae, plankton, and silts from the water; and serving as a food source for otters, raccoons, herons, and some fish. The reproductive cycle of freshwater mussels involves a fish host, often a single species specific to each species of mussel. The presence of diverse and healthy mussel populations can serve as an

indicator of a healthy aquatic system, including fish,

waterfowl habitat, and water quality.

Conservation and recovery of freshwater mussels in the Susquehanna River and elsewhere is not only dependent on maintenance of water quality and flows in the river, but also on conservation practices in terrestrial habitats (Williams and Neves 1995). Freshwater areas are indirectly affected by erosion and chemical runoff in the surrounding uplands of the watershed. Siltation and removal of riparian vegetation can destabilize the river substrates and eliminate habitat for bottom-dwelling organisms such as mussels. Populations of rare mussels are generally dependent on conservation practices that will improve and maintain water quality and restore natural flows to the river. Reduction of erosion and chemical runoff, restoration and maintenance of riparian forested buffers and restoration of natural flows will all improve habitat for freshwater mussels and associated aquatic organisms. Any individual area of mussel habitat is affected by the entire upstream area, and therefore mussel conservation should focus on watershed level protection.

waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

Franklin Township & Middleburg Borough

NATURAL HERITAGE SITES:	PNHP Rank ¹		State Last Seen		Quality ²
NATURAL HERITAGE SHES.	Global	State	Status	(m/d/y)	Quanty
MIDDLE CREEK		h	igh signi	ficance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	5/12/2005	Е
SHADE MOUNTIAN BARRENS		hi	igh signi	ficance	
Ridgetop dwarf-tree forest	G4	S3	-	4/12/2005	E
A Zale Moth (Zale submediana)	G4	S2	-	5/3/2001	E
A Noctuid Moth (Apharetra purpurea)	G4	S2	-	6/23/2000	E
A Noctuid Moth (Aplectoides condita)	G4	S2S3	-	5/27/1998	E
Southern Pine Looper Moth (Caripeta aretaria)	G4	S1	-	8/8/1997	E
A moth (Cerastis fishii)	G4G5	SNR	-	4/14/1998	E
Pine Devil Moth (Citheronia sepulcralis)	G4	S2S4	-	7/6/1999	E
A Midget Moth (Elaphria georgei)	G4	SNR	-	5/4/2006	E
Attentive Dart (Eueretagrotis attenta)	G4	SNR	-	7/6/1999	E
Footpath Sallow Moth (Metaxaglaea semitaria)	G5	S2	-	10/8/1997	E
A Moth (Sideridis maryx)	G4	S1S3	-	7/1/2000	E
Gordian Sphinx (Sphinx gordius)	G4	S1S3	-	5/24/1998	E
Broad Sallow Moth (<i>Xylotype capax</i>)	G4	S3	-	9/25/1997	E
Oblique Zale moth (<i>Zale obliqua</i>)	G4	S3	-	6/13/2001	E
Pine Barrens Zanclognatha (Zanclognatha martha)	G4	S1S2	-	7/6/1999	E

Limestone Ridge and Paxtonville Cave

PUBLICLY MANAGED LANDS:

Bald Eagle State Forest

OTHER CONSERVATION AREAS:

Blacklog Mountain IMA

site significance rank: exceptional

high notable local

local significance

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:

Bowersox Run (HQ-CWF), Erb Run (HQ-CWF)

AOUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Middle Creek
- Middle Creek-Unnamed Creek at
- Middleburg
- North Branch Mahantango Creek North Branch Middle Creek-Walker Lake

- Warmwater Community 2: Eastern Elliptio Community
 - Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio
- Community
- Warmwater Community 1
- Coolwater Community 1; High Quality Small Stream Community

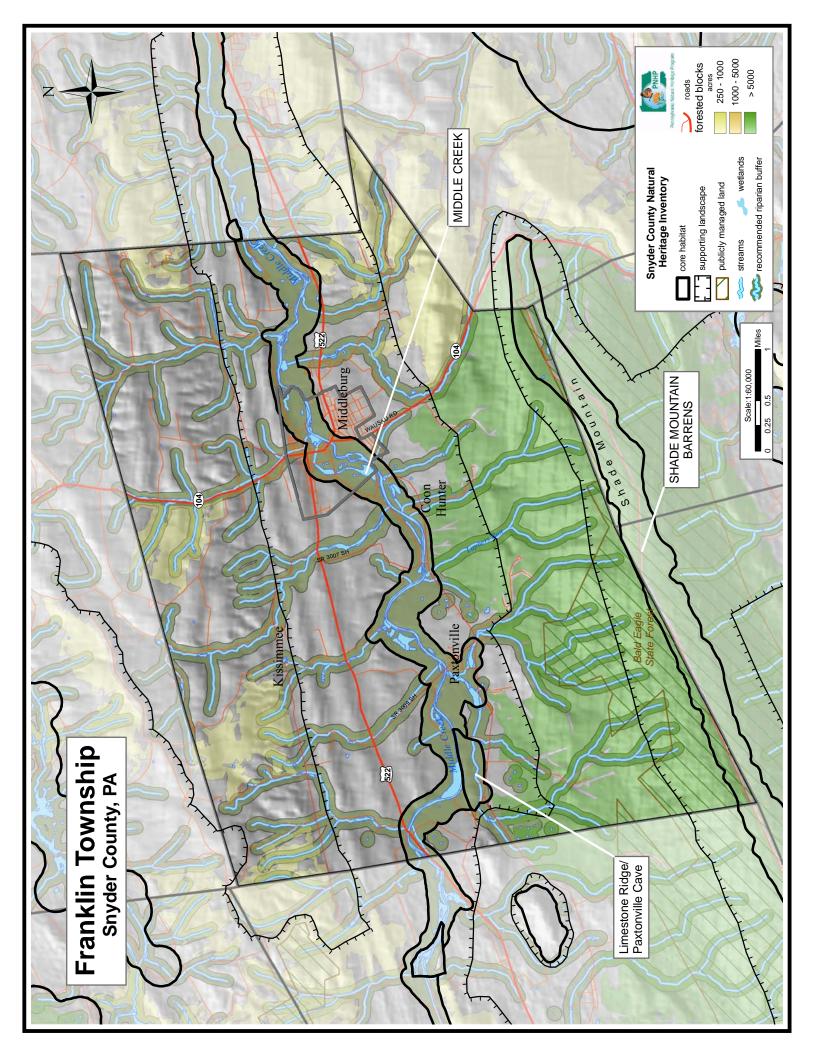
Franklin Township is located in central Snyder County and is the second largest township in the county. Shade Mountain creates the southern border of the township with the bedrock geology mostly comprised of shale with some smaller areas of sandstone and limestone. Forests make up 55% of the total land cover in Franklin Township, most of which is one large forest block on Shade Mountain managed by the Bureau of Forestry. Having the managed areas of Bald Eagle State Forest in the township should help to preserve the large forest blocks, which are

JACKSON CENTER MIDDLE CREEK ADAMS BEAVER WEST PERRY

beneficial for interior forest species. Other smaller forest blocks can be connected by planting corridors. Agriculture makes up 39% of the total land cover in Franklin Township, most of which is located in the center of the township

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks



Franklin Township is located in central Snyder County and is the second largest township in the county. Shade Mountain creates the southern border of the township with the bedrock geology mostly comprised of shale with some smaller areas of sandstone and limestone. Forests make up 55% of the total land cover in Franklin Township, most of which is one large forest block on Shade Mountain managed by the Bureau of Forestry. Having the managed areas of Bald Eagle State Forest in the township should help to preserve the large forest blocks, which are beneficial for interior forest species. Other smaller forest blocks can be connected by planting corridors. Agriculture makes up 39% of the total land cover in Franklin Township, most of which is located in the center of the township.

Middle Creek is the major stream flowing through Franklin Township. The streams originating in southern Franklin Township flow through the large forest blocks that provide an excellent buffer. The other streams in the township flow through the open agricultural areas, which provide a poor buffer to filter out sediments and chemicals before they enter into the streams. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. Blacklog Mountain Important Mammal Area (IMA) is located along Shade Mountain in the southern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. Middleburg Borough is located within Franklin Township. Most of the land cover in the borough is residential (35%) and 34% of the land cover is devoted to agriculture.



This cave feature, formed over tens of thousands of years, now sits on the roadside of Route 104 in Franklin Township. Its current location is a few hundred yards from a cave that's known to support a species of special concern. Quarrying in karst areas puts not only the cave features in jeopardy as shown here, but also the species specially adapted to this environment.

FRANKLIN TOWNSHIP

MIDDLE CREEK (Franklin, Beaver, Middle Creek, Penn, Spring, Union & Washington Townships)
Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the Yellow Lampmussel (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek, primarily in Penn, Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page



A Yellow Lampmussel (*Lampsilis cariosa*) buried in river gravel photo source: PNHP

68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree forest**, ranked G4 S3, composed of pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*), and mixed hardwoods. Within this Ridgetop dwarf-tree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy, acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3

FRANKLIN TOWNSHIP

- Southern Pine Looper Moth (Caripeta aretaria) G4 S1
- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (Elaphria georgei) G4 SNR
- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site.

Threats and Disturbances

A dirt forestry road and some hiking trails and a single-track dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force; however natural fires have historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the

Limestone Ridge and Paxtonville Cave (Franklin Township)

Limestone bedrock is common throughout the valleys of the Ridge and Valley physiographic province, but areas where the limestone is more durable and has resisted erosion or has been uplifted into ridges are far

less frequent in the region. These limestone ridges generally have shallow soils and are high in certain minerals, including calcium, that create unique growing conditions and can house an exceptional suite of species that are specially adapted to these growing conditions. This site contains a healthy population of American yew (Taxus canadensis), a species known to be declining in the state. The yew at this site covers several acres and appears to be in good condition. This site once contained a cave opening that has since been destroyed by small quarrying operations in the 1960's. While the human entrance has been eliminated, the geology of the site, along with the former existence of the cave opening, indicates that the ridge is karstic in nature and other smaller openings to an underground labyrinth may be present. These smaller entrances may not be accessible by humans, but may still be useable to cave species, including bats.

Threats and Disturbances

Just to the west of this site, an adjacent limestone ridge has been mined for years to harvest the limestone that is close to the surface. This mined ridge likely once had habitat much like the intact ridge, but was destroyed long ago. It is possible that the intact ridge could be targeted for large-scale mining operations in the future. Mining at this site would be detrimental to the unique species that inhabit the site. Recent timbering has also occurred at the site.

American yew is a favorite food of White-tailed Deer and their overpopulation is thought to be the primary cause of the decline of the yew. Currently, American yew is usually restricted to steep slopes that are inaccessible to deer.



American Yew (Taxus canadensis)

FRANKLIN TOWNSHIP

Caves and karst topography are highly sensitive natural features. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms. but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

The very presence of the American vew population indicates that deer populations are under control. unlike the majority of the rest of the state where American vew has severely declined. A forested buffer should be established around the ridge to maintain the habitats at this site. Though the limestone is close to the surface on the ridge and may be a tempting location for a quarry, these operations should be prohibited at this site. Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The groundwater quality in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

<u>Herbaceou</u>	s Vegetation:		
agrimony	Agrimonia sp.		<u>Trees</u> :
garlic mustard	Alliaria petiolata	box-elder	Acer negundo
smooth rock-cress	Arabis laevigata	silver maple	Acer saccharinum
wild ginger	Asarum canadense	sugar maple	Acer saccharum
ebony spleenwort	Asplenium platyneuron	hawthorn	Crataegus sp.
rattlesnake fern	Botrychium virginianum	American beech	Fagus grandifolia
honewort	Cryptotaenia canadensis	ash	Fraxinus sp.
bush-honeysuckle	Diervilla lonicera	hop-hornbeam	Ostrya virginiana
wild yam	Dioscorea quaternata	sycamore	Platanus occidentalis
marginal wood fern	Dryopteris marginalis	sweet cherry	Prunus avium
trout-lily	Erythronium americanum	white oak	Quercus alba
white-snakeroot	Eupatorium rugosum	chestnut oak	Quercus montana
white avens	Geum canadense	northern red oak	Quercus rubra
dame's-rocket	Hesperis matronalis	eastern hemlock	Tsuga canadensis
jewelweed	Impatiens sp.	basswood	Tilia americana
broom-rape	Orobanche uniflora	American elm	Ulmus americana
violet wood-sorrel	Oxalis violacea	red elm	Ulmus rubra
may-apple	Podophyllum peltatum		
Solomon's-seal	Polygonatum pubescens	Shri	ubs & Vines:
Halberd-leaved tearthumb	Polygonum arifolium	speckled alder	Alnus serrulata
kidney-leaf buttercup	Ranunculus abortivus	Japanese barberry	Berberis thunbergii
bloodroot	Sanguinaria canadensis	oriental bittersweet	Celastrus orbiculatus
wild stonecrop	Sedum ternatum	silky dogwood	Cornus amomum
false Solomon's-seal	Smilacina racemosa	burning-bush	Euonymus atropurpureu
bladdernut	Staphylea trifolia	witchhazel	Hamamelis virginiana
yellow pimpernel	Taenidia integerrima	multiflora rose	Rosa multiflora
skunk-cabbage	Symplocarpus foetidus	American yew	Taxus canadensis
early meadow-rue	Thalictrum dioicum	poison ivy	Toxicodendron radicans
wild coffee	Triosteum aurantiacum	black-haw	Viburnum prunifolium
bellwort	Uvularia sessifolia		
golden-alexanders	Zizia aurea		

Jackson Township

NATURAL HERITAGE SITES:	<u>PNHP</u>	PNHP Rank ¹		Last Seen	Quality ²
WIT OWNE HEMITIGE SHES.	Global	State	Status	(m/d/y)	Quality
PENNIC CREEK				. On	
PENNS CREEK		except	ional signi	ficance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/18/2006	D
Elktoe (Alasmidonta marginata)	G4	S4	-	7/18/2006	D
species of special concern ³	G3	S2	-	7/27/1994	D
PENNS CREEK NORTH OF KRATZERVILLE		70.0 400	hla sionifi		
		пош	ble signific	cance	
Jeweled shooting-star (Dodecatheon meadia)	GNR	S2	PT	5/9/2006	C
PUBLICLY MANAGED LANDS: none					
I UBLICLI IVIAIVAGED LAIVDS, HORC	site	significance ra	ınk: <i>exceptio</i>	nal <mark>high not</mark> e	<mark>able</mark> local

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AOUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

Penns Creek
 Penns Creek-Tuscarora Creek
 Warmwater Community 1; Eastern Elliptio Community
 Warmwater Community 1; Eastern Elliptio Community

² Please refer to Appendix V for an explanation of quality ranks

Jackson Township is located in northern Snyder County, bordered by Union County. Penns Creek runs along the northwestern and southeastern border of the township. The bedrock geology is comprised of shale and sandstone. Forests make up 22% of the total land cover in Jackson Township, the second lowest total in Snyder County. The forests in Jackson Township are all small and fragmented, with no forest blocks larger than 300 acres. This provides poor habitat for interior forest species that need large tracts of intact forest. There is the potential for some of the

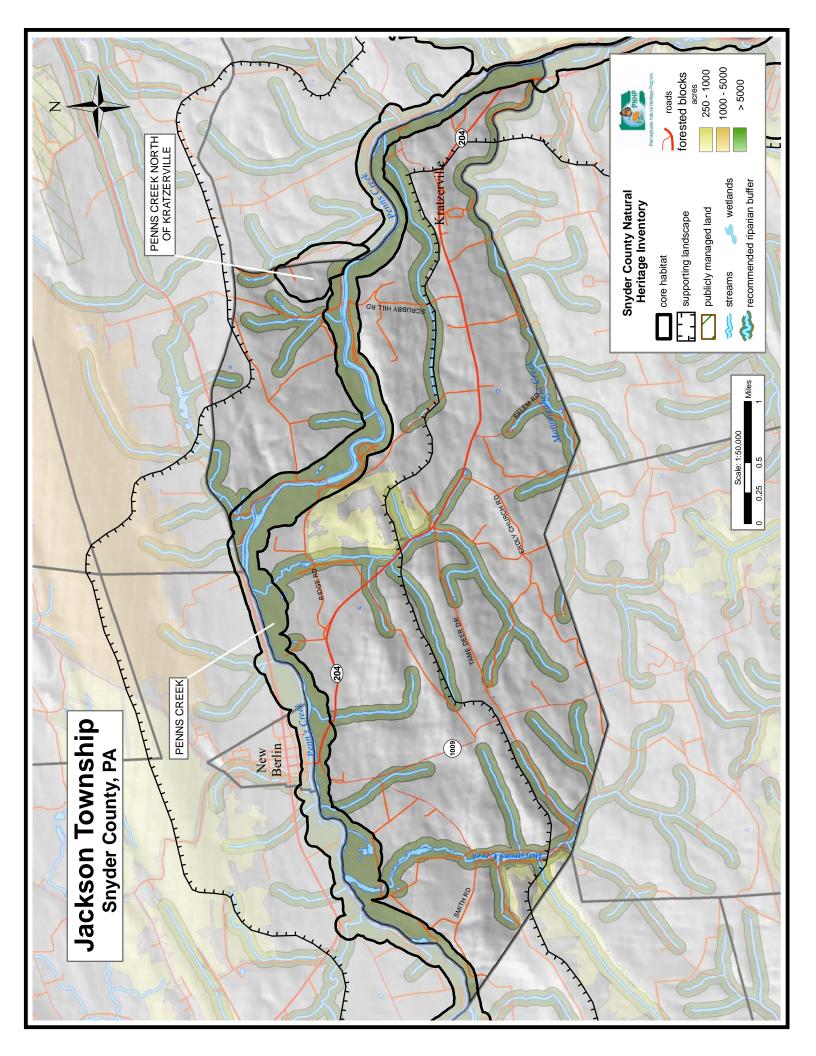
WEST SPRING BEAVER WASHINGTON WASHINGTON WEST PERRY PERRY PERRY PERRY CHAPMAN

smaller forest blocks to be connected by planting trees to create a corridor. Agriculture is the predominant land cover in Jackson Township, making up 69% of the total.

Penns Creek and Monongahela Creek are the major streams flowing through the township. All of the streams flow through the open agricultural areas, which provide a poor buffer for the streams and do little to filter out sediments and chemicals before they enter into the streams. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. The Central Susquehanna Valley Important Mammal Area (IMA) is located in Jackson Township. This IMA was chosen due to the available habitat for beavers, otters, and other mammal species.

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

³ This species is not named at the request of the agency overseeing its protection



JACKSON TOWNSHIP

PENNS CREEK (Jackson, Center, Monroe, & Penn Townships and Union County)

Penns Creek and Middle Creek are the two major creeks in Snyder County, draining eastward to the Susquehanna. Recent surveys along Penns Creek revealed a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern and a population of the Elktoe (Alasmidonta marginata), a G4 S4 species of special concern. Additionally, surveys in 1994 uncovered a population of a globally vulnerable, state imperiled species of **special concern** in Penns Creek. The similarity of the "G" and "S" ranks on all of these species shows that Pennsylvania is host to a large percentage of the populations of these mussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Penns Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Portions of Penns Creek above the Snyder County line are listed as impaired by DEP, because of elevated levels of mercury in fish tissues. Additionally, many of the tributaries, especially throughout Penn Township, are listed as impaired due to siltation from agriculture and residential runoff. Several sewage treatment plants are located along Penns Creek, a likely source of nutrient enrichment.

Conservation Recommendations

Since the waters of Penns Creek at this site are drained from most of the acreage in northern Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

PENNS CREEK NORTH OF KRATZERVILLE (Jackson & Monroe Townships)

Just to the north of the town of Kratzerville lies a small scalloped shale bedrock outcrop along the banks of Penns Creek. Recent surveys of the creek in this area revealed a population of the GNR S2 state threatened **Jeweled shooting-star** (*Dodecatheon meadia*). Though the population is small, the steep outcrops where this plant grows are generally under less threat due to the rugged nature of the slope. The adjacent forested matrix is dominated by sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), shagbark hickory (*Carya ovata*), red elm (*Ulmus rubra*), and a few eastern hemlocks (*Tsuga canadensis*). The surrounding land is primarily agricultural, with a few homes or summer cottages along the creek edge.

Threats and Disturbances

Because this site is so rugged, the site is not under much threat from human disturbance. However, these habitats are under threat from invasive exotic species. The site is currently being invaded by Garlic mustard (*Alliaria petiolata*) which could displace the population of Jeweled Shooting-star at this site. This habitat is very susceptible to invasions of tree-of-heaven (*Ailanthus altissima*), which secretes a toxic compound into the soil to poison other vegetation surrounding the tree, thereby eliminating competitors.

Conservation Recommendations

It is critical to control the invasive exotic species at this site in order to support the population of Jeweled shooting-star at this site. The Garlic mustard should be pulled annually and properly disposed of (usually through burning) to ensure that other areas are not invaded by the plant waste. Any invasions of tree-of-heaven must be dealt with immediately, before advancement of the tree displaces the Jeweled shooting-star.



Jeweled shooting-star (Dodecatheon meadia)

Riparian buffers are critically important to stream health. **Wooded waterways** are less prone to drastic flooding, reduce soil erosion, filter out pollutants before they enter the water, keep the water cooler, support greater diversity of species, and increase the natural beauty of the waterway. These two creeks in Snyder **County showcase** drastic differences in land use, and therefore riparian buffers. The above stream has an adequate forested buffer, while the stream below has no buffer, with the agricultural land directly abutting the creek. In addition to decreasing the quality of the water of the creek, this farmer is daily losing precious land to the creek due to soil erosion. photo source: PNHP





Middle Creek Township

NATURAL HERITAGE SITES:	<u>PNHP</u>	Rank ¹	State	Last Seen	Quality ²
IVAT UKAL HERITAGE SHES.	Global	State	Status	(m/d/y)	Quality

MIDDLE CREEK high significance

Yellow Lampmussel (*Lampsilis cariosa*) G3G4 S3S4 - 5/12/2005 E

First Day of Spring Cave local significance

PUBLICLY MANAGED LANDS: none site significance rank: exceptional high notable local

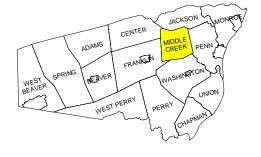
OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

Middle Creek
 Penns Creek
 Warmwater Community 2; Eastern Elliptio Community
 Warmwater Community 1; Eastern Elliptio Community

Middle Creek Township is located in central Snyder County and is the second smallest township in the county. The bedrock geology is mostly composed of shale with some smaller areas of sandstone and limestone. Forests make up 38% of the total landcover in Middle Creek Township. Most of the forest blocks are fragmented and scattered, but some larger forest blocks exist with the potential to be connected. Trees should be planted between forest blocks to create a corridor between habitat patches. Agriculture makes up 54% of the total landcover in Middle Creek Township.



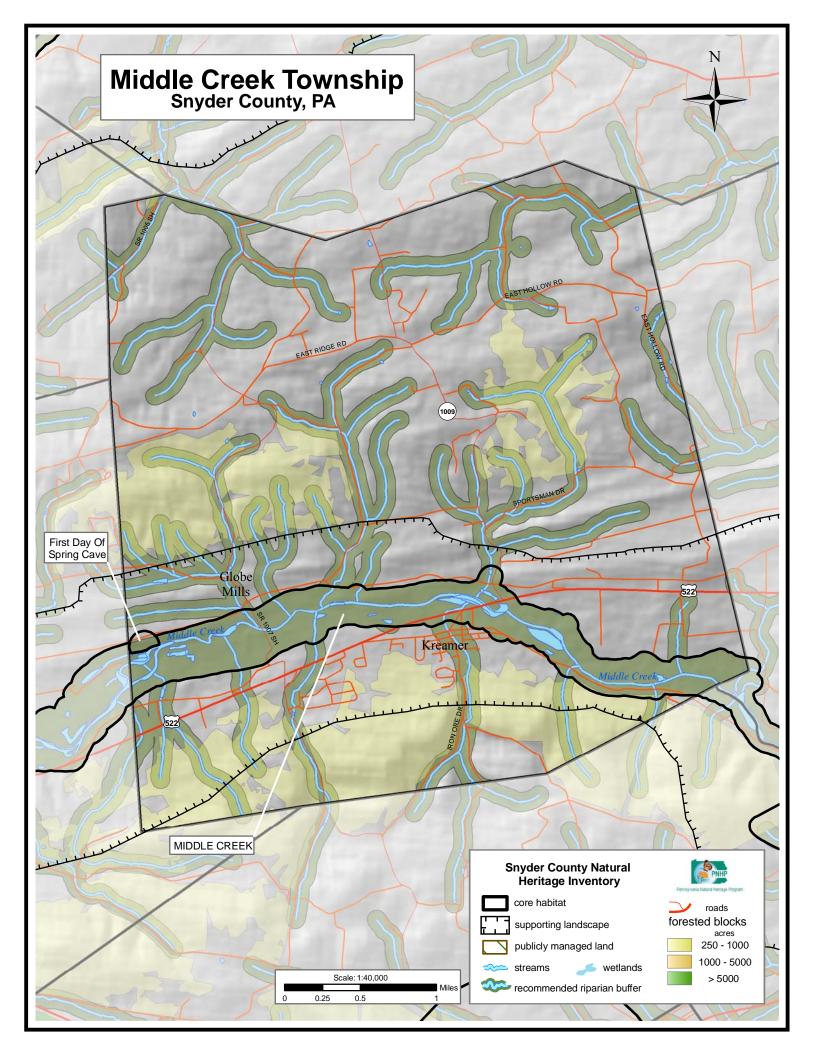
Middle Creek is the major stream flowing through the township. Many of the streams flow through the open agricultural areas, which provide a poor buffer to filter out sediments and chemicals before they enter into the streams. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. The Central Susquehanna Valley Important Mammal Area (IMA) is located in Middle Creek Township. This IMA was chosen due to the available habitat for beavers, otters, bats, and other mammal species.



A view of Middle Creek through Snyder County. Middle Creek provides critical habitat for a globally vulnerable species of freshwater mussel, the Yellow Lampmussel (*Lampsilis cariosa*).

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks



MIDDLE CREEK TOWNSHIP

MIDDLE CREEK (Middle Creek, Beaver, Franklin, Penn, Spring, Union, & Washington Townships)

Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek,

primarily in Penn, Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

First Day of Spring Cave (Middle Creek Township)

This cave has a rather large opening, but is otherwise a small cave. A small room, jammed with breakdown, is followed by a short passage that ends in clay fill. While no species of concern are known from this site, survey work has not been conducted at the cave and it may very well support populations of cave specialists.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation

MIDDLE CREEK TOWNSHIP

on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.



Aquatic invertebrates, like this isopod (*Caecidotea* sp.) can inhabit underground water in caves if the water quality is high. Living in complete darkness, cave invertebrates do not need camouflage, and the lack of pigment is often an indicator of cave adapted species.

Monroe Township & Shamokin Dam Borough

NATURAL HERITAGE SITES:	<u>PNH</u>	PNHP Rank ¹		Last Seen	Quality ²
NATURAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quanty
PENNS CREEK		exceptional significance			
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/18/2006	D
Elktoe (<i>Alasmidonta marginata</i>)	G4	S4	-	7/18/2006	D
species of special concern ³	G3	S2	-	7/27/1994	D
PENNS CREEK NORTH OF KRATZERVILLE		notal	ole signifi	cance	
Jeweled shooting-star (Dodecatheon meadia)	GNR	S2	PT	5/9/2006	С
ROLLING GREEN RUN SLOPES		notal	ole signifi	cance	
Northern Myotis (Myotis septentrionalis)	G4	S3B,S3N	-	7/18/2001	Е
SHAMOKIN DAM SLOPES		notal	ole signifi	cance	
Northern Myotis (Myotis septentrionalis)	G4	S3B,S3N	-	7/20/2001	Е
SHIKELLAMY BLUFFS		except	ional sign	ificance	
Jeweled shooting-star (Dodecatheon meadia)	GNR	S2	PT	5/20/1997	В
Golden corydalis (Corydalis aurea)	G5	S1	PE	5/20/1997	C
Calcareous opening/cliff	GNR	S2	-	4/26/1987	В
SUSQUEHANNA RIVER AT SELINSGROVE		hig	h signific	ance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	8/15/2001	CD
SUSQUEHANNA RIVER AT SHAMOKIN DAM/SU	NBURY	nota	ble signif	ficance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	8/17/1995	D
Moyer Homestead Site		local significance			
Penn's Drive Cave		local significance			
PUBLICLY MANAGED LANDS: none	site sig	gnificance rank:	exceptiona	l <mark>high notab</mark> l	l <mark>e</mark> local

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

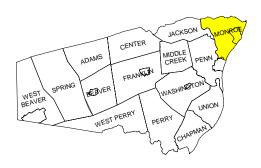
AOUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Penns Creek
 Warmwater Community 1; Eastern Elliptio Community
- Susquehanna River Warmwater Community 2
- West Branch Susquehanna River
 River and Impoundment Community; Low Gradient Valley Stream Community; Yellow Lampmussel

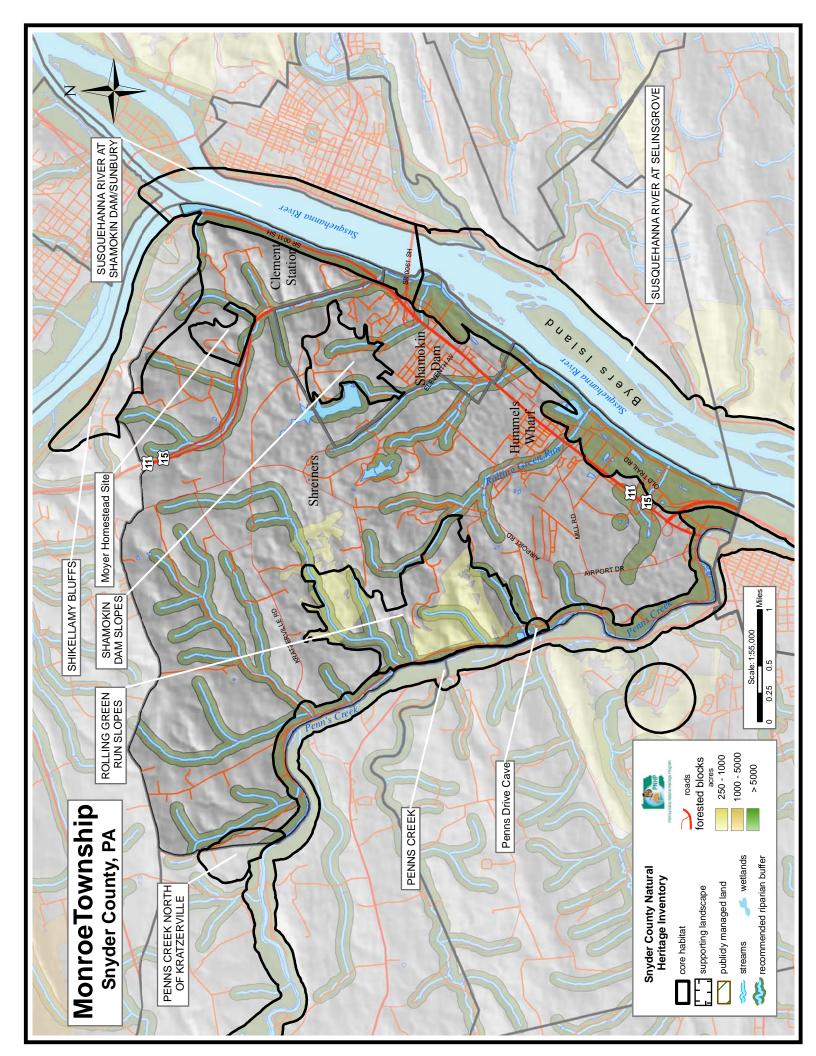
¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

Monroe Township is located in northeastern Snyder County, bordered by Union County to the north and Northumberland County to the east. The Susquehanna River forms the eastern boundary of the township. The bedrock geology is composed mostly of shale and sandstone with some limestone. Forests make up 29% of the total landcover in Monroe Township, which are made up of small, scattered forest blocks. Some of the forested areas have the potential to be connected by planting trees to create corridors between existing forest blocks, in turn creating habitat for forest species. Agriculture makes up 53% of the total landcover in Monroe Township.



³ This species is not named at the request of the agency overseeing its protection



Penns Creek is the major stream flowing through the township. The streams flow through the non-forested agricultural areas, which provide a poor buffer to filter out sediment and chemicals before they enter into the stream. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. The Central Susquehanna Valley Important Mammal Area (IMA) is located in Monroe Township. This IMA was chosen due to the available habitat for beavers, otters, and other mammal species. Shamokin Dam Borough is located within Monroe Township, on the western shore of the Susquehanna River.



A view of the Shikellamy Bluffs site from adjacent Northumberland County. Note the contrast in the clarity of the water coming from the main stem of the Susquehanna (bottom right of the photo), and the water coming from the West Branch of the Susquehanna River (top right of the photo). The stark difference in clarity is due to the land use upstream of Snyder County. The main stem of the Susquehanna River flows primarily through agricultural and the urban and suburban areas of Scranton/Wilkes-Barre, with little riparian buffer, allowing pollution runoff and soil erosion to enter and degrade the water quality of the Susquehanna. The West Branch of the Susquehanna has much more forested riparian areas that help filter the pollutants in runoff before they reach the river, as well as serving to limit soil erosion. Riparian buffers on smaller waterways exhibit this same pattern, and restoration of riparian buffers around Snyder County's degraded creeks and streams can only help improve the water quality of all waterways downstream.

PENNS CREEK (Monroe, Center, Jackson, Penn, & Union Townships and Union County)

Penns Creek and with Middle Creek are the two major creeks in Snyder County, draining eastward to the Susquehanna. Recent surveys along Penns Creek revealed a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern and a population of the Elktoe (Alasmidonta marginata), a G4 S4 species of special concern. Additionally, surveys in 1994 uncovered a population of a globally vulnerable, state imperiled species of **special concern** in Penns Creek. The similarity of the "G" and "S" ranks on all of these species shows that Pennsylvania is host to a large percentage of the populations of these mussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Penns Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Portions of Penns Creek above the Snyder County line are listed as impaired by DEP, because of elevated levels of mercury in fish tissues. Additionally, many of the tributaries, especially

throughout Penn Township, are listed as impaired due to siltation from agriculture and residential runoff. Several sewage treatment plants are located along Penns Creek, a likely source of nutrient enrichment.

Conservation Recommendations

Since the waters of Penns Creek at this site are drained from most of the acreage in northern Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

PENNS CREEK NORTH OF KRATZERVILLE

(Monroe & Jackson Townships)

Just to the north of the town of Kratzerville lies a small scalloped shale bedrock outcrop along the banks of Penns Creek. Recent surveys of the creek in this area revealed a population of the GNR S2 state threatened **Jeweled shooting-star** (*Dodecatheon meadia*). Though the population is small, the steep outcrops where this plant grows are generally under less threat due to the rugged nature of the slope. The adjacent forested matrix is dominated by sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), shagbark hickory (*Carya ovata*), red elm (*Ulmus rubra*), and a few eastern hemlocks (*Tsuga canadensis*). The surrounding land is primarily agricultural, with a few homes or summer cottages along the creek edge.



Map Turtles (Graptemys geographica) are known from Penn's Creek

Threats and Disturbances

Because this site is so rugged, the site is not under much threat from human disturbance. However. these habitats are under threat from invasive exotic species. The site is currently being invaded by Garlic mustard (Alliaria petiolata) which could displace the population of Jeweled Shooting-star at this site. This habitat is very susceptible to invasions of tree-of-heaven (Ailanthus altissima), which secretes a toxic compound into the soil to poison other vegetation surrounding the tree, thereby eliminating competitors.

Conservation Recommendations

It is critical to control the invasive exotic species at this site in order to support the population of Jeweled

shooting-star at this site. The Garlic mustard should be pulled annually and properly disposed of (usually through burning) to ensure that other areas are not invaded by the plant waste. Any invasions of tree-of-heaven must be dealt with immediately, before advancement of the tree displaces the Jeweled shooting-star.

ROLLING GREEN RUN SLOPES (Monroe Township)

The Rolling Green Run Slopes site is a cluster of small forest patches overlooking Penns Creek, just to the northwest of the town of Hummels Wharf. A population of **Northern Myotis** (*Myotis septentrionalis*), a G4 S3BS3N species of concern, was recently found feeding along the small rivulets that cascade down the slopes at this site. While the relationship of this location to a maternity site or roost is unknown, the multiple individuals captured here on several different nights show that this population used this site for foraging. These Northern Myotis were feeding on the insects here because of the hatches that occur along steams with high water quality.

Threats and Disturbances

The forest at this site has been highly fragmented, with several large utility right-of-ways splitting the forest into small clusters of trees



The Northern Myotis (*Myotis septentrionalis*) is known from the Rolling Green Run site and the Shamokin Dam Slopes site.

photo source: PNHP

Conservation Recommendations

The bats at this site rely on the insect hatches that occur in the small streams that flow down the slopes. The water quality of these rivulets must be maintained to allow insect hatches and ensure a healthy food source for the bats that feed at this site. The water quality of the site relies on an intact forest, which filters contaminants from runoff and maintains water temperatures. Additional fragmentation of the forested area at this site should be avoided.

SHAMOKIN DAM SLOPES (Monroe Township)

Just north of the town of Shamokin Dam is a small patch of mixed forest, containing both evergreen and deciduous trees. Recent surveys at the site revealed a population of G4 S3BS3N **Northern Myotis** (*Myotis septentrionalis*), a species of concern in Pennsylvania. The bats at this site were captured while foraging along one of the small unnamed watercourses that flow into the Susquehanna River. These bats were found foraging along the small rivulets that cascade down the slopes, feeding on the insects here because of the hatches that occur along steams with high water quality.

Threats and Disturbances

The forest at this site has been highly fragmented, with several roads splitting the forest into a cluster of forested scraps.

Conservation Recommendations

The bats at this site rely on the insect hatches that occur in the small streams that flow down the slopes. The water quality of these rivulets must be maintained to allow insect hatches and ensure a healthy food source for the bats that feed at this site. The water quality of the site relies on an intact forest, which filters contaminants from runoff and maintains water temperatures. Additional fragmentation of the forested area at this site should be avoided.

SHIKELLAMY BLUFFS (Monroe Township and Union County)

This site is a good quality Calcareous shale cliff, a GNR S2 natural community formed on horizontal shales of the Devonian Sherman Creek and Irish Valley formations. The site is a steep, 300-foot (91m) high east and northeast facing shale cliff along the Susquehanna River, extending north into Union County. There is an abandoned railroad bed at the base and woods and fields along the summit. The natural community encompasses an area of about 60 acres and contains xeric ridges, mesic forested areas, open rock faces and dripping ledges. The open, xeric ridges are dominated by Virginia pine (Pinus virginiana) and oaks, lowbush blueberry (Vaccinium pallidum) and various herbs and grasses. The bluff is a mosaic of mesic woods on ledges and the lower slopes and open rock ledges and sheer cliffs, both wet and dry. These cliffs represent the most important component of the site. The cool north and northeast aspect of the cliffs, the bedrock, and the available water combine to provide habitats for a wide variety of ferns and attractive wild flowers that are found here in April and May. Two large populations of **Jeweled** shooting-star (Dodecatheon meadia), a GNR S2 state threatened plant, can be found on moist vertical rock faces with a few scattered individuals in various places. The larger of the two populations contains over 100 plants and is found growing on the steep east to northeast facing calcareous shale cliff. This population may be threatened by any interruption to water flow through the shale and over the surface. Also found at the site is a population of **golden** corydalis (Corydalis aurea), a G5 S1 Pennsylvania endangered plant. Associated plant species include rock geranium (Heuchera americana), liverwort (Marchantia polymorpha) and fragile fern (Cystopteris sp.). Some of the cliff top is contained within Shikellamy State Park. The scenic value of the



Jeweled shooting-star (*Dodecatheon meadia*) is known from the Shikellamy Bluffs site

photo source: PNHP

bluffs and the potential for a recreation trail that the abandoned railroad bed offers are two additional reasons for protecting the full extent of Shikellamy Bluffs.

Threats and Disturbances

Because of the rugged terrain of this site, the cliff face is naturally protected from most human disturbance. The site could be harmed by excavation or blasting if the railroad that runs along the base of the cliff is ever expanded. Cliff communities are highly susceptible to invasions of exotic species. Plants like tree-of-heaven (*Ailanthus altissima*) can rapidly take hold in incredibly harsh conditions and many cliff faces have been invaded by this aggressive exotic. This species exhibits a trait known as allelopathy, where toxic compounds are released into the soil to eliminate other plant species surrounding the tree.

A selection of plants found at the Shikellamy Bluffs site

Box elder Acer negundo
Striped maple Acer pensylvanicum
Silver maple Acer saccharinum
Alleghany-vine Adlumia fungosa
Wild columbine Aquilegia canadensis
Smooth rock-cress Arabis laevigata
Lyre-leaved rock-cress Arabis lyrata

Ebony spleenwort Asplenium platyneuron
Maidenhair spleenwort Asplenium trichomanes

Pleel birek

Black birch Betula lenta Hairy bitter-cress Cardamine hirsuta Redbud Celtis occidentalis Field chickweed Cerastium arvense Spring-beauty Claytonia virginica Golden corydalis Corydalis aurea Yellow fumewort Corydalis flavula Rock harlequin Corydalis sempervirens Fragile fern Cystopteris tenuis Squirrel corn Dicentra canadensis Dutchman's-breeches Dicentra cucullaria Jeweled shooting star Dodecatheon meadia Marginal wood fern Dryopteris marginalis

An ash Fraxinus sp.

Alum-root Heuchera?-americana
Wild hydrangea Hydrangea arborescens
Virginia waterleaf Hydrophyllum virginianum
False Solomon's-seal Maianthemum racemosum
ninebark Physocarpus opulifolius
Solomon's seal Polygonatum pubescens
Rock polypody Polypodium virginianum

Wild black cherry Prunus serotina
Kidney-leaf buttercup Ranunculus abortivus
Staghorn sumac Rhus typhina

Wild gooseberry Ribes rotundifolium Purple-flowering raspberry Rubus odoratus Red-berried elder Sambucus racemosa Early saxifrage Saxifraga virginiensis Lanceleaf figwort Scrophularia lanceolata Sticky flycatch Silene caroliniana bladdernut Staphylea trifolia Tilia americana American basswood Toxicodendron radicans Poison sumac

Rusty woodsia Woodsia ilvensis

Conservation Recommendations

Expansion of the state park or creation of another managed area to include the rest of the bluffs and the old railroad bed at the base of the cliffs is the surest way to protect the plant population and the natural community where the plants are found. Control of invasive exotic species is of utmost importance at this site if the unique natural community is to be preserved at Shikellamy Bluffs.

SUSQUEHANNA RIVER AT SELINSGROVE

(Monroe & Penn Townships and Northumberland County) This stretch of the Susquehanna River contains a chain of islands that include Byer's Island, Cherry Island, and Fischer's Island. A population of a G3G4 S3S4 species of special concern, the Yellow Lampmussel (Lampsilis cariosa), was found at this site in 2001. This particular population appeared to be very healthy. These mussels were found in the shoals along the islands and the shoreline. Aggregations of mussels are most frequently found in the shallows, but deeper waters throughout the river may contain populations of freshwater mussels as well. Surveying for these species under these conditions requires a tremendous amount of effort but where these methods have been employed, mussels are found at depths that cannot be surveyed from the surface. It is likely that these mussel species occur at greater depths throughout the site but have simply not yet been recorded. The river habitats further from the shallows around the islands are of equal importance to the species of concern at this site as the shallows where the mussels have been recorded

Threats and Disturbances

Disruption of the substrates along the shoals of the islands and the shores of the river would likely have impacts on the freshwater mussel populations at this site. The Yellow Lampmussel may also be competing for resources with the exotic Asiatic clam (Corbicula fluminea) that was noted at the site. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban. suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, including Selinsgrove. a likely source of nutrient inputs to the river. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs.

Conservation Recommendations

The Yellow Lampmussel is dependent on maintaining the water quality and healthy fish populations, which are used as a host in the reproduction of freshwater mussels. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers

should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. General information on riparian buffer recommendations can be found on page 68.

SUSQUEHANNA RIVER AT SHAMOKIN

DAM/SUNBURY (Monroe Township and Northumberland & Union Counties)

The Susquehanna River at Shamokin Dam/Sunbury is distinct from the downstream portions of the river in that there are very few islands in this stretch. The river at this site is very distinct because it lies at the confluence of the main stem of the Susquehanna and the West Branch of the Susquehanna. Surveys at this site uncovered a population of **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of special concern in the state.

Threats and Disturbances

Disruption of the substrates in this stretch of the river would likely have impacts on the freshwater mussel populations. This portion of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban, suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, a likely source of nutrient inputs. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs.

Conservation Recommendations

The Yellow Lampmussel is dependent on maintaining the water quality and healthy fish populations, which are used as a host in the reproduction of freshwater mussels. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

Moyer Homestead Site (Monroe Townships)

This site lies on fairly poor soils, creating unique growing conditions suitable for certain species of plants. Some of the soil is mixed with shale, with the uplands covered in various species of oak (*Quercus*

spp.). In one of the open areas at this site, a population of a **globally secure**, **state vulnerable plant species of special concern** was located in the late 1980s. Since then, a housing development has been erected directly on top of the site.

Threats and Disturbances

This site has likely been destroyed by the recent housing development.

Conservation Recommendations

Further surveys should be conducted in the remaining undeveloped lots and along the forest edge to see if any remaining specimens persist.

Penn's Drive Cave (Monroe Township)

This tiny cave, which is usually flooded, is significant in Snyder County because it is the only cave that has formed in limy shale associated with sandstone. This cave lies on the bank of Penns Creek and while no species of concern are known from this site, caves have the potential to be used by a host of cave specialists and their conservation is critical to the biological makeup of Snyder County.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. The porous bedrock allows solid and liquid wastes to seep into caves and groundwater, bypassing filtration through soil and sediment. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

Penn Township & Selinsgrove Borough

NATURAL HERITAGE SITES:	<u>PNH</u>	P Rank ¹	State	Last Seen	Quality ²
NATURAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quanty
MIDDLE CREEK		h	igh signifi	cance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	5/12/2005	Е
PENNS CREEK		ехсер	otional sig	nificance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/18/2006	D
Elktoe (Alasmidonta marginata)	G4	S4	-	7/18/2006	D
species of special concern ³	G3	S2	-	7/27/1994	D
RACCOON CAVE/MEDVILLE'S MUDHOLE		high significance			
Northern Myotis (Myotis septentrionalis)	G4	S3B,S3N	-	9/11/1991	E
SUSQUEHANNA RIVER AT SELINSGROVE		hi	igh signifi	cance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	8/15/2001	CD
SUSQUEHANNA RIVER AT STATE GAME LAND	S #233 NOI	RTH h	igh signifi	cance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	8/14/2001	AB
species of special concern ³	G5	S2B	PT	8/14/2001	В
species of special concern ³	G5	S3B,S3N	-	7/25/2005	E
PUBLICLY MANAGED LANDS: none	site	significance rank	c: exceptiona	ıl <mark>high notable</mark>	local

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: non

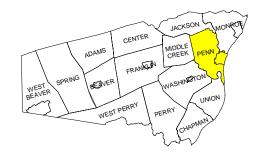
AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Middle Creek
 Warmwater Community 2; Eastern Elliptio Community
- Penns Creek
 Warmwater Community 1; Eastern Elliptio Community
- Susquehanna River Warmwater Community 2
- West Branch Susquehanna River
 River and Impoundment Community; Low Gradient Valley Stream Community;
 - Yellow Lampmussel

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

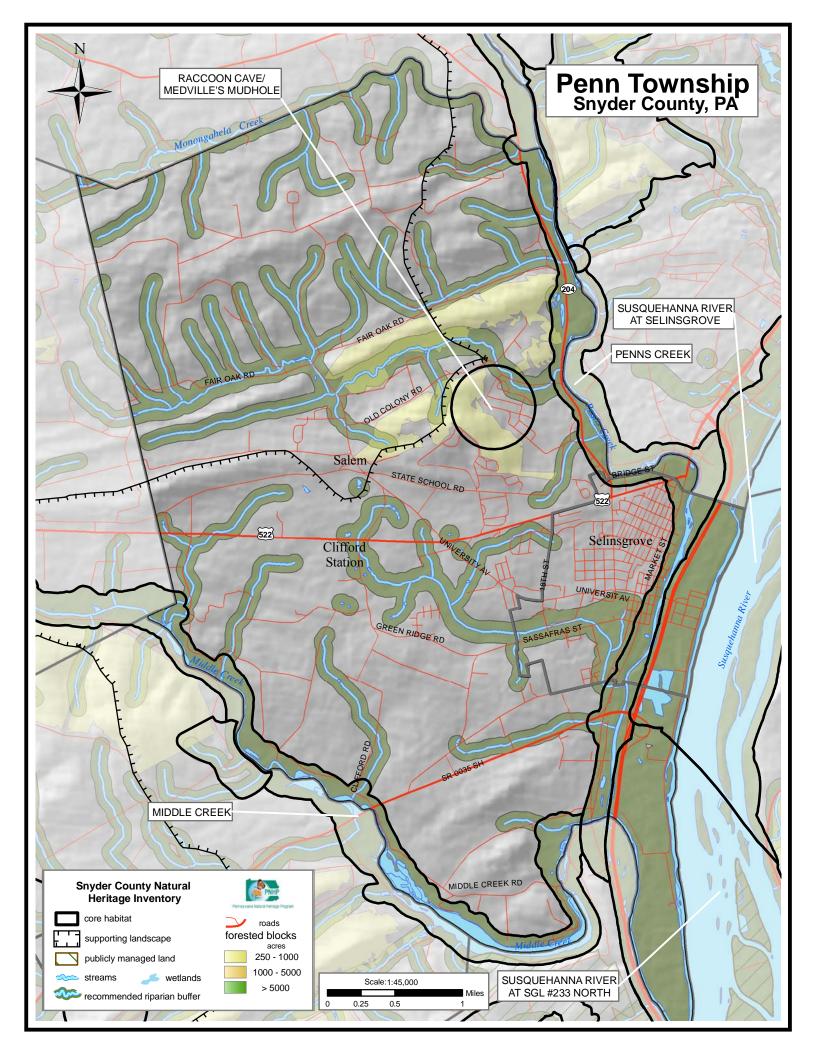
² Please refer to Appendix V for an explanation of quality ranks

Penn Township is located in eastern Snyder County, bordered by Northumberland County. The Susquehanna River forms the eastern border of the township and Monongahela Creek forms the northern border. The bedrock geology is comprised mostly of shale with some smaller areas of sandstone and limestone. Forests make up 20% of the total landcover in Penn Township, the least of any township in the county. The forest blocks are small and highly fragmented, which limits use by forest species. Corridors



should be created by planting trees wherever possible to increase the amount of usable habitat. Agriculture is the predominant landcover in Penn Township, making up 70% of the total landcover, the most of any township in Snyder County. Monongahela Creek and Middle Creek are the major streams flowing through the township. Middle Creek Lake is in the eastern part of the township before it enters into the Susquehanna River. The streams in Penn Township are flowing through the non-forested agricultural areas, which provide a poor buffer to filter out sediment and chemicals before they enter into the stream. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat. The Central Susquehanna Valley Important Mammal Area (IMA) is located in Penn Township. This IMA was chosen due to the available habitat for beavers, otters, bats, and other mammal species. Selinsgrove Borough is located along the eastern shore of the Susquehanna River within Penn Township. Most of the landcover in this borough is residential.

³ This species is not named at the request of the agency overseeing its protection



PENN TOWNSHIP

MIDDLE CREEK (Penn, Beaver, Franklin, Middle Creek, Spring, Union & Washington Townships)

Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in

Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek. including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek, primarily in Penn, Union and Washington Townships, are listed as impaired because the

fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

PENNS CREEK (Penn, Center, Jackson, Monroe & Union Townships and Union County)

Penns Creek and with Middle Creek are the two major creeks in Snyder County, draining eastward to the Susquehanna. Recent surveys along Penns Creek revealed a population of the **Yellow Lampmussel**



Elktoe (Alasmidonta marginata) at the Penns Creek site

PENN TOWNSHIP

(Lampsilis cariosa), a G3G4 S3S4 species of concern and a population of the Elktoe (Alasmidonta marginata), a G4 S4 species of special concern. Additionally, surveys in 1994 uncovered a population of a globally vulnerable, state imperiled species of special concern in Penns Creek. The similarity of the "G" and "S" ranks on all of these species shows that Pennsylvania is host to a large percentage of the populations of these mussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

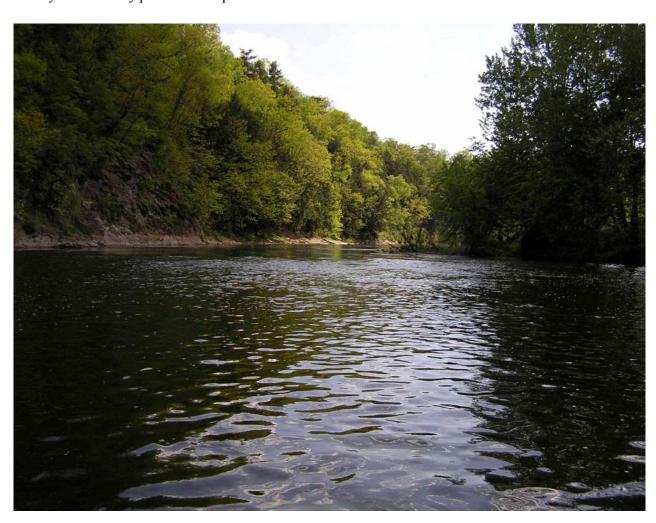
Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Penns Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point

pollution, agricultural runoff, and industrial and urban runoff. Portions of Penns Creek above the Snyder County line are listed as impaired by DEP, because of elevated levels of mercury in fish tissues. Additionally, many of the tributaries, especially throughout Penn Township, are listed as impaired due to siltation from agriculture and residential runoff. Several sewage treatment plants are located along Penns Creek, a likely source of nutrient enrichment.

Conservation Recommendations

Since the waters of Penns Creek at this site are drained from most of the acreage in northern Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.



Penns Creek meanders along the northern and eastern sides of Penn Township. In addition to offering beautiful scenery, Penns Creek, provides critical habitat for many aquatic organisms. Because the creek is free of dams, it serves as exceptional freshwater mussel habitat, and harbors several mussel species of special concern.

PENN TOWNSHIP

RACCOON CAVE/MEDVILLE'S MUDHOLE (Penn Township)

This site is composed of two caves. Raccoon Cave is fairly extensive, with 385 mapped feet (117-m) and over 90 feet (27-m) of vertical drop. Medville's Mudhole is rather small, with three levels and a moderately sized room with a floor of knee-deep mud. This site contains critical habitat for a species of special concern.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms. but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

SUSQUEHANNA RIVER AT SELINSGROVE

(Penn & Monroe Townships and Northumberland County) This stretch of the Susquehanna River contains a chain of islands that include Byer's Island, Cherry Island, and Fischer's Island. A population of a G3G4 S3S4 species of special concern, the **Yellow Lampmussel**

(Lampsilis cariosa), was found at this site in 2001. This particular population appeared to be very healthy. These mussels were found in the shoals along the islands and the shoreline. Aggregations of mussels are most frequently found in the shallows, but deeper waters throughout the river may contain populations of freshwater mussels as well. Surveying for these species under these conditions requires a tremendous amount of effort but where these methods have been employed, mussels are found at depths that cannot be surveyed from the surface. It is likely that these mussel species occur at greater depths throughout the site but have simply not vet been recorded. The river habitats further from the shallows around the islands are of equal importance to the species of concern at this site as the shallows where the mussels have been recorded

Threats and Disturbances

Disruption of the substrates along the shoals of the islands and the shores of the river would likely have impacts on the freshwater mussel populations at this site. The Yellow Lampmussel may also be competing for resources with the exotic Asiatic clam (Corbicula fluminea) that was noted at the site. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban, suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, including Selinsgrove, a likely source of nutrient inputs to the river. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs.

Conservation Recommendations

The Yellow Lampmussel is dependent on maintaining the water quality and healthy fish populations, which are used as a host in the reproduction of freshwater mussels. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. General information on riparian buffer recommendations can be found on page 68.

PENN TOWNSHIP

SUSQUEHANNA RIVER AT STATE GAME LANDS #233 NORTH (Penn & Union Townships and Northumberland County)

This section of the Susquehanna River contains a number of very large islands including Blood Island, Bowers Island, Carls Island, Hoover Island, Little Hoover Island, Kinney Island, and Toad Island. These islands are primarily managed by the Pennsylvania Game Commission. The shoals around the many islands in this complex create a great diversity of underwater habitats and support a healthy population of the G3G4 S3S4 Yellow Lampmussel (*Lampsilis cariosa*), a species of concern in Pennsylvania.

A barn located on the Pennsylvania Game Commission's Hoover's Island, is known to support a large maternity colony of bats. More survey work should be conducted to determine which species are using this structure, but it certainly appears that the barn is a critical habitat for this large bat colony.

This site also includes foraging and breeding grounds for a globally secure, state vulnerable, Pennsylvania threatened species and a globally secure, state vulnerable species of special concern.

Threats and Disturbances

Disruption of the substrates along the shoals of the islands and the shores of the river would likely have impacts on the freshwater mussel populations at this site. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban, suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanov Creeks. There are also many sewage treatment plants along the river, a likely source of nutrient inputs. Above Snyder County, the Susquehanna is designated by DEP as impaired. because fish have been found with elevated levels of mercury and PCBs. Recreational visits to the island could disrupt the species breeding at this site.

The western shore of the river, where Penns Creek enters the Susquehanna, is known as critical habitat for the species of special concern at this site. This area lies just south of Selinsgrove and could be marked for future development.

Conservation Recommendations

The islands are under considerable protection because they are managed by the Pennsylvania Game Commission. The Yellow Lampmussel is dependent on maintaining the water quality and healthy fish populations, which are used as a host in the reproduction of freshwater mussels. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. The species of special concern known from this site are also dependent on the health of the river, as well as the open grasslands where they may forage. Maintenance of these grasslands is of utmost importance to the breeding success of these species.

Perry Township

NATURAL HERITAGE SITES:	<u>PNH</u>	PNHP Rank ¹		Last Seen	Quality ²
NATURAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quality
BOYER CAVE GROUP		hi	gh signific	eanco	
species of special concern ³	G4	S3B,S3N	g n signiju CR	1/25/1990	Е
species of special concern ³	G3	S1B,S1N	PT	1/25/1990	E
species of special concern	G3	310,311	ГІ	1/23/1990	Ľ
MOUNT PLEASANT MILLS VERNAL POOLS		excep	tional sign	nificance	
Ephemeral/fluctuating Natural Pool	GNR	S3	-	5/2/2006	BC
species of special concern ³	G5	S3	-	5/2/2006	E
SHADE MOUNTIAN BARRENS		h	igh signifi	cance	
Ridgetop dwarf-tree forest		S3	-	4/12/2005	Е
A Zale Moth (<i>Zale submediana</i>)		S2	_	5/3/2001	Е
A Noctuid Moth (<i>Apharetra purpurea</i>)		S2	_	6/23/2000	Е
A Noctuid Moth (Aplectoides condita)		S2S3	_	5/27/1998	Е
Southern Pine Looper Moth (Caripeta aretaria)		S 1	-	8/8/1997	E
A moth (<i>Cerastis fishii</i>)		SNR	-	4/14/1998	E
Pine Devil Moth (<i>Citheronia sepulcralis</i>)		S2S4	-	7/6/1999	E
A Midget Moth (Elaphria georgei)		SNR	-	5/4/2006	E
Attentive Dart (Eueretagrotis attenta)		SNR	-	7/6/1999	E
Footpath Sallow Moth (Metaxaglaea semitaria)		S2	-	10/8/1997	E
A Moth (Sideridis maryx)		S1S3	-	7/1/2000	E
Gordian Sphinx (Sphinx gordius)		S1S3	-	5/24/1998	E
Broad Sallow Moth (<i>Xylotype capax</i>)		S3	-	9/25/1997	E
Oblique Zale moth (<i>Zale obliqua</i>)		S3	-	6/13/2001	E

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA, Blacklog Mountain IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

• Middle Creek

Middle Creek-Unnamed Creek at Middleburg

- North Branch Mahantango Creek
- West Branch Mahantango

- Warmwater Community 2; Eastern Elliptio Community
- Warmwater Community 2; High Quality Small Stream Community; Eastern
- Elliptio Community
- Warmwater Community 1
- Warmwater Community 1

Perry Township is located in southern Snyder County, bordered by Juniata County. Shade Mountain forms the northern boundary and West Branch Mahantango Creek forms the southern boundary.

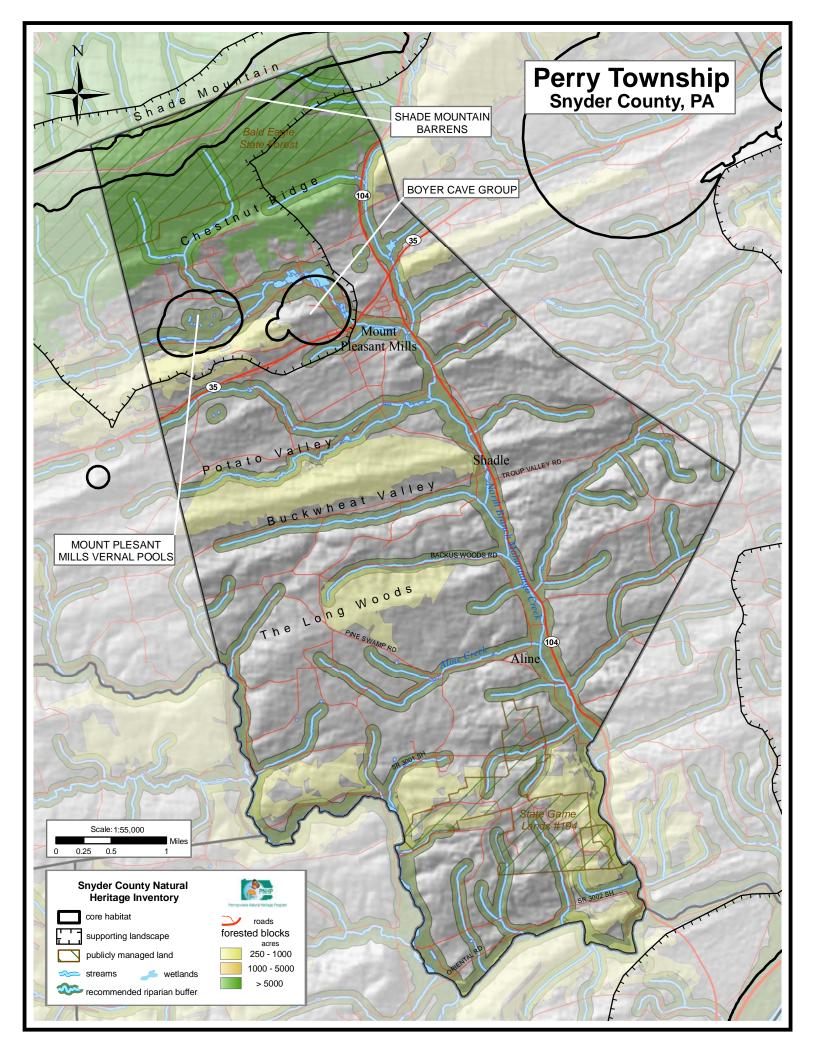
The bedrock geology is almost entirely shale with some small areas of sandstone and limestone. Forests make up 46% of the total landcover in Perry Township. Some of the forest is located in the large forested blocks in northern Perry Township, but much of the forest is in smaller scattered

blocks. Bald Eagle State Forest is located in the large forest blocks, which should help to protect them from further fragmentation. State Game Lands #194 is located in southern Perry Township. The forests in this area have been

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection



fragmented, but having management may help to increase connectivity. Forests in other areas of the township also have the potential to be connected by planting corridors. Agriculture makes up 49% of the total landcover in Perry Township.

North Branch Mahantango Creek and West Branch Mahantango Creek are the major streams flowing through the township. Most of the streams in Perry Township flow through the open agricultural areas, which do little to filter out the sediments and chemicals before they enter into the stream. Planting trees along streams would create a buffer to filter out pollutants and connect forested habitat patches. Blacklog Mountain and Central Susquehanna Valley Important Mammal Areas (IMA) are located in Perry Township. Blacklog Mountain Important Mammal Area (IMA) is located along Shade Mountain in the northern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. The Central Susquehanna Valley IMA is located in the southern part of the township and was chosen due to the available habitat for beavers, otters, bats, and other mammal species.





Surveys of winter hibernating bats are conducted periodically by PA Game Commission wildlife biologists. Minute anatomical differences help differentiate between several species of bats.



PERRY TOWNSHIP

BOYER CAVE GROUP (Perry Township)

While these caves were naturally formed, the current entrance was opened up by quarrying operations sometime before 1900. 499 feet (152m) of passageways have been mapped in the largest of these caves with some stalagmite, stalactite and helectite features in a single moderately sized room. This site also serves as critical habitat for a globally apparently secure, state vulnerable species and a globally vulnerable, state critically imperiled, Pennsylvania threatened species.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

MOUNT PLEASANT MILLS VERNAL POOLS (Perry Township)

Mount Pleasant Mills Vernal Pools contains a community of **Ephemeral/fluctuating Natural Pools**, a GNR S3 tracked community in the state. The small patch of forest surrounding the pool community houses an incredibly high density of pools with over 45 peppering the landscape. These pools are critical for a number of species that are specially adapted to the annual wet/dry cycle of these fishless pools. In



A vernal pool at the Mount Pleasant Mills Vernal Pools site suffering from nutrient eutrophication, likely from the fertilizers from the agricultural field in the background. The algae film on the top of this pool is due to unnaturally high levels of nutrients and can deplete the oxygen within the pool, choking out specially adapted vernal pool species.

PERRY TOWNSHIP

two of these pools, a population of a globally secure, state vulnerable species of special concern was found.

Threats and Disturbances

Surrounding farming operations have eliminated some of the forest around these pools, and fragmented the connectivity between the vernal pools in this community. Additionally, agricultural runoff has decreased the water quality of some of the pools, causing them to develop a thick mat of algae that clogs the pools, preventing much of the natural pool life from successfully breeding.

Conservation Recommendations

A forested buffer of at least 1000 feet (305m) should be established around this pool community to protect the habitats used by the species that rely on the vernal pools in this community. Agricultural practices surrounding this pool community should minimize the use of pesticides, herbicides and fertilizers to protect the species that depend on the clean water of these pools.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree forest**, ranked G4 S3, composed of pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*), and mixed hardwoods. Within this Ridgetop dwarf-tree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy, acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3
- Southern Pine Looper Moth (Caripeta aretaria) G4 S1

- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (*Elaphria georgei*) G4 SNR
- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site

Threats and Disturbances

A dirt forestry road and some hiking trails and a single-track dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force: however natural fires have historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the site.

Spring Township

BEAVER SPRINGS VERNAL POOLS Ephemeral/fluctuating Natural Pool FIRESTONE RIDGE AND CAVE Hard-leaved goldenrod (Solidago rigida) GRASS MOUNTAIN VERNAL POOLS Ephemeral/fluctuating Natural Pool Brown sedge (Carex buxbaumii) KREB TRAIL VERNAL POOLS Ephemeral/fluctuating Natural Pool LITTLE MOUNTAIN VERNAL POOLS Ephemeral/fluctuating Natural Pool	GNR G5 GNR G5 GNR GNR GNR GNR G3	S3 notab S1 high S3 S3 notab S3 high S3	Status significate TU significate TU significate TU le significate Tu significate Tu significate significate significate significate significate	4/21/2005 icance 7/26/2006 ance 4/15/2003 8/31/1995 icance 4/12/2005	D BC BC D CD
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LITTLE MOUNTAIN VERNAL POOLS Ephemeral/fluctuating Natural Pool	GNR	high S3	- signific		CD
Ephemeral/fluctuating Natural Pool		S3	signific	anaa	
	G3		-	4/12/2005	BC
species of special concern ³		S3	PE	7/20/1995	A
MIDDLE CREEK		high	signific	ance	
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	5/12/2005	E
MIDDLE CREEK AT MILL RUN LAKE		notab	le signifi	icance	
Hard-stemmed bulrush (Schoenoplectus acutus)	G5	S2	PE	6/20/1987	E
MULLS GAP VERNAL POOLS	notable significance				
Ephemeral/fluctuating Natural Pool	GNR	S3	-	4/11/2005	CD
SHADE MOUNTAIN BARRENS		high	signific	ance	
Ridgetop dwarf-tree forest	G4	S3	-	4/12/2005	E
A Zale Moth (Zale submediana)	G4	S2	-	5/3/2001	E
A Noctuid Moth (Apharetra purpurea)	G4	S2	-	6/23/2000	E
A Noctuid Moth (Aplectoides condita)	G4	S2S3	-	5/27/1998	E
Southern Pine Looper Moth (Caripeta aretaria)	G4	S1	-	8/8/1997	E
A moth (Cerastis fishii)	G4G5	SNR	-	4/14/1998	E
Pine Devil Moth (Citheronia sepulcralis)	G4	S2S4	-	7/6/1999	E
A Midget Moth (Elaphria georgei)	G4	SNR	-	5/4/2006	E
Attentive Dart (Eueretagrotis attenta)	G4	SNR	-	7/6/1999	E
Footpath Sallow Moth (Metaxaglaea semitaria)	G5	S2	-	10/8/1997	E
A Moth (Sideridis maryx)	G4	S1S3	-	7/1/2000	E
Gordian Sphinx (Sphinx gordius)	G4	S1S3	-	5/24/1998	E
Broad Sallow Moth (<i>Xylotype capax</i>)	G4	S3	-	9/25/1997	E
Oblique Zale moth (<i>Zale obliqua</i>)	G4	S3	-	6/13/2001	E
Pine Barrens Zanclognatha (Zanclognatha martha)	G4	S1S2	-	7/6/1999	E
SNYDER MIDDLESWARTH NATURAL AREA		exception	onal sign	ificance	
Hemlock (white pine) – northern hardwood forest	G5	S3S4	-	10/13/2006	AB
TALL TIMBERS NATURAL AREA		notab	le signifi	icance	
Hemlock (white pine) – northern hardwood forest	G5	S3S4	-	10/13/2006	AB

PUBLICLY MANAGED LANDS: Bald Eagle State Forest, Snyder-Middleswarth Natural Area, Tall Timbers Natural Area

site significance rank: exceptional high notable local

OTHER CONSERVATION AREAS:

Tall Timbers, Snyders-Middleswarth Natural Areas IBA, Central Mountains IMA, Blacklog Mountain IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:

Kreb Gap Run (HQ-CWF), Swift Run (HQ-CWF), Ulsh Gap Run (HQ-CWF)

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Honey Creek
- Lost Creek
- Middle Creek-Faylor Lake Dam
- Middle Creek-Unnamed Creek at Middleburg
- North Branch Middle Creek
- Penns Creek-Coral Run
- Penns Creek-Tuscarora Creek

- Coolwater Community 2
- Warmwater Community 1
- Warmwater Community 1; AMD Stream Community
- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community
- Warmwater Community 2; High Quality Small Stream Community
- Coldwater Community 1
- Warmwater Community 1; Eastern Elliptio Community

Spring Township is located in northern Snyder County, bordered by Union County and is the largest township in the county. Thick Mountain and Jacks Mountain are located in the northern part of the township and Shade Mountain creates the southern border.

The bedrock geology is comprised mostly of shale, with some sandstone and limestone. Spring Township is 64% forested, the second most forested of any township in Snyder County. Most of this forest occurs in the large forested blocks in the mountains the north and south of the Township.



Much of the forested areas are part of state forests managed by the Bureau of Forestry, which will hopefully protect these areas from further fragmentation. Bald Eagle State Forest, including the Tall Timbers Natural Area and the Snyder-Middleswarth Natural Area, is helping to keep the large forested blocks intact, which will provide habitat for interior forest species. Agriculture makes up 31% of the total landcover in Spring Township, which occurs in the center of the township.

South Branch Middle Creek, Ulsh Gap Run, and Kreb Gap Run are the major streams flowing through the township. Faylor Lake is also located in Spring Township. Some of the streams flow through the heavily forested areas, which provide an excellent buffer to filter out sediments and chemicals before they enter the stream. Many of the streams, however, flow through the open agricultural areas that provide little buffering capacity for the streams. Trees should be planted along streams to improve water quality and connect habitat. The Central Mountains and Blacklog Mountain Important Mammal Areas (IMA) are located in West Beaver Township. The Central Mountains IMA is located in the northern forests of Thick Mountain and Jacks Mountain. Blacklog Mountain IMA is located along Shade Mountain in the southern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. The Tall Timbers Snyders-Middleswarth Natural Area Important Bird Area (IBA) is located in northern West Beaver Township. This IBA was chosen due to the presence of old-growth forest that provides important habitat for interior forest species and for its use as a stopover during spring migration.



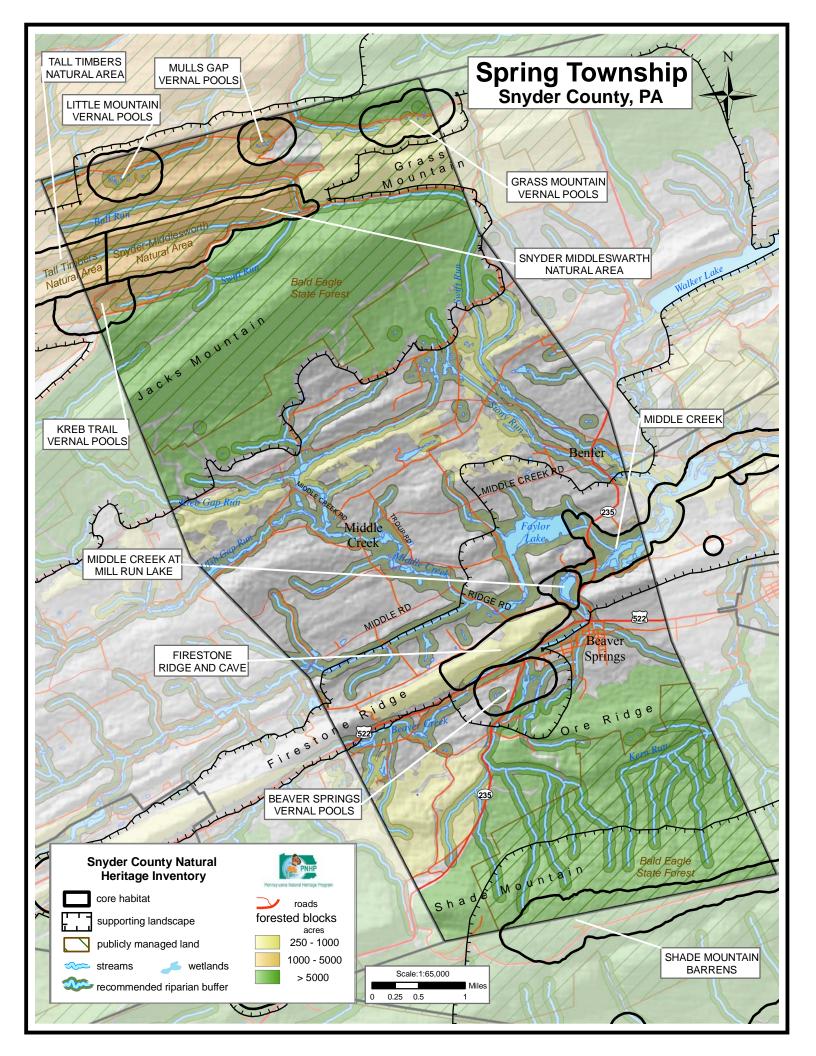


Spring Township is home to several very healthy populations of Northeastern Bulrush (*Scirpus ancistrochaetus*).

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection



BEAVER SPRINGS VERNAL POOLS

(Spring Township)

This site, just south of Beavertown, contains a cluster of **Ephemeral/fluctuating Natural Pools**, a GNR S3 tracked community in Pennsylvania. Some of the pools in this community are heavily vegetated and provide very good habitat for vernal pool amphibians.

Threats and Disturbances

This vernal pool community has been split by Center Street. The surrounding forest at this site has been cropped around this vernal pool community, lessening the quality of the habitat used by vernal pool amphibians. These amphibians require a forested buffer around the pools, as the majority of the year they are subterranean, found at various depths in the soils around the pools. Vernal pool amphibians have been found to travel more than 0.62 miles (1000m) from their natal pools, but the majority of these specialized animals could be captured by a 1000 foot (305-m) buffer. Pools found in close association with agricultural areas are often under threat of agricultural fertilizer, pesticide and herbicide runoff.

Conservation Recommendations

A no-cut forested buffer of 1000 feet (305-m) should be established around the forest patch containing these pools. Any agricultural applications in the surrounding fields should be done with extreme care to minimize the runoff into the vernal pools. The land surrounding this community would be a good candidate for restoration and if the land is no longer used for agriculture, it should be allowed to revert to forest.

FIRESTONE RIDGE AND CAVE (Spring Township)

Just west of the town of Beaver Springs, the limestone ridge known as Firestone Ridge rises from the valley floor over 300 feet (91-m). This limestone ridge has thin soils that provide unique growing conditions for a healthy population of a G5 S1 species of concern, the **Hard-leaved**

goldenrod (*Solidago rigida*). This site also contains a small cave with an entrance that was opened by quarrying on the side of a ridge. Most moderately sized caves have the possibility of being used by bats as hibernacula.

Threats and Disturbances

The Hard-leaved goldenrod at this site is threatened by succession, as open habitats are choked out by growing woody vegetation and invasive plant species.

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Measures should be taken to ensure that succession does not overtake the population of Hard-leaved goldenrod at this site. Removal of woody vegetation and invasive plant species as they arrive should be conducted to promote the goldenrod's success.

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m).

The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

GRASS MOUNTAIN VERNAL POOLS

(Spring & Adams Townships)

This GNR S3 Ephemeral/fluctuating Natural **Pool** community contains a group of 30 vernal pools at the headwaters of Coral Run. The surrounding forest is mixed hardwoods, including red maple (Acer rubrum), northern red oak (Quercus rubra), and white oak (Quercus alba), with scattered eastern white pine (*Pinus strobus*) and eastern hemlock (Tsuga canadensis). A thick heath shrub layer coats the ground around the pools at this site. In one of the pools is a population of the G5 S3 species of concern, brown sedge (Carex buxbaumii). This sedge species is not typically found growing in vernal pools, but the conditions in this particular pool are unique and provide suitable growing conditions for this rare plant.

Threats and Disturbances

This site lies on Bald Eagle State Forest land and while this affords the pools some degree of

protection, the forest around the pools could be slated for future timbering practices. Additionally, this vernal pool community has been bisected by Hunter Road. Inappropriate road maintenance has led to siltation and runoff from the road surface during heavy rains. These contaminants not only serve to decrease the water quality, but also may slowly fill in the affected pools over time. Several of the pools in this community have had artificial channels dug between them to connect the pools.

Conservation Recommendations Road maintenance should be conducted with the vernal pool community water

quality in mind. Efforts should be made to minimize the silt input from the road surface into the pools. The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5-m) of no-cut, and 100 feet (30.5-m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool amphibians are to be conserved. A minimum 1000-foot (305-m) no-cut forested buffer should be established around the pools at this site to protect the unique suite of vernal pool amphibians and the population of the Brown sedge that inhabit this vernal pool community.

KREB TRAIL VERNAL POOLS (Spring & West Beaver Townships)

This site contains an **Ephemeral/fluctuating Natural Pool** community ranked GNR S3. This vernal pool community contains at least eight pools that are in good condition and are full of amphibian egg masses in the spring. The forest surrounding this pool community consists of red maple (*Acer rubrum*), eastern white pine (*Pinus strobus*), black gum (*Nyssa sylvatica*), black birch (*Betula lenta*), pitch pine (*Pinus rigida*), yellow birch (*Betula allegheniensis*), chestnut oak (*Quercus montana*), and northern red oak (*Quercus rubra*).



One of the vernal pools at the Little Mountain Vernal Pools site.

Threats and Disturbances

This site lies on Pennsylvania Bureau of Forestry land and has a certain degree of protection because of this. This pool community is close to forestry roads.

Conservation Recommendations

The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5m) of no-cut, and 100 feet (30.5m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool amphibians are to be conserved. A minimum 1000-foot (305-m) no-cut forested buffer should be established around the pools at this site to protect the unique suite of vernal pool amphibians that inhabit this vernal pool community.

LITTLE MOUNTAIN VERNAL POOLS

(Spring Township and Union County)

This Ephemeral/fluctuating Natural Pool community ranked GNR S3 contains 17 vernal pools that support breeding amphibians. The forest surrounding this site is composed of red maple (Acer rubrum), white oak (Quercus alba), black cherry (Betula lenta), black gum (Nyssa sylvatica), eastern white pine (Pinus strobus), chestnut oak (Quercus montana), and eastern hemlock (Tsuga canadensis). Many vernal pool amphibians were recorded during recent surveys of this site. Unfortunately, this pool community is in close proximity to a forestry road. This vernal pool community also includes a globally vulnerable, state vulnerable Pennsylvania endangered species.

Threats and Disturbances

This site lies on Pennsylvania Bureau of Forestry land and has a certain degree of protection because of this. A small dirt forestry road skirts along the north side of this vernal pool community.

Conservation Recommendations

The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5m) of no-cut, and 100 feet (30.5m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic

vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool amphibians are to be conserved. A minimum 1000-foot (305-m) nocut forested buffer should be established around the pools at this site to protect the unique suite of vernal pool amphibians and species of special concern that inhabit this community of pools.

MIDDLE CREEK (Spring, Beaver, Franklin, Middle Creek, Penn, Union & Washington Townships)

Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver

Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek, primarily in Penn, Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

MIDDLE CREEK AT MILL RUN LAKE (Spring Township)

This section of Middle Creek is a fast flowing, narrow portion of the creek without much backwater along the sides of the creek. Although there is little floodplain or marsh at this portion of the creek, a population of the state endangered G5 S2 Hard-stemmed bulrush (*Schoenoplectus acutus*) was located near Mill Run Lake.

Threats and Disturbances

Mill Run Lake is manmade, and with its margins intensely mowed there is little to no marsh vegetation around the lake. Often manmade lakes are created in areas that were once low lying or marshy. It is likely that the Hard-stemmed

bulrush population once occupied the more expansive area now covered by the lake.

Conservation Recommendations

The creation of deep impounded wetlands was once thought to be good for the environment by creating a more diverse landscape for wildlife and securing a steady water supply. We now see the dangers of creating such impoundments, both to the safety of our citizens and to the biological resources of the county. Many prime marshes, wet meadows, shrub swamps, and floodplains have been converted into more stagnant ponds over the years, and as a result, these unique natural wetlands are becoming increasingly rare. Restoration of the wetland that is now Mill Run Lake would require removal of the earthen dyke at this site. Appropriate engineering may allow the lake bed to return to a more natural wetland and likely allow the restricted population of the Hard-stemmed bulrush to recover.

MULLS GAP VERNAL POOLS (Spring Township)

This Ephemeral/fluctuating Natural Pool community ranked GNR S3 contains a nice cluster of 10 vernal pools. Some of these pools appear to have some groundwater influence and may be associated with some type of spring in the area. The forest surrounding the pool community is composed of red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), eastern white pine (*Pinus strobus*), northern red oak (*Quercus rubra*), black gum (*Nyssa sylvatica*), and white oak (*Quercus alba*).

Threats and Disturbances

This site lies on Pennsylvania Bureau of Forestry land and therefore has a certain degree of protection. However, this site is located at the junction of two forestry roads and some of the road surface material is flowing into some of the pools. The invasive Japanese stilt-grass (*Microstegium vimineum*) was noted at this site during recent surveys.

Conservation Recommendations

Any road maintenance should be conducted with the vernal pool community water quality in mind.

Efforts should be made to minimize the silt input from the road surface into the pools. The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5m) of no-cut, and 100 feet (30.5m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool amphibians are to be conserved. A minimum 1000-foot (305-m) no-cut forested buffer should be established around the pools at this site to protect the unique suite of amphibians that inhabit this vernal pool community.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree** forest, ranked G4 S3, composed of pitch pine (Pinus rigida), scrub oak (Quercus ilicifolia), and mixed hardwoods. Within this Ridgetop dwarftree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy. acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3
- Southern Pine Looper Moth (Caripeta aretaria) G4 S1
- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (Elaphria georgei) G4 SNR

- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site.

Threats and Disturbances

A dirt forestry road and some hiking trails and a single-track dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force: however natural fires have historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the site.

SNYDER MIDDLESWARTH NATURAL

AREA (Spring Township)

This natural area, which is also a designated National Natural Landmark, encompasses more

than 500 acres, 250 acres of which is virgin timber old-growth Hemlock (white pine) – northern hardwood forest, a G5 S3S4 tracked community in the state. This tract is one of the finest remaining examples in the state and is dominated by eastern hemlock (Tsuga canadensis), yellow birch (Betula allegheniensis), black birch (Betula lenta), red maple (Acer rubrum) and chestnut oak (Quercus montana) with eastern white pine (Pinus strobus) and striped maple (Acer pensylvanicum) being less dominant. Some downed hemlocks in this tract have been aged to well over 400 years. While old trees are a required component of old-growth forest, the community is classified by having quality forest structure, including much woody debris on the forest floor, and many slow growing sub canopy trees, awaiting the death of one of their ancient neighbors to take advantage of the newly opened hole in the forest canopy.

Threats and Disturbances

Hemlock woolly adelgid (Adelges tsugae) presents the greatest threat to this unique natural community. The adelgid is an exotic pest that was first detected in Pennsylvania in 1967. Hemlock woolly adelgid feeds on the fluids found in hemlock needles, and injects toxins into the remaining living tissue of the tree. Some trees are able to survive adelgid infestations for years, while others die off rather quickly. Other pathogens that may threaten the integrity of Snyder Middleswarth include the elongate hemlock scale (Fiorinia externa), spruce spider mite (Oligonychus ununguis), hemlock rust mite (Nalepella tsugifolia) and cyrptomeria scale (Aspidiotus cryptomeriae). Overbrowsing by deer may also limit the number of young oaks in the system.

Conservation Recommendations

Unfortunately, there is not yet an effective measure to control hemlock woolly adelgid. It remains to be seen what the lasting effect of this exotic pest is. As a Bureau of Forestry Natural Area, the site is already afforded adequate protection. Deer hunting at this site should be promoted by the Bureau of Forestry to help

maintain a natural composition of tree species in this forest.

TALL TIMBERS NATURAL AREA (Spring & West Beaver Townships and Mifflin County)

This site covers more than 660 acres of second-growth Hemlock (white pine) – northern hardwood forest, a G5 S3S4 tracked community in the state, adjacent to the Snyder Middleswarth Natural Area that lies to the east. Despite the name "Tall Timbers", this site actually has shorter trees than Snyder Middleswarth Natural Area because the area was cut centuries ago. While not virgin timber, Tall Timbers has all the components of a functioning old-growth forest.

Threats and Disturbances

Hemlock woolly adelgid (Adelges tsugae) presents the greatest threat to this unique natural community. The adelgid is an exotic pest that was first detected in Pennsylvania in 1967. Hemlock woolly adelgid feeds on the fluids found in hemlock needles, and injects toxins into the remaining living tissue of the tree. Some trees are able to survive adelgid infestations for years, while others die off rather quickly. Other pathogens that may threaten the integrity of Tall Timbers Natural Area include the elongate hemlock scale (Fiorinia externa), spruce spider mite (Oligonychus ununguis), hemlock rust mite (Nalepella tsugifolia) and cyrptomeria scale (Aspidiotus cryptomeriae). Over browsing by deer may also limit the number of young oaks in the system.

Conservation Recommendations

Unfortunately, there is not yet an effective measure to control hemlock woolly adelgid. It remains to be seen what the lasting effect of this exotic pest is. As a Bureau of Forestry Natural Area, the site is already afforded adequate protection. Deer hunting at this site should be promoted by the Bureau of Forestry to help maintain a natural composition of tree species in this forest.

Union Township

NATURAL HERITAGE SITES:	PNHP Rank ¹		State	Last Seen	Quality ²	
NATURAL HERITAGE SITES.	Global	State	Status	(m/d/y)	Quality	
MIDDLE CREEK high significance						
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	ign signij -	5/12/2005	Е	
, , , , , , , , , , , , , , , , , , , ,	020.					
PENNS CREEK		exce	ptional sig	gnificance		
Yellow Lampmussel (Lampsilis cariosa)	G3G4	S3S4	-	7/18/2006	D	
Elktoe (<i>Alasmidonta marginata</i>)	G4	S4	-	7/18/2006	D	
species of special concern ³	G3	S2	-	7/27/1994	D	
SUSQUEHANNA RIVER AT STATE GAME LANDS #233	NORTH	h	igh signif	icance		
species of special concern ³	G5	S2B	PT	8/14/2001	В	
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	G3G4	S3S4	-	8/14/2001	AB	
species of special concern ³	G5	S3B,S3N	-	7/25/2005	E	
SUSQUEHANNA RIVER AT STATE GAME LANDS #233 SOUTH high significance						
	G3G4	S3S4	ugu signij	7/31/2001	BC	
Yellow Lampmussel (Lampsilis cariosa)	U3U4	3334	-	//31/2001	ВС	
VERDILLA EAST GRASSLANDS		h	igh signif	icance		
species of special concern ³	G5	S3B,S3N	-	10/1/2005	Е	
PUBLICLY MANAGED LANDS: State Game Lands #212	site	significance rar	nk: exceptio	nal <mark>high nota</mark> i	<mark>ble</mark> local	

OTHER CONSERVATION AREAS: Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: no.

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

Middle Creek
 Warm Water Community 2; Eastern Elliptio Community

North Branch Mahantango Creek - Warm Water Community 1

Penns Creek
 Warm Water Community 1; Eastern Elliptio Community

Susquehanna River-Mahantango Creek
 Yellow Lampmussel Community

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

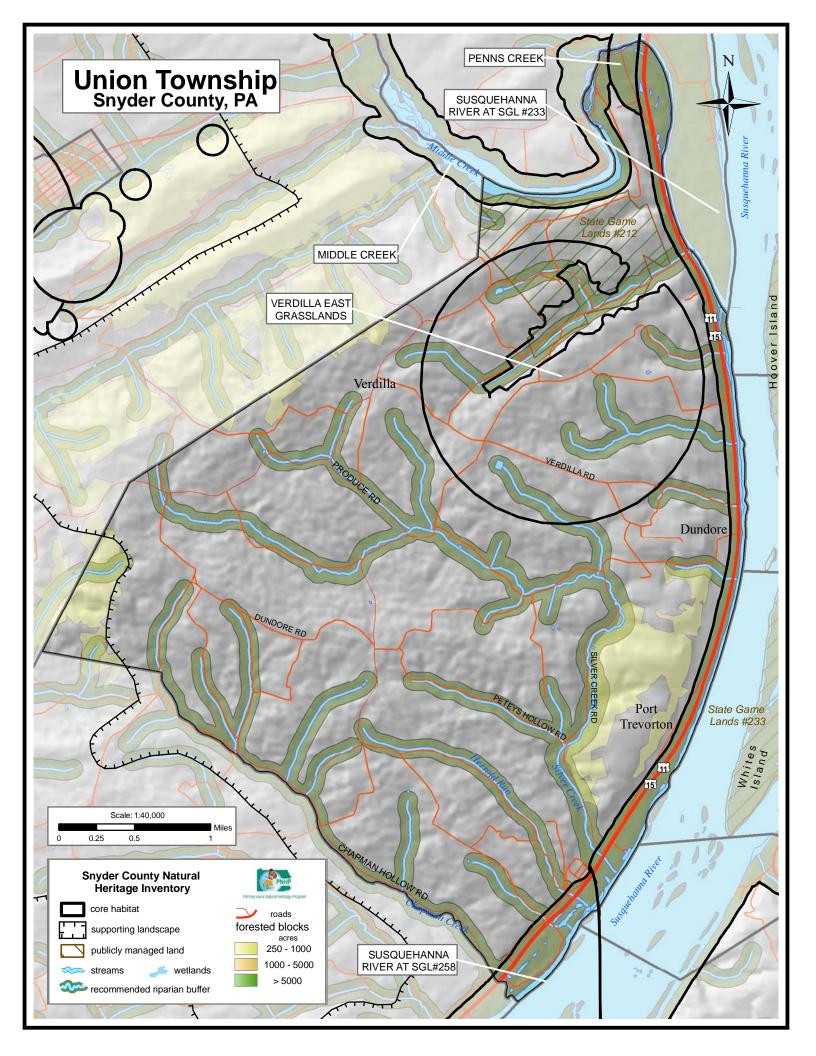
³ This species is not named at the request of the agency overseeing its protection

Union Township is located in eastern Snyder County, bordered by Northumberland County. Middle Creek forms the northern boundary, Chapman Creek forms the southern boundary, and the Susquehanna River forms the eastern boundary.

The bedrock geology is comprised of shale and sandstone. Forests make up 26% of the total landcover in the township, arrayed in small scattered forest blocks. State Game Lands #212 is located in northeastern Union Township

along Middle Creek Lake. Forests here have been fragmented, but are more connected than the rest of the township. Agriculture makes up 65% of the total landcover in Union Township.

Silver Creek, Chapman Creek, and Middle Creek are the major streams flowing through Union Township. Most of the streams in this township run through the open agricultural areas that do little to filter out sediments and chemicals before they enter into the stream. Planting trees along streams would create a buffer to filter out pollutants and connect forested habitat patches. The Central Susquehanna Valley Important Mammal Area (IMA) is located along eastern Union Township. This IMA was chosen due to the available habitat for beavers, otters, bats, and other mammal species.



UNION TOWNSHIP

Creek, Penn, Spring & Washington Townships)
Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the Yellow Lampmussel (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of

MIDDLE CREEK (Union, Beaver, Franklin, Middle

Threats and Disturbances

the species.

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-bycase basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid deposition. The lower sections of Middle Creek, primarily in Penn. Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of

concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

PENNS CREEK (Union, Center, Jackson, Monroe, & Penn Townships and Union County)

Penns Creek and Middle Creek are the two major creeks in Snyder County, draining eastward to the Susquehanna. Recent surveys along Penns Creek revealed a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern and a population of the Elktoe (Alasmidonta marginata), a G4 S4 species of special concern. Additionally, surveys in 1994 uncovered a population of a globally vulnerable, state imperiled species of **special concern** in Penns Creek. The similarity of the "G" and "S" ranks on all of these species shows that Pennsylvania is host to a large percentage of the populations of these mussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Penns Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Portions of Penns Creek above the Snyder County line are listed as impaired by DEP, because of elevated levels of mercury in fish tissues. Additionally, many of the tributaries, especially throughout Penn Township, are listed as impaired due to siltation from agriculture and residential runoff. Several sewage treatment plants are located along Penns Creek, a likely source of nutrient enrichment.

Conservation Recommendations

Since the waters of Penns Creek at this site are drained from most of the acreage in northern Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and

UNION TOWNSHIP



One of Union Township's Natural Heritage Inventory sites, Penn's Creek, offers great biological habitats for fish, freshwater mussels, reptiles, amphibians, and birds, as well as offering a number of recreational opportunities.

allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

SUSQUEHANNA RIVER AT STATE GAME LANDS #233 NORTH (Union & Penn Townships and Northumberland County)

This section of the Susquehanna River contains a number of very large islands including Blood Island, Bowers Island, Carls Island, Hoover Island, Little Hoover Island, Kinney Island, and Toad Island. These islands are primarily managed by the Pennsylvania Game Commission. The shoals around the many islands in this complex create a great diversity of underwater habitats, and support a healthy population of the G3G4 S3S4 Yellow Lampmussel (*Lampsilis cariosa*), a species of concern in Pennsylvania.

A barn located on the Pennsylvania Game Commission's Hoover's Island, is known to support a large maternity colony of bats. More survey work should be conducted to determine which species are using this structure, but it certainly appears that the barn is a critical habitat for this large bat colony.

This site also includes foraging and breeding grounds for a globally secure, state vulnerable, Pennsylvania threatened species and a globally secure, state vulnerable species of special concern.

Threats and Disturbances Disruption of the substrates along the shoals of the islands and the shores of the river would likely have impacts on the freshwater mussel populations at this site. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban. suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, a likely source of

nutrient inputs. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs. Recreational visits to the island could disrupt the species breeding at this site.

The western shore of the river, where Penns Creek enters the Susquehanna, is known as critical habitat for the species of special concern at this site. This area lies just south of Selinsgrove and could be marked for future development.

Conservation Recommendations

photo source: PNHP

This site is under considerable protection because it is managed by the Pennsylvania Game Commission. The Yellow Lampmussel is dependent on maintaining the water quality and healthy fish populations, which are used as a host in the reproduction of freshwater mussels. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. The species of special concern known from this site are also dependent on the health of the river, as well as the open grasslands where they may forage. Maintenance of these grasslands is of utmost importance to the breeding success of this species.

UNION TOWNSHIP

SUSQUEHANNA AT STATE GAME LANDS

#233 SOUTH (Union & Chapman Townships and Northumberland County)

This site consists of a cluster of islands in the Susquehanna River including Browns, Herrold, and Zeigler Islands. Browns Island is owned and managed by the Pennsylvania Game Commission. The channels between the islands tend to have shallow, quick-flowing water over a substrate of gravel, cobbles and sand, with a few bedrock ridges. A population of the **Yellow Lampmussel** (*Lampsilis cariosa*), a G3G4 S3S4 species of concern was documented at this site. The shoals around the islands at this site are critical habitat for numerous freshwater mussels, both common and rare, and are crucial for the maintenance of the water quality through this stretch of the Susquehanna River.

Deeper waters throughout the river may contain populations of freshwater mussels, but surveying for these species under these conditions requires a tremendous amount of effort. It is likely that these mussel species occur at greater depths throughout the site but have simply not yet been recorded. The river habitats further from the shallows around the islands are of equal importance to the species of concern at this site as the shallows where the mussels have been recorded.

Threats and Disturbances

Disruption of the substrates around these islands would likely have impacts on the freshwater mussel populations. This stretch of the Susquehanna River is very vulnerable to pollution and excessive siltation due to runoff from the urban, suburban, and agricultural lands that drain into the river. In Snyder County, the river this threatened by acid mine drainage, primarily coming in from the Northumberland County side via Shamokin and Mahanoy Creeks. There are also many sewage treatment plants along the river, a likely source of nutrient inputs. Above Snyder County, the Susquehanna is designated by DEP as impaired, because fish have been found with elevated levels of mercury and PCBs.

Conservation Recommendations

The species of concern at this site is dependent on maintaining the fish populations and the water quality of the Susquehanna River. Since the waters of the Susquehanna at this site are drained from millions of acres of land, general recommendations such as maintaining riparian buffers should improve the

water quality of the site and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68.

VERDILLA EAST GRASSLANDS (Union Township)

A population of a globally secure, state vulnerable species of special concern was recently located at this site. This site encompasses an area of pastoral landscape with a portion on Pennsylvania State Game Lands #212. Much of the site is planted in row crops. The core area includes the necessary foraging habitat within the agricultural setting. Prior research has shown home ranges of this species to occupy up to 30 km² (approximately 7,400 acres). The site is primarily composed of a matrix of agricultural fields. pastureland, and interspersed woodland edge. The prev of this species includes various agricultural pests. While populations of this species are globally secure, local populations are declining throughout much of the range. With changes in agricultural practices and suburban development, grasslands and agricultural lands are rapidly being converted to other land uses.

Threats and Disturbances

The major threat to a viable population for this species is the loss of pastures and grasslands to commercial development and intensive row-crop farming. These land use practices decrease habitat for prey populations by reducing cover or by completely eliminating habitats. Additionally, the conversion to high-intensity agriculture or development has decreased the number of old farm structures and trees with large accessible cavities that provide suitable or stable habitat. Other stresses include pesticide poisoning through chronic exposure, accidental poisoning with rodenticide, and vehicle related mortality.

Conservation Recommendations

Land use practices that adversely affect prey species, such as the conversion to development or high-intensity agriculture, should be avoided within the core habitat. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population (NatureServe 2006). Prescribed burning (when done correctly and safely) is another potential management technique to maintain the open fields. Installation of appropriate nest boxes is suggested in areas with abundant prey populations where nesting structures are unavailable or inaccessible.

Washington Township & Freeburg Borough

NATURAL HERITAGE SITES:		<u>PNH</u> Global	P Rank ¹ State	State Status	Last Seen (m/d/y)	Quality ²			
		Global	State	Status	(III Gi J)				
FREEBURG WEST GRASSLANDS			high significance						
species of special concern ³		G5	S3B,S3N	-	7/2/2006	E			
MIDDLE CREEK			high significance						
Yellow Lampmussel (Lampsilis cario	osa)	G3G4	S3S4	-	5/12/2005	E			
MIDDLE CREEK MOUNTAIN LEDGES			notable significance						
Jeweled shooting-star (Dodecatheon i	neadia)	GNR	S2	PT	5/12/2005	В			
SHADE MOUNTIAN BARRENS	DE MOUNTIAN BARRENS high significance				ance				
Ridgetop dwarf-tree forest		G4	S3	-	4/12/2005	Е			
A Zale Moth (Zale submediana)		G4	S2	-	5/3/2001	Е			
A Noctuid Moth (Apharetra purpured	a)	G4	S2	-	6/23/2000	Е			
A Noctuid Moth (<i>Aplectoides condita</i>)		G4	S2S3	-	5/27/1998	E			
Southern Pine Looper Moth (Caripeta aretaria)		G4	S 1	-	8/8/1997	E			
A moth (Cerastis fishii)		G4G5	SNR	-	4/14/1998	E			
Pine Devil Moth (Citheronia sepulcralis)		G4	S2S4	-	7/6/1999	E			
A Midget Moth (Elaphria georgei)		G4	SNR	-	5/4/2006	E			
Attentive Dart (Eueretagrotis attenta)		G4	SNR	-	7/6/1999	E			
Footpath Sallow Moth (Metaxaglaea semitaria)		G5	S2	-	10/8/1997	E			
A Moth (Sideridis maryx)		G4	S1S3	-	7/1/2000	E			
Gordian Sphinx (Sphinx gordius)		G4	S1S3	-	5/24/1998	E			
Broad Sallow Moth (<i>Xylotype capax</i>)		G4	S3	-	9/25/1997	E			
Oblique Zale moth (<i>Zale obliqua</i>)		G4	S3	-	6/13/2001	E			
Pine Barrens Zanclognatha (Zanclognatha martha)		G4	S1S2	-	7/6/1999	E			
SOUTH FREEBURG CAVE GROUP			high	ı signific	ance				
species of special concern ³		G4	S3B,S3N	-	1/24/1989	Е			
Freeburg Cave		local significance							
M.A.R. Cave		local significance							
One Time Cave		local significance							
PUBLICLY MANAGED LANDS:	Bald Eagle State Forest State Game Lands #212								

OTHER CONSERVATION AREAS: Blacklog Mountain IMA, Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Middle Creek Warmwater Community 2; Eastern Elliptio Community
- North Branch Mahantango Creek
 Susquehanna River-Mahantango
- Susquehanna Kiver-Manantango Yellow Lampmussel

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status ² Please refer to Appendix V for an explanation of quality ranks

This species is not named at the request of the agency overseeing its protection

Washington Township is located in central Snyder County. Middle Creek forms the eastern boundary of the township. The bedrock geology is almost entirely shale with some small areas of sandstone and limestone. Forests make up 45% of

This species is not named at the request of the agency overseeing its protection

the total landcover in Washington Township, but most of that is in smaller scattered forest blocks. There is some potential for the smaller forest blocks to be connected, but many are fragmented by roads, which will make creating corridors difficult in many areas. Only small portions of Bald Eagle State Forest and State Game Lands #212 cross into Washington Township.

Agriculture makes up 49% of the landcover in Washington Township.

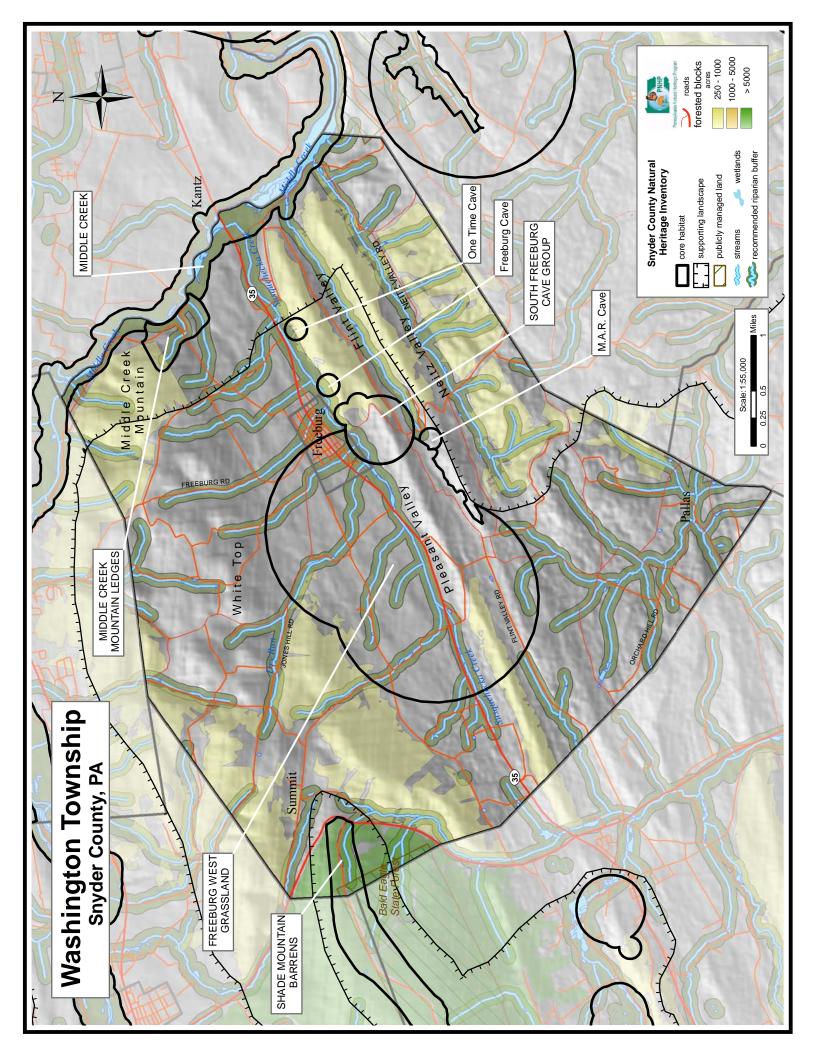
Susquehecka Creek and Middle Creek are the major streams flowing through the township. Few streams in Washington Township flow through the forested areas that would better buffer the streams. Most streams in the



township are running through the open agricultural areas that do little to filter out the sediments and chemicals before they enter into the stream. Planting trees along streams would create a buffer to filter out pollutants and connect forested habitat patches.

Blacklog Mountain and Central Susquehanna Valley Important Mammal Areas (IMA) are located in Washington Township. Blacklog Mountain IMA just crosses into western Washington Township at Bald Eagle State Forest and was chosen because of the habitat available for a state threatened species as well as other mammals. The Central Susquehanna Valley IMA covers much of the eastern half of the township and was chosen due to the available habitat for beavers, otters, bats, and other mammal species. Freeburg Borough is located within Washington Township. Residential areas make up 49% of the total landcover, and agriculture is 43% of the landcover in the borough.





WASHINGTON TOWHSHIP

SOUTH FREEBURG CAVE GROUP (Washington Township)

This site is composed of a cluster of cave openings. Though not confirmed, the proximity of these caves to one another suggests that they are probably all connected. Arnold Cave is a sizeable cave at nearly 400 feet (122m) long with a large entrance. The cave consists of a series of vertical drops, pits, and passages with a number of stalactites and cascading flowstones. BBET 2 cave is a very small, short cave, with only a few places for a person to stand upright. One of these openings has a number of speleothems. Valentine's Day Cave is another very small cave opening which is filled with breakdown that limits further passage. Despite the overall small size of this cave system, it offers a direct connection with the sensitive subterranean environment. This site also serves as critical habitat for an apparently globally secure, state vulnerable species of special concern.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves. bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave. including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be

protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Additionally, access to caves should be limited in winter months.

FREEBURG WEST GRASSLANDS (Washington Township)

This site encompasses an area of pastoral landscape and provides critical habitat for a globally secure, state vulnerable species of concern. The core area includes the necessary foraging habitat within the agricultural setting. Prior research has shown home ranges of this species to occupy up to 30 km² (approximately 7,400 acres). The site is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various agricultural pests. While populations of this species are globally secure, local populations are declining throughout much of the range. With changes in agricultural practices and suburban development, grasslands and agricultural lands are rapidly being converted to other land uses.

Threats and Disturbances

The major threat to a viable population for this species is the loss of pastures and grasslands to commercial development and intensive row-crop farming. These land use practices decrease habitat for prey populations by reducing cover or by completely eliminating habitats. Additionally, the conversion to high-intensity agriculture or development has decreased the number of old farm structures and trees with large accessible cavities that provide suitable or stable habitat. Other stresses include pesticide poisoning through chronic exposure, accidental poisoning with rodenticide, and vehicle related mortality.

Conservation Recommendations

Land use practices that adversely affect prey species, such as the conversion to development or high-intensity agriculture, should be avoided within the core habitat. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population (NatureServe 2006). Prescribed burning (when done correctly and safely) is another potential management technique to maintain the open fields. Installation of nest boxes is suggested in areas with abundant prey populations where nesting structures are unavailable or inaccessible.

WASHINGTON TOWHSHIP

MIDDLE CREEK (Washington, Beaver, Franklin, Middle Creek, Penn, Spring, & Union Townships)

Middle Creek, along with Penns Creek, is one of the major waterways in the county, flowing east into the Susquehanna River. In 2005, a population of the Yellow Lampmussel (Lampsilis cariosa), a G3G4 S3S4 species of concern was located in Middle Creek. Pennsylvania is host to a large percentage of the Yellow Lampmussels in North America; therefore, preservation of the Commonwealth's populations is critical to the overall conservation of the species.

Threats and Disturbances

Freshwater mussels depend on good water quality and fish populations. Maintaining the water quality of Middle Creek is critical to the preservation of both mussel and fish populations and the water quality is continually threatened by point and non-point pollution, agricultural runoff, and industrial and urban runoff. Dams along streams, creeks, and rivers create barriers that reduce the ability of mussels and their host fish to naturally disperse throughout these modified waterways. Typically, removal of dams has positive effects on all aspects of the ecology of the targeted waterway, but decisions for dam removal are site specific, and must be considered on a case-by-case basis. Although no large dams occur directly in Middle Creek, even small dams can inhibit fish movements, and therefore freshwater mussels, and the removal of these smaller dams can improve the overall ecological integrity of the creek. Several dams are known from the tributaries of Middle Creek, including Walker Lake Dam and Faylor Lake Dam. Some of the small tributaries, especially those that drain off of Shade Mountain in Spring and Beaver Townships, are listed by DEP as impaired, because of high nutrient levels from the sewage treatment plant on one of Kern Run's tributaries, low dissolved oxygen levels, siltation from residential construction, and atmospheric acid

deposition. The lower sections of Middle Creek, primarily in Penn, Union and Washington Townships, are listed as impaired because the fish found in this stretch are contaminated with mercury.

Conservation Recommendations

Since the waters of Middle Creek at this site are drained from most of the acreage in central Snyder County, general recommendations such as maintaining riparian buffers should improve the water quality of the site, and allow the species of concern that rely on these waters to continue to thrive. Information on riparian buffer recommendations can be found on page 68. Middle Creek may be a prime candidate for restoration of natural stream flow via dam removal and interested landowners and municipalities can work together with local watershed groups, DEP Dam Safety and American Rivers to identify those dams that should be removed. In Pennsylvania, dams are privately owned and the owner of the dam is therefore responsible for maintaining the dam and ensuring safety for all those who pass the waterway, including boaters and fishermen.

MIDDLE CREEK MOUNTAIN LEDGES (Washington Township)

This site overlooks a meander in Middle Creek. Along these shaded cool slopes, a population of **Jeweled Shooting-star** (*Dodecatheon meadia*), a GNR S2 state threatened species was located. This species is rather rare in the state, usually growing on mesic limestone or dolomite outcrops that face north or east.

Threats and Disturbances

This site is not under much threat from human disturbance due to its rugged terrain, but some illegal garbage dumps have been noted in the area. Jeweled Shooting-star habitats are at risk of being invaded by exotic species and their habitat is particularly susceptible to invasions of tree-of-



flowering Jeweled shooting-star (*Dodecatheon radicatum*)

WASHINGTON TOWHSHIP

heaven (*Ailanthus altissima*) and Garlic mustard (*Alliaria petiolata*). Both of these species secrete toxic compounds into the soil to poison other vegetation surrounding the plant, thereby eliminating competitors. The eastern hemlocks (*Tsuga canadensis*) that shade the site are currently being attacked by hemlock wooly adelgid.

Conservation Recommendations

It is critical to control the invasive exotic species at this site in order to support the population of Jeweled Shooting-star at this site. Any invasions of tree-of-heaven or Garlic mustard must be dealt with immediately. Unfortunately, at this point in time there is no effective measure to control hemlock wooly adelgid.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree forest**, ranked G4 S3, composed of pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*), and mixed hardwoods. Within this Ridgetop dwarf-tree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy, acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3
- Southern Pine Looper Moth (Caripeta aretaria) G4 S1
- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (Elaphria georgei) G4 SNR
- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site.

Threats and Disturbances

A dirt forestry road and some hiking trails and a single-track dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force; however natural fires have historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the site

Freeburg Cave (Washington Township)

M.A.R. Cave (Washington Township)

One Time Cave (Washington Township)

The entrances to Freeburg Cave, M.A.R. Cave, and One Time Cave were all opened by quarrying operations. Though no species of special concern are known from these sites, most moderately sized caves have the possibility of being used by cave specialists. Threats and Disturbances to caves, as well as Conservation Recommendations are similar for all caves in Washington Township, and can be found under the description for the South Freeburg Cave Group found on page 144.

West Beaver Township & McClure Borough

NATURAL HERITAGE SITES:		PNHP Rank ¹		State	Last Seen	Quality ²		
		Global	State	Status	(m/d/y)	Quanty		
JACKS MOUNTAIN EAST			nota	ble signif	ficance			
Timber Rattlesnake (Crotalus horridus)		G4	S3S4	PC	9/7/2006	Е		
KREB TRAIL VERNAL POOLS		notable significance						
Ephemeral/fluctuating Natural Pool		GNR	S3	-	4/12/2005	CD		
MCCLURE CAVE		high significance						
species of special concern ³		G4	S3B,S3N	CR	1/31/1989	E		
TALL TIMBERS NATURAL AREA		notable significance						
Hemlock (white pine) – northern hardwood forest		G5	S3S4	-	10/13/2006	AB		
Lost Creek Headwater Vernal Pools		local significance						
PUBLICLY MANAGED LANDS:	Bald Eagle State Forest, Tall Timbers Natural Area	site sign	nificance rank:	exceptional	high notable	local		

OTHER CONSERVATION AREAS:

Tall Timbers, Snyders-Middleswarth Natural Areas IBA, Blacklog Mountain IMA, Central Susquehanna Valley IMA

EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:

Kreb Gap Run (HQ-CWF), Swift Run (HQ-CWF), Ulsh Gap Run (HQ-CWF)

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Honey Creek
- Jack's Creek
- Lost Creek
- Middle Creek-Faylor Lake Dam
- Middle Creek-Unnamed Creek at Middleburg
- North Branch Middle Creek
- Penns Creek-Coral Run
- Treaster Run

- Coolwater Community 2
- Warmwater Community 1; Low Gradient Valley Stream Community
- Warmwater Community 1
- Warmwater Community 1; AMD Stream Community
- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community
- Warmwater Community 2; High Quality Small Stream Community
- Coldwater Community 1
- Coolwater Community 1

West Beaver Township is located in the northwestern corner of Snyder County, bordered by Union County to the north, Mifflin County to the west, and Juniata County to the south. The bedrock geology is mostly comprised of shale, with smaller areas of sandstone and limestone. Split by Jacks Mountain, the township is bordered on the north by Thick Mountain and on the south by Shade Mountain. West Beaver Township is 61% forested. Much of this forest is contained in large blocks within State Forests in the mountainous areas in the northern and southern part of the

WEST SPRING BEAVER WASHINGTON WASHINGTON WEST PERRY PERRY UNION WEST PERRY CHAPMAN

township. Bald Eagle State Forest, including the Tall Timbers Natural Area and the Snyder-Middleswarth Natural Area, is helping to keep the large forested blocks intact, which will provide habitat for interior forest species. Agriculture dominates the center of the township at 36% of the total landcover.

The South Branch Middle Creek and Ulsh Gap Run are the major streams flowing through the township. Some of the streams flow through the large forest blocks in the state forests, which provide an excellent buffer to filter out sediments and chemicals. Many of the streams, however, run through the agricultural areas in the valley. Trees should be planted along the streams in these areas to provide a buffer.

¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection

The Central Mountains and Blacklog Mountain Important Mammal Areas (IMA) are located in West Beaver Township. The Central Mountains IMA is located in the northern forests of Thick Mountain and Jacks Mountain. Blacklog Mountain IMA is located along Shade Mountain in the southern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. The Tall Timbers Snyders-Middleswarth Natural Area Important Bird Area (IBA) is located in northern West Beaver Township. This IBA was chosen due to the presence of old-growth forest that provides important habitat for interior forest species and for its use as a stopover during spring migration. McClure Borough is contained within West Beaver Township. Most of the borough is forested (52%), and 35% of the total landcover is devoted to agriculture.



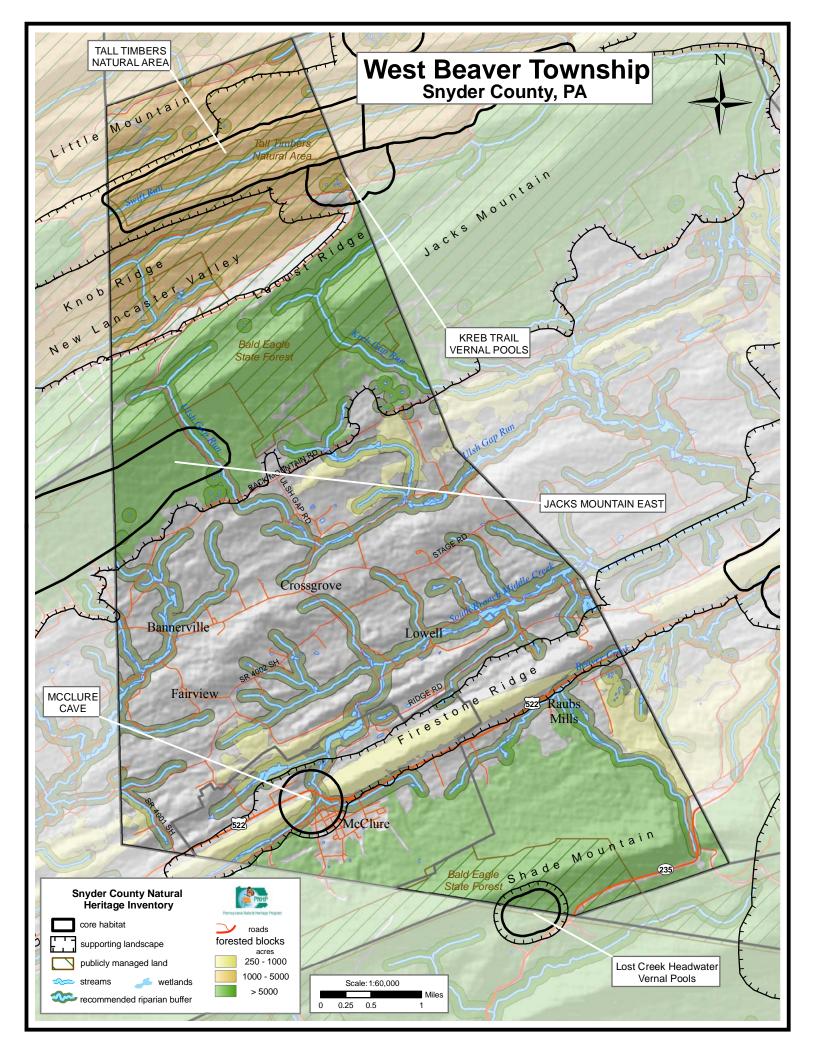
Talus slopes, also known as scree slopes, provide critical habitat for several species of special concern, including the Timber Rattlesnake (*Crotalus horridus*), and the Allegheny Woodrat (*Neotoma magister*). While there are no records for the Allegheny Woodrat in Snyder County, there is ample suitable habitat, and future surveys may reveal a population in the county



photo source: Calvin Butchkoski



photo source: Charlie Eichelberger



WEST BEAVER TOWNSHIP

JACKS MOUNTAIN EAST (West Beaver Township and Mifflin County)

The open scree woodlands and south-facing slopes of Jacks Mountain provide excellent habitat for the PAcandidate G4 S3S4 Timber Rattlesnake (Crotalus horridus). Rattlesnakes primarily occur on rocky talus slopes where they can find refuge in spaces between the boulders as well as thermoregulate in the sunny openings. Males may travel far from the den site in the summer, moving into valleys and low-lying areas. Gravid females, which will give live birth in late summer, are far less mobile and tend to stay within a short distance of the den. Specific locations of dens (hibernacula) and summer birthing sites have not been well inventoried along this ridge, but many landowners report encountering rattlesnakes on the mountain. The majority of the ridge consists of typical dry oak woodlands, broken by openings created by bedrock outcrops and scree. The length of Jacks Mountain contains a large contiguous forest block that serves as an important corridor for wildlife. including raptor and songbird migrations, connectivity of populations of forest inhabitants, and dispersal of growing populations. The habitat is broken only occasionally by utility lines and roads.

Threats and Disturbances:

The most immediate threats to Timber Rattlesnakes throughout their range in Pennsylvania are habitat loss and over hunting. The majority of Jacks Mountain is in private ownership, and is thus subject to potential future alterations of habitat through forest clearing or development.

Conservation Recommendations:

Further surveys to determine specific concentrations of rattlesnakes could improve protection of these sites. Cooperation of landowners is critical to protection of the rattlesnake. Programs to encourage best management practices in forestry, limiting fragmentation of the forest block, and educating landowners about rattlesnakes are all needed.

KREB TRAIL VERNAL POOLS (West Beaver & Spring Townships)

This site contains an **Ephemeral/fluctuating Natural Pool** community ranked GNR S3. This vernal pool community contains at least eight pools that are in good condition and are full of amphibian egg masses in the spring. The forest surrounding this pool community consists of red maple (*Acer rubrum*),

eastern white pine (*Pinus strobus*), black gum (*Nyssa sylvatica*), black birch (*Betula lenta*), pitch pine (*Pinus rigida*), yellow birch (*Betula allegheniensis*), chestnut oak (*Quercus montana*), and northern red oak (*Quercus rubra*).

Threats and Disturbances

This site lies on Pennsylvania Bureau of Forestry land and has a certain degree of protection because of this. This pool community is close to forestry roads.

Conservation Recommendations

The Bureau of Forestry uses vernal pool buffers of 100 feet (30.5m) of no-cut, and 100 feet (30.5m) more of 50% cut. While this is a definite start, it is only suitable for maintaining aesthetic vernal pool characteristics and the 200-foot buffer is inadequate if vernal pool amphibians are to be conserved. A minimum 1000-foot (305-m) no-cut forested buffer should be established around the pools at this site to protect the unique suite of vernal pool amphibians that inhabit this vernal pool community.

MCCLURE CAVE (West Beaver Township)

McClure Cave is the most expansive cave in Snyder County with approximately 2,500 feet (762m) of mapped passages. Some passages of this cave have been enlarged, but many spots are still very constricting. Many small rooms occur throughout with some fossils in the cave walls being found in several portions. Near the entrance to the cave, several rather extensive pools exist, evidence of the direct connection with the water table. This site contains critical habitat for an apparently globally secure, state vulnerable species of special concern.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought

WEST BEAVER TOWNSHIP

of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal. Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Because of the massive size of McClure Cave, the entrance should be generously buffered from disturbance. The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance the species inhabiting this cave. The cave should be surveyed for the presence of rare aquatic invertebrates, which may inhabit the pools in this cave.

TALL TIMBERS NATURAL AREA (West Beaver & Spring Townships and Mifflin County)

This site covers more than 660 acres of second-growth Hemlock (white pine) – northern hardwood forest, a G5 S3S4 tracked community in the state, adjacent to the Snyder Middleswarth Natural Area that lies to the east. Despite the name "Tall Timbers", this site actually has shorter trees than Snyder Middleswarth Natural Area because the area was cut centuries ago. While not virgin timber, Tall Timbers has all the components of a functioning old-growth forest.

Threats and Disturbances

Hemlock woolly adelgid (*Adelges tsugae*) presents the greatest threat to this unique natural community. The adelgid is an exotic pest that was first detected in Pennsylvania in 1967. Hemlock woolly adelgid feeds on the fluids found in hemlock needles, and injects toxins into the remaining living tissue of the tree. Some trees are able to survive adelgid infestations for years, while others die off rather quickly. Other pathogens that may threaten the integrity of Tall Timbers Natural Area include the elongate hemlock scale (*Fiorinia externa*), spruce spider mite (*Oligonychus ununguis*), hemlock rust mite (*Nalepella tsugifolia*) and cyrptomeria scale (*Aspidiotus cryptomeriae*). Over browsing by deer may also limit the number of young oaks in the system.

Conservation Recommendations

Unfortunately, there is not yet an effective measure to control hemlock woolly adelgid. It remains to be seen what the lasting effect of this exotic pest is. As a Bureau of Forestry Natural Area, the site is already afforded adequate protection. Deer hunting at this site should be promoted by the Bureau of Forestry to help maintain a natural composition of trees in the forest.

Lost Creek Headwater Pools (West Beaver Township and Juniata County)

This small saddle in the headwaters of Lost Creek contains several pools comprising a GNR S3 **Ephemeral/Fluctuating Natural Pools Community.** These isolated pools offer an important breeding location for the surrounding amphibian community. The surrounding forest is composed of a dry oak – heath community (Fike, 1999) with chestnut oak (*Quercus montana*) dominating the overstory and a thick layer of mountain laurel (*Kalmia latifolia*) being the understory. The condition of the pool appears good.

Threats and Disturbances:

The site is owned and managed by a pair of landowners. The primary land use at this site is recreational uses of the forest. Logging within proximity to the pools without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland.

Conservation Recommendations:

At the very least, a 305-meter no-cut buffer should be established around this pool complex. Though vernal pools are often thought of as isolated wetlands, the species within the pools rely on the linkages between the wetlands, often apparent only in heavy rains. The preservation of an intact forest canopy around this site will help maintain habitat for the rare plants, animals, and other species that occur here.

West Perry Township

NATURAL HERITAGE SITES:	<u>PNHP</u>		State	Last Seen	Quality ²		
	Global	State	Status	(m/d/y)			
RICHFIELD MARSH	notable significance						
Hard-stemmed bulrush (Schoenoplectus acutus)	G5	S2	PE	8/21/1987	В		
SHADE MOUNTIAN BARRENS		high significance					
Ridgetop dwarf-tree forest	G4	S3	-	4/12/2005	E		
A Zale Moth (Zale submediana)	G4	S2	-	5/3/2001	E		
A Noctuid Moth (Apharetra purpurea)	G4	S2	-	6/23/2000	E		
A Noctuid Moth (Aplectoides condita)	G4	S2S3	-	5/27/1998	E		
Southern Pine Looper Moth (Caripeta aretaria)	G4	S 1	-	8/8/1997	E		
A moth (Cerastis fishii)	G4G5	SNR	-	4/14/1998	E		
Pine Devil Moth (Citheronia sepulcralis)	G4	S2S4	-	7/6/1999	E		
A Midget Moth (Elaphria georgei)	G4	SNR	-	5/4/2006	E		
Attentive Dart (Eueretagrotis attenta)	G4	SNR	-	7/6/1999	E		
Footpath Sallow Moth (Metaxaglaea semitaria)	G5	S2	-	10/8/1997	E		
A Moth (Sideridis maryx)	G4	S1S3	-	7/1/2000	E		
Gordian Sphinx (Sphinx gordius)	G4	S1S3	-	5/24/1998	E		
Broad Sallow Moth (<i>Xylotype capax</i>)	G4	S3	-	9/25/1997	E		
Oblique Zale moth (<i>Zale obliqua</i>)	G4	S3	-	6/13/2001	E		
Pine Barrens Zanclognatha (Zanclognatha martha)	G4	S1S2	-	7/6/1999	E		
WEST BRANCH MAHANTANGO CREEK VERNAL PO	OLS	exc	eptional s	significance			
Ephemeral/fluctuating Natural Pool	GNR	S3	-	4/28/2006	В		
species of special concern ³	G5	S3	-	4/28/2006	E		
Swamp dog-hobble (Leucothoe racemosa)	G5	S2S3	TU	4/28/2006	E		
Haa's Cave	local significance						
Varner Gap Vernal Pools	local significance						
PUBLICLY MANAGED LANDS: Bald Eagle State Forest	orest site significance rank: exceptional high notable				p <mark>le</mark> local		

OTHER CONSERVATION AREAS: Blacklog Mountain IMA, Central Susquehanna Valley IMA

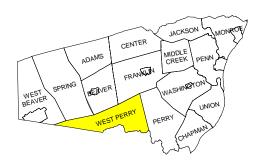
EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: none

AQUATIC COMMUNTIY CLASSIFICATION PROJECT RESULTS:

- Cocolamus Creek-Stony Run
- Lost Creek
- Middle Creek-Unnamed Creek at Middleburg
- North Branch Mahantango Creek
- West Branch Mahantango

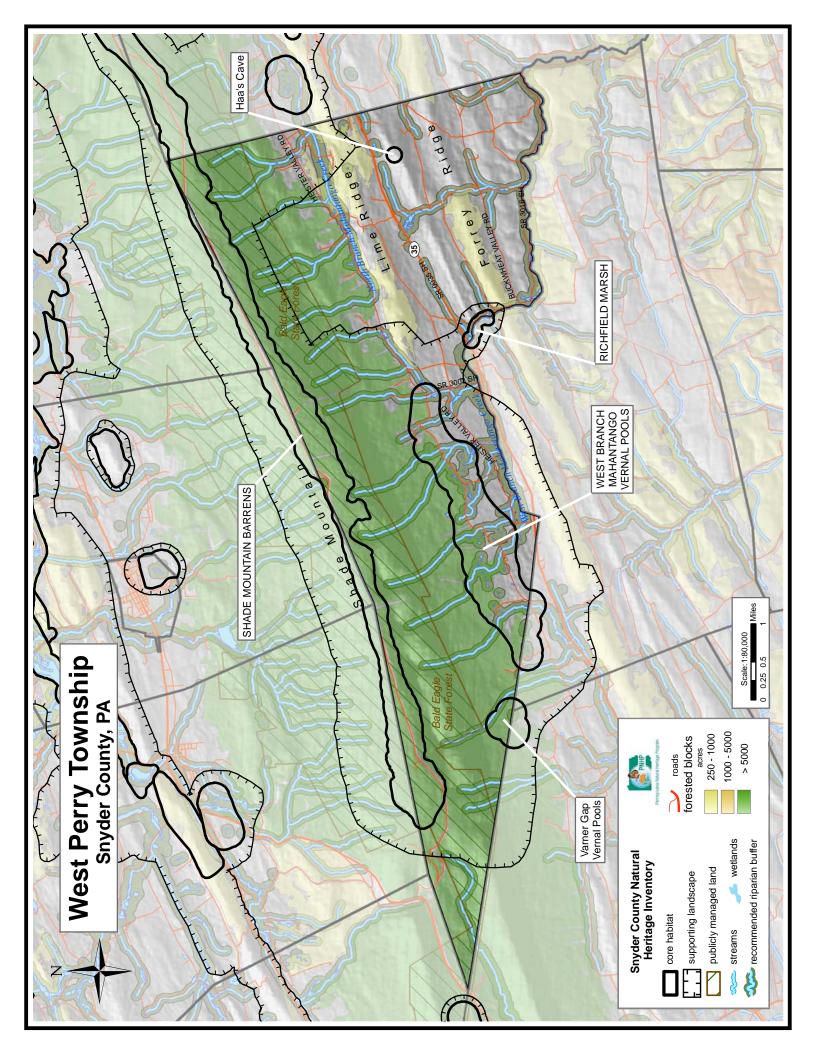
- River and Impoundment Community; Low Gradient Valley Stream
- Community
- Warmwater Community 1
- Warmwater Community 2; High Quality Small Stream Community; Eastern Elliptio Community
- Warmwater Community 1
- Warmwater Community 1
- ¹ Please refer to Appendix IV for an explanation of PNHP ranks and legal status

West Perry Township is located in southern Snyder County, bordered by Juniata County. Shade Mountain forms the northern boundary, and the West Branch Mahantango Creek forms part of the southern boundary. The bedrock geology is comprised mostly of shale with some smaller areas of sandstone and limestone. Forests make up 69% of the total landcover in West Perry Township, the largest percentage in Snyder County. Most of



² Please refer to Appendix V for an explanation of quality ranks

³ This species is not named at the request of the agency overseeing its protection



that consists of a single large forest block located in Bald Eagle State Forest. West Perry Township has the lowest agricultural landcover in the county, 28%, which occurs in the southern part of the township.

North Branch Mahantango Creek and West Branch Mahantango Creek are the major streams flowing through the township. Most of the streams in West Perry Township originate in the large forest blocks that provide an excellent buffer. The other streams in the township flow through the open agricultural areas, which provide a poor buffer to filter out sediments and chemicals before they enter into the streams. Trees should be planted along the streams wherever possible to improve water quality and connect forested habitat.

Blacklog Mountain and Central Susquehanna Valley Important Mammal Areas (IMA) are located in West Perry Township. Blacklog Mountain IMA is located along Shade Mountain in the northern part of the township and was chosen because of the habitat available for a state threatened species as well as other mammals. The Central Susquehanna Valley IMA is located in the southeastern part of the township and was chosen due to the available habitat for beavers, otters, bats, and other mammal species.



A view of the Shade Mountain Barrens site. These Ridgetop dwarf-tree forest communities are maintained by periodic fires. Fire suppression over the past century has led to these communities becoming increasingly scarce. Implementation of disturbance regimes, such as prescribed fires, may allow these unique natural communities to recover.

photo source: PNHP

WEST PERRY TOWNSHIP

RICHFIELD MARSH (West Perry Township and Juniata County)

This site is a small 1-2 acre wetland along the West Branch Mahantango Creek. These wetlands consist of a small shrub swamp and marsh. The shrub swamp, which appears to have some seepage input, at this site is dominated by speckled alder (*Alnus serrulata*), poison sumac (*Toxicodendron vernix*), and ninebark (*Physocarpus opulifolius*). A G5 S2 state endangered plant, the **Hard-stemmed Bulrush** (*Schoenoplectus acutus*), was recorded from this site in 1987. A specimen was originally collected from the area in 1908. During the 1908 survey, another species of concern, the cattail sedge (*Carex typhina*) was also located. Unfortunately, this species has not been seen at this site since 1908.

Threats and Disturbances

The Richfield Marsh is encircled with roads. The marsh is likely receiving runoff from these road surfaces.

Conservation Recommendations

A buffer should be established around these wetlands to help maintain the habitat for the Hard-stemmed Bulrush found at this site.

SHADE MOUNTAIN BARRENS (Beaver, Franklin, Perry, Spring, Washington & West Perry Townships)

This site is an extensive **Ridgetop dwarf-tree forest**, ranked G4 S3, composed of pitch pine (*Pinus rigida*), scrub oak (*Quercus ilicifolia*), and mixed hardwoods. Within this Ridgetop dwarf-tree forest are different natural community components such as pitch pine - heath woodland, pitch pine - mixed hardwood woodland, and pitch pine - scrub oak woodland. The dry, sandy, acidic soils commonly found in barrens create unique growing conditions in which a limited number of species can grow. Historically thought of as desolate areas that are of little use to humans because of their harsh growing conditions, barrens are now known to harbor a suite of species that depend on the unique growing conditions found in the community.

This site also harbors an extremely diverse array of moth species. Over 325 different species of moths have been recorded from this site. Not only does the site house a great diversity of moths, 14 species of rare moths have been documented from the Shade Mountain Barrens, including:

Dominant and Characteristic Plant Species of Shade Mountain Barrens

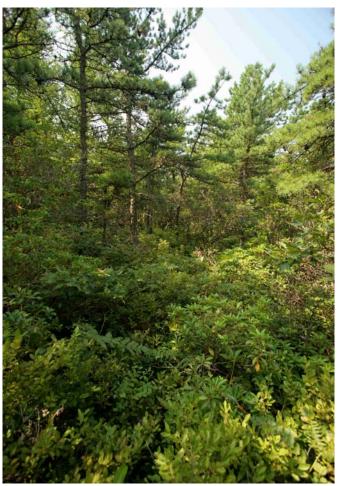
black birch chestnut oak eastern hemlock pitch pine red maple scarlet oak scrub oak Chestnut oak eastern hemlock pitch pine Pinus rigida Acer rubrum chestnut oak Quercus coccinea Quercus ilicifolia

Shrubs:

black huckleberry Gaylussacia baccata
low sweet blueberry Vaccinium angustifolium
mountain laurel Kalmia latifolia
teaberry Gaultheria procumbens

Herbaceous Vegetation:

bracken fern Pteridium aquilinum



A portion of the Ridgetop dwarf tree forest at the Shade Mountain Barrens site. This site is in need of a prescribed burn if this unique natural community is to persist.

WEST PERRY TOWNSHIP

- A Zale moth (Zale submediana) G4 S2
- A Noctuid Moth (Apharetra purpurea) G4 S2
- A Noctuid Moth (Aplectoides condita) G4 S2S3
- Southern Pine Looper Moth (Caripeta aretaria) G4 S1
- A Moth (Cerastis fishii) G4G5 SNR
- Pine Devil Moth (Citheronia sepulcralis) G4 S2S4
- A Midget Moth (Elaphria georgei) G4 SNR
- Attentive Dart (Eueretagrotis attenta) G4 SNR
- Footpath Sallow Moth (Metaxaglaea semitaria) G5 S2
- A Moth (Sideridis maryx) G4 S1S3
- Gordian Sphinx (Sphinx gordius) G4 S1S3
- Broad Sallow Moth (Xylotype capax) G4 S3
- Oblique Zale moth (Zale obliqua) G4 S3
- Pine Barrens Zanclognatha (Zanclognatha martha) G4 S1S2

Several of these species require pines for a food source, and pitch pine is one of the dominant species at the site.

Threats and Disturbances

A dirt forestry road and some hiking trails and a single-track dirt bike track are throughout the natural community. Pine plantations were established in small pockets within the barrens, and these plantations are now mature.

Several of Pennsylvania's natural communities depend on periodic fires to maintain their early state of succession. We usually think of fire as being a destructive natural force; however natural fires have

historically maintained communities and habitats throughout Pennsylvania. When pitch pine reaches maturity, the tree forms a thick, fire resistant bark that allows low intensity fires to spread through the woodland with very little harm to the trees. The cones of this species also require fire to release their seeds, initiating the addition of new pitch pines to the community. In the few places where burns still take place around these natural communities, the forest has a short shrub layer with occasional tall pines. Historically, this site was burned by locals to promote the growth of blueberries that were harvested from the mountaintop. This human induced fire likely mimicked the natural fire that periodically took place on the mountain before Europeans settled in the area. More recently, fire has been suppressed and the vegetative structure of the community has become too dense to sustain the unique natural community at the site.

WEST BRANCH MAHANTANGO VERNAL

POOLS (West Perry Township and Juniata County)

This site contains a cluster of **Ephemeral/fluctuating Natural Pools**, a GNR S3 tracked community. Several dozen vernal pools occur at this site, clustered along the base of the forested ridge and centered around the headwaters of the west branch of



Swamp dog hobble (Leucothoe racemosa)

WEST PERRY TOWNSHIP

Mahantango Creek. This site also contains a population of a **globally secure**, **state vulnerable species of special concern**. At two of the vernal pools in this community, specimens of the **Swamp dog-hobble** (*Leucothoe racemosa*), a G5 S2S3 species of concern were located. This species is rare in Pennsylvania and is more typically associated with the coastal plain.

Threats and Disturbances

Many of the ponds have been rather recently cut around. During some of these forestry operations, the tops of the trees were thrown into the pools. Vernal pool communities in Pennsylvania have existed in the landscape for tens of thousands of years and are generally best managed by not cutting the vegetation around the pools.

Conservation Recommendations

A no-cut forested buffer of 1000 feet (305 m) should be established around this community to protect the delicate nature of these communities and the species that rely on them.

Haa's Cave (West Perry Township)

Haa's Cave is associated with an old lime kiln and quarry. The artificial openings and sinkholes in the roof have allowed a considerable amount of soil to drain into the cave. Though no species of special concern are noted from this site, most moderately sized caves have the possibility of being used by cave specialists.

Threats and Disturbances

Caves are highly sensitive natural features. Species of animals that may inhabit this cave rely on low levels of disturbance to the water quality and cave environment. In addition to providing habitat for highly specialized animals, caves are conduits into the water table. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in



The Spotted Salamander (*Ambystoma maculatum*) is one of the vernal pool species present at the West Branch Mahantango Creek Vernal Pools Site.

photo source: Charlie Eichelberger

WEST PERRY TOWNSHIP

caves. For this reason, protected buffers should be established to minimize the influx of contaminants into the groundwater tables. In the past many thought of sinkholes, which form as limestone is dissolved into subterranean waters, as perfect sites for trash disposal.

Most of these dumps leach toxic substances into the groundwater and affect not only the cave organisms, but contaminate the groundwater that humans rely on.

Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect the climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations

Cave entrances should be buffered from disturbance by a minimum of 525 feet (160 m). The water quality of the groundwater in karst regions is critical to maintaining the aquatic life in the caves and can be protected with restoration and maintenance of vegetated riparian buffers along streams, springs, around sinkholes and cave openings. Access to caves should be limited in winter months in order to avoid disturbance to hibernating bats.

Varner Gap Vernal Pools (West Perry Township and Juniata County)

The south toe-slope of Shade Mountain contains many locations where water naturally pools. This location, below Varners Gap, contains several closely grouped small pools comprising a GNR S3

Ephemeral/Fluctuating Natural Pools Community.

This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. The isolated pools offer an important breeding location for the surrounding amphibian community.

Threats and Disturbances:

The site is owned and managed by numerous landowners. The primary land use within the site is recreational with agriculture and forestland dominating the surrounding landscape. Logging within proximity to the pool without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland.



A highly diverse vernal pool at the West Branch Mahantango Creek Vernal Pools site. In addition to containing a unique mix of plants, the pool community provides critical habitat for vernal pool reptiles and amphibians.

photo source: PNHP

Conservation Recommendations:

At the very least, a 305-meter no-cut buffer should be established around this pool complex. Though vernal pools are often thought of as isolated wetlands, the species within the pools rely on the linkages between the wetlands, often apparent only in heavy rains. The preservation of an intact forest canopy around this site will help maintain habitat for the rare plants, animals, and other species that occur here.

CONSERVATION RECOMMENDATIONS

Snyder County has a number of groups pursuing the protection of natural areas within the county. The following are general recommendations for conservation organizations, public agencies, and private landowners interested in protecting the biological diversity of Snyder County.

Approaches to protecting a natural area are wideranging, and factors such as land ownership, time constraints, and tools/resources available should be considered when prioritizing protection of these sites. Prioritization works best within a planning situation; however, opportunities may arise that do not conform to a plan and the decision on how to manage or protect a natural heritage area may be made on a site-by-site basis. Personnel in PNHP or staff from state natural resource agencies are available to discuss more specific options as needed.

1. Consider conservation initiatives for natural areas on private land.

- •Conservation easements protect land while leaving it in private ownership. A conservation easement is a legal agreement between a landowner and a conservation or government agency that permanently limits a property's use in order to protect its conservation values. It can be tailored to the needs of both landowner and conservation organization. Tax incentives apply to conservation easements.
- •Leases, management agreements, and mutual covenants also allow the landowner to retain ownership and ensure permanent protection of land, though in a much more limited way. There are no tax deductions for these conservation methods. A lease to a land trust or government agency can protect land temporarily and ensure that its conservation values will be maintained. This can be a first step to help a landowner decide if they want to pursue more permanent protection methods. Management agreements require landowner and land trust to work together to develop a plan for managing resources such as plant or animal habitat, or protecting a watershed. Mutual covenants can be appropriate where land protection is important to several landowners but not of sufficient benefit to the general public to warrant a conservation easement.
- •Land acquisition can be at fair market value, as a last resort by a conservation organization, or as a bargain sale in which a sale is negotiated for a purchase price below fair market value with tax benefits that reduce or eliminate the disparity. The Snyder County Natural

Heritage Inventory will help to pinpoint areas that may be excellent locations for new county or township parks. Sites that can serve more than one purpose such as wildlife habitat, flood and sediment control, water supply, recreation, and environmental education would be particularly ideal. Private lands adjacent to public land should be examined for acquisition when a priority site is present on either property and there is a need of additional land to complete protection of the associated natural features.

• Fee simple acquisition gives the landowner maximum control over the use and management of the property and its resources. This conservation initiative is appropriate when the property's resources are highly sensitive and protection cannot be guaranteed using other conservation approaches. • Local zoning ordinances are one of the best-known regulatory tools available to municipalities. Examples of zoning ordinances a municipality can adopt include: overlay districts where the boundary is tied to a specific resource or interest such as riverfront protection and floodplains, and zoning to protect stream corridors and other drainage areas using buffer zones.

2. Prepare management plans that address species of special concern and natural communities.

Many of the already-protected natural areas are in need of additional management recommendations to ensure the continued existence of the associated natural elements. We hope that managers will incorporate specific recommendations into existing plans or prepare new plans. These may include: removal of exotic plant species; leaving the area alone to mature and recover from previous disturbance; creating natural areas within existing parks; limiting land-use practices such as mineral extraction, residential or industrial development, agriculture and certain forestry practices.

Existing parks and conservation lands provide important habitat for plants and animals at both the county level and on a regional scale. For example, these lands may serve as nesting or wintering areas for birds or as stopover areas during migration. Management plans for these areas should emphasize a reduction in activities that fragment habitat. Adjoining landowners should be educated about the



Prescribed fire can be a necessary tool for management of unique natural communities. Many of the barren communities in the state were historically maintained by fire, but decades of fire suppression in the state have further threatened the future of these barrens areas. These communities and unique species that inhabit these barrens, are in need of prescribed burns maintain them.

photo source: DCNR - Bureau of Forestry

importance of their land as it relates to species of special concern and their habitat needs and agreements should be worked out to minimize encroachments that may threaten native flora and fauna.

3. Protect bodies of water.

Protection of reservoirs, wetlands, rivers, and creeks is vital; especially those that protect biodiversity, supply drinking water, and are attractive recreational resources. Many sites that include rare species, unique natural communities, or locally significant habitats are associated with water. Protection of high quality watersheds is the only way to ensure the viability of natural habitats and water quality. Land managers and township officials should scrutinize development proposals for their impact on entire watersheds not just the immediate project area. Cooperative efforts in land use planning among municipal, county, state, and federal agencies, developers, and residents can lessen the impact of development on watersheds.

4. Provide for buffers around natural areas.

Development plans should provide for natural buffers between disturbances and natural areas, be it a barrens community, wetland, water body, or forest. Disturbances may include construction of new roads and utility corridors, non-conservation timber harvesting, and disruption of large pieces of land. County and township officials can encourage landowners to maintain vegetated buffer zones within riparian zones. Vegetated buffers (preferably of PAnative plant species) help reduce erosion and sedimentation and shade/cool the water. This benefits aquatic animal life, provides habitat for other wildlife species, and creates a diversity of habitats along the creek or stream.

Watersheds or subwatersheds where natural communities and species of special concern occur (outlined on the Township maps in this report) should

be viewed as areas of sensitivity, although all portions of the watershed may not be zones of potential impact. As an example, conserving natural areas around municipal water supply watersheds provides an additional protective buffer around the water supply, habitat for wildlife, and may also provide low-impact recreation opportunities.

5. Reduce fragmentation of surrounding landscape.

Residents and township officials should encourage development in sites that have already seen past disturbances. Care should be taken to ensure that protected natural areas do not become "islands" surrounded by development. In these situations, the site is effectively isolated and its value for wildlife is reduced. Careful planning can maintain natural environments and the plants and animals associated with them. A balance between growth and the conservation of natural and scenic resources can be achieved by guiding development away from the most environmentally sensitive areas.

The reclamation of previously disturbed areas, or brownfields development, for commercial and industrial projects presents one way to encourage economic growth while allowing ecologically sensitive areas to remain undisturbed. Cluster development could be used to allow the same amount of development on much less land and leave much of the remaining land intact for wildlife and native plants. By compressing development into already disturbed areas with existing infrastructure (villages, roads, existing ROWs), large pieces of the landscape can be maintained intact. If possible, networks or corridors of woodlands or greenspace should be preserved linking sensitive natural areas to each other.

6. Encourage the formation of grassroots organizations.

County and municipal governments can do much of the work necessary to plan for the protection and management of natural areas identified in this report. However, grassroots organizations are needed to assist with obtaining funding, identifying landowners who wish to protect their land, providing information about easements, land acquisition, and management and stewardship of protected sites. Increasingly, local watershed organizations and land trusts are taking proactive steps to accomplish conservation at the local level. When activities threaten to impact ecological features, the responsible agency should be contacted. If no agency exists, private groups such as

conservancies, land trusts, and watershed associations should be sought for ecological consultation and specific protection recommendations.

7. Manage for invasive species.

Invasive species threaten native diversity by dominating habitat used by native species and disrupting the integrity of the ecosystems they occupy. Management for invasives depends upon the extent of establishment of the species. Small infestations may be easily controlled or eliminated but more well established populations might present difficult management challenges.

8. Promote community education.

Educating the public about the environment and its protection is key to meeting the recommendations in this section. Without a sense of involvement and investment in environmental programs, public support will be hard to earn. By making educational resources readily available to the public, sponsoring booths and outreach activities during local community events, and promoting public programs and events about the environment, active public application of these recommendations is promoted.

9. Incorporate CNHI information into planning efforts.

Through internal planning, decision-making related to land-use development, and participation in regional planning initiatives, counties, and municipalities could profoundly shape the land and landscapes of Pennsylvania. Sites identified in the Snyder County Natural Heritage Inventory can be readily included in comprehensive plans, greenway and open space plans, parks and recreation plans, and regional planning initiatives. DCNR-funded greenway and open space plans, Heritage Region plans, and River Conservation Plans are good examples of planning efforts that reach beyond county boundaries.

GLOSSARY

Abandoned Mine Drainage (AMD) – drainage flowing from or caused by surface mining, deep mining, or coal refuse piles that are typically highly acidic or basic with elevated levels of dissolved metals (DEP).

Acidophilic – a plant that requires or prefers acidic soil conditions.

Alluvium – material such as sand, silt, or clay that is deposited on land by streams.

Ambystomatid – A group of salamanders belonging to the family Ambystomatidae. This group is commonly referred to as the "mole salamanders", referring to their extremely secretive, subterranean nature. In fact, some species of mole salamanders have been found nearly 10 feet underground! Pennsylvania's Ambystomatid salamanders are considered vernal pool obligate species, meaning they require the seasonal hydrologic fluctuations found only in vernal pools in order to successfully reproduce.

Anthracite - Dense, shiny coal that has a high carbon content and little volatile matter and burns with a clean flame. Also called hard coal.

Anthropogenic – human caused.

ATV – all-terrain-vehicle.

Bedrock - The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Bt (*Bacillus thuringiensis*) – an insecticide, which is produced by the fermentation of a bacterium (Bt), used to control many caterpillar-type pests (e.g., gypsy moth).

Bog – a nutrient poor, acidic peatland that receives water primarily from direct rainfall with little or no input from groundwater or runoff; vegetation consists primarily of peat moss and ericaceous shrubs.

Calcareous- composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.

Canopy – the layer formed by the tallest vegetation.

Circumneutral – pH between 5.5 and 7.

Co-dominant – where several species together comprise the dominant layer (see "dominant" below).

Community – an assemblage of plant or animal populations sharing a common environment and interacting with each other and the physical environment.

Core Habitat - The essential habitat that cannot absorb significant levels of activity without substantial impact the plants, animals, or unique natural communities of special concern contained within them. Core Habitats include those that house species of special concern, areas found to possess a high diversity of plants and animals native to the county, or rare or exemplary natural community (assemblage of plants and animals), including the highest quality and least disturbed examples of relatively common types of communities.

DBH (Diameter Breast Height) – the diameter of a tree at 4.5 feet (1.4m) above the ground (breast height).

DCNR – Pennsylvania Department of Conservation and Natural Resources.

DEP – Pennsylvania Department of Environmental Protection.

Diabase – a dark gray igneous rock. The chemical composition of diabase may support unusual plant communities.

Dimilin – a commercially produced, restricted-use insecticide containing diflubenzuron as the active ingredient. Diflubenzuron, which has been used as a method to control gypsy moth, interferes with chitin production during the early development stages of certain insects (DCNR, Division of Pest Management).

Dominant – the species (usually plant) exerting the greatest influence on a given community either by numerical dominance or influence on microclimate, soils and other species.

Ecosystem - an ecological community together with its environment, functioning as a unit.

Element – all-inclusive term for species of special concern and exemplary natural communities.

EPT richness - the total number of mayflies (Order: *E*phemeroptera), stoneflies (Order: *P*lecoptera), and caddisflies (Order: *T*richoptera) orders in a given sample

Ericaceous – members of the heath family including blueberries, huckleberries, rhododendrons, and azaleas; these plants are adapted to living in acidic soils.

Exceptional Value Waters (EV) – DEP designation for a stream or watershed which constitutes an outstanding national, state, regional or local resource, such as waters of national, state or county parks or forests; or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuges or State Game Lands, and other waters of substantial recreational or ecological significance. For more detailed information about EV stream designations, the reader is referred to the Special Protection Waters Implementation Handbook (Shertzer 1992).

Exotic – non-native; used to describe plant or animal species that were introduced by humans; examples include Japanese honeysuckle, purple loosestrife and grass carp; exotics present a problem because they may out-compete native species.

Extant – currently in existence.

Extirpation – removal of a species from part of its natural range; also referred to as "localized extinction"

Fen – open-canopy peatland that has developed under the influence of basic-rich waters

Floodplain – low-lying land generally along streams or rivers that receives periodic flooding.

Forb – non-grass herbaceous plant such as goldenrod.

Fragipan - a very dense soil layer that prevents water from draining quickly through the soil.

Graminoid – grass or grass-like plant such as a sedge or a rush.

Ground cover – low shrubs, herbs and mosses that are found at or close to the ground surface.

Hemic – an organic soil in which the plant remains show a good degree of decomposition (between 1/3 and 2/3 of the fibers are still visible after rubbing the material between the fingers).

Herptile – a reptile or amphibian

Herpetofauna – the group of reptiles and amphibians found in a particular region

Hibernacula – a location where animals hibernate.

Hibernation – the period of winter inactivity during which time normal physiological processes are reduced and a significant decrease in body temperature occurs. In Pennsylvania, true hibernation is shown by woodchucks, jumping mice, and bats.

High-Quality Coldwater Fisheries (HQ-CWF) – DEP designation (PA Code, Chapter 93) for a stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.

Hydrology – water system of an area including both surface water and ground water.

Invasives – plants or animals that tend to spread and alter the overall makeup and character of sites. These invasions are either due to the introduction of an exotic species, or due to natural succession. The introduction of invasives can often cause the breakdown of the natural community.

Karst—a landscape of characteristic landforms (sinkholes) and subsurface features (caves, sinking streams, limestone springs) produced primarily as a result of solution of the underlying bedrock.

Lacustrine – any species living in or process involving lakes.

Lepidoptera – moths and butterflies.

Listed species – species that is monitored and considered to be of concern by PNHP.

Littoral – the area where water meets land, the shoreline.

Matrix – the form of land use or habitat that surrounds a focal patch of habitat.

Mesic – moist, not saturated.

Minerotrophic – groundwater fed; influenced by water that has been in contact with bedrock or soil, and is richer in mineral content than rainwater.

Native – describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities.

Natural Area - State Forest Natural Areas, which are specific management units designated by DCNR Bureau of Forestry.

Natural Heritage site - as used in this study, a site with either an exemplary natural community or species of special concern; not to be confused with the State Forest Natural Areas which are specific management units designated by DCNR Bureau of Forestry.

Neo-tropical - referring to the tropical locations in the new world; Mexico, Caribbean Islands, and Central and parts of Northern South America.

Non-point – refers to diffuse sources of pollution such as storm water runoff contaminated with oil or pesticides.

Odonate – dragonflies and damselflies.

Obligate species - able to exist or survive only in a particular environment or by assuming a particular role

Oligotrophic – poor to extremely poor in nutrients; typically describes dilute waters with low base metal ion concentrations.

Palustrine - describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominately hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.

Peat – partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable.

PNHP – the Pennsylvania Natural Heritage Program

Potential Natural Area – used by The Nature Conservancy to denote an area that may have desirable environmental characteristics to support rare species or exemplary natural communities, but which needs a field survey to confirm; a preliminary category given to sites prior to field survey (see METHODS section).

Prescribed burning – burning under controlled conditions; needed to maintain communities such as limestone glades and pitch pine barrens.

Riparian – streamside.

Rookery - the breeding ground of certain birds or animals, such as herons, penguins and seals.

R-O-W – strip of land occupied or intended to be occupied by a street, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer line, or other special use.

Sapric – organic soils (muck) in which most of the plant material is decomposed and the original constituents cannot be recognized.

Sedge - grasslike herbaceous plant of the family Cyperaceae, especially members of the genus Carex.

Seeps – where water flows from the ground in a diffuse pattern and saturates the soil; lush herbaceous vegetation often grows in these wet areas.

Shrub - a perennial, woody plant that differs from a tree in its short stature [less than 16.4 feet (5 m) in height] and typically multi-growth form.

Soil association – a group of soils that are geographically associated in a characteristic repeating pattern and defined and delineated as a single unit.

Soil series – groups of soils that have vertical profiles that are almost the same, that is, with horizons (layers) that are similar in composition, thickness, and arrangement.

sp. – a single species

spp. – a number of species. This abbreviation is usually used to refer to multiple species belonging to the same genus.

Subcanopy - in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).

Succession – natural process of vegetation change through time; over time, the plant species of a site will change in composition and structure as light and soil conditions change (e.g., a field that is left alone may, over time, be taken over by shrubs, then small trees and eventually a woodland).

Supporting Natural Landscape - areas necessary to maintain vital ecological processes or secondary habitat that may be able to accommodate some types of lower level impacts. Activities within the Supporting Natural Landscape should be conducted with the needs of the Core Habitats in mind.

Swamp - a wooded wetland, intermittently or permanently flooded

Talus – slope formed of loose rock and gravel that accumulates at the base of mountains or cliffs.

TNC – The Nature Conservancy

Understory – layer of shrubs and small trees between the herbaceous layer and the canopy.

Upland - sites with well-drained dry to mesic soils.

Wetlands - areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.

WPC – the Western Pennsylvania Conservancy

Vernal – occurring in the spring.

Xeric – extremely dry or droughty.

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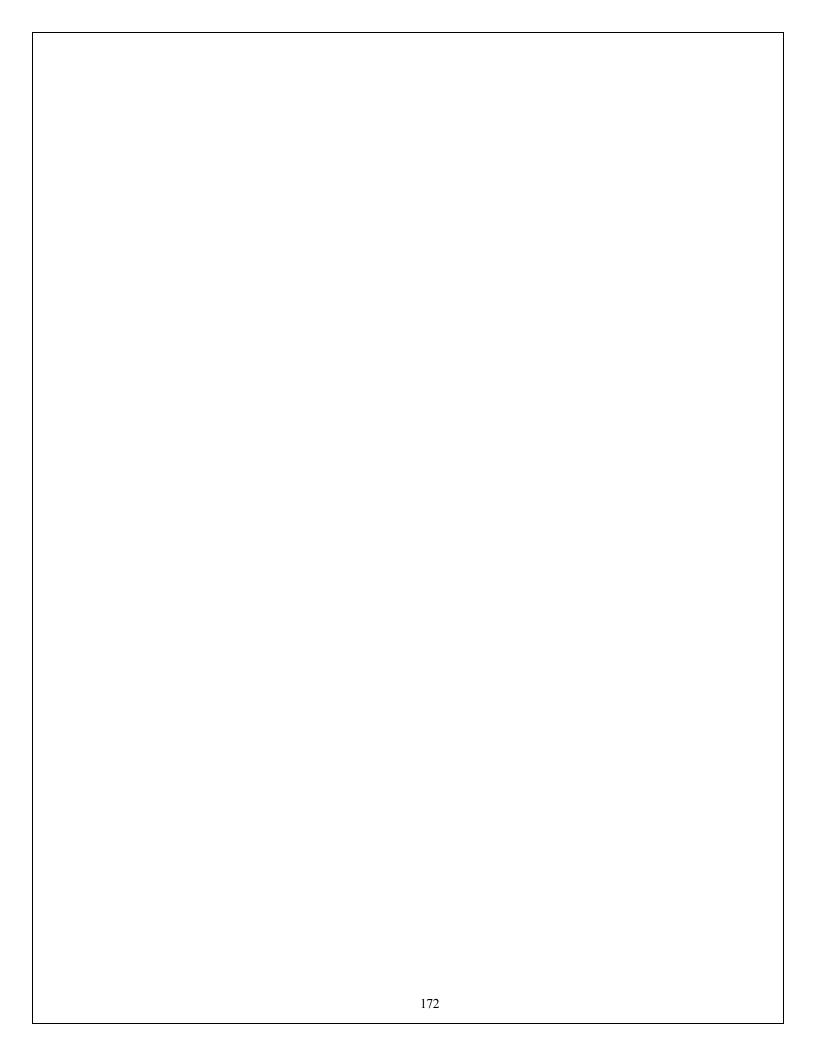
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APPENDIX I: Field Survey Form

PLANT & ANIMAL SPECIES OF SPECIAL CONCERN REPORT (PLEASE INCLUDE A MAP)

DATE OF VISIT:	TIME SPENT AT SITE:
USGS QUADRANGLE:	
SITE NAME AND DIRECTIONS TO SITE:	GPS Coordinates: Latitude:
	DATUM (e.g. NAD27,
	NAD83)
Owner Information: • Public Land: give tract	
name: • <u>Private Land:</u> Please fill out landowner info below. NOT permission! Landowner Name:	E: We cannot accept data collected on private land if you didn't have Address:
Phone Number:	City / State / Zipcode:
Landowner Signature: WHERE IS THE SPECIMEN BEING HELD HABITAT DESCRIPTION: Give a general description of the stopography, land use, weather, etc. If revisiting a site, indicate	ite. You might include other plant/animal species at site, substrate/soils,
DISTURBANCES/THREATS: Include human and/or natural dis	sturbances and threats to the species at this site.
SPECIES DATA: Fill out as much of the following as you can	n - include anything else you feel is of importance.
♣Give general description of what you saw (i.e.: found scat,	heard song, animal crossing road, found plant in bog)
♣Count or estimate the number of plants / animals you obser	ved & estimate the size of the area they occupy.
*Age and condition of individual(s) (i.e.: fresh adult buttery	fly; healthy mature plants - 50% flowering and with immature fruit)
*Behavior (animals) (i.e.: nectaring insect, breeding birds,	turtle basking)
♣If revisiting this site, compare the heath and size of the popular	ulation to previous visits.
♣Confidence level on Identification: ID Positive	ID Somewhat Uncertain ID Unknown
*Voucher specimen or photo taken? (Please include if possi	
* Voucher specimen of photo taken: (I tease include if possi	ible)
Additional information:	ible)

APPENDIX II: Community Classification

CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA (Fike 1999)

Community Name	State Rank
Terrestrial Forests	
CONIFEROUS TERRESTRIAL FORESTS:	
Hemlock (white pine) forest	S4
CONIFER – BROADLEAF TERRESTRIAL FORESTS	
Serpentine pitch pine - oak forest	S1
Serpentine Virginia pine - oak forest	S1
Pitch pine - mixed oak forest	S4
Virginia pine - mixed hardwood forest	S5
Dry white pine (hemlock) - oak forest	S4
Hemlock (white pine) -northern hardwood forest	S5
Hemlock (white pine) - red oak - mixed hardwood forest	S4
Hemlock - tuliptree - birch forest	S4
Rich hemlock - mesic hardwoods forest	S2S3
BROADLEAF TERRESTRIAL FORESTS	
Dry oak-heath forest	S4S5
Dry oak-mixed hardwood forest	S3
Red oak - mixed hardwood forest	S5
Northern hardwood forest	S4
Black cherry - northern hardwood forest	S4
Tuliptree- beech -maple forest	S4
Sugar maple - basswood	S4
Mixed mesophytic forest	S1S2
Sweet gum - oak coastal plain forest	S1
Red maple (terrestrial) forest	S5
Black-gum Ridgetop Forest	S3
Aspen/gray (paper) birch forest	S3 NOT TRACKED
Palustrine Forests	
CONIFEROUS PALUSTRINE FORESTS	
	S3
Black spruce - tamarack peatland forest Red spruce palustrine forest	S3 S3
Hemlock palustrine forest	S3
CONIFER – BROADLEAF PALUSTRINE FORESTS	33
Hemlock - mixed hardwood palustrine forest	S3S4
Red spruce - mixed hardwood palustrine forest	S3
BROADLEAF PALUSTRINE FORESTS	33
Bottomland oak - hardwood palustrine forest	S2
Red maple - black-gum palustrine forest	S3S4
Red maple - black ash palustrine forest	S2S3
Red maple - magnolia Coastal Plain palustrine forest	S1
Great Lakes Region lakeplain palustrine forest	S1 S1
Sycamore - (river birch) - box-elder floodplain forest	S3
Silver maple floodplain forest	S3
Red maple - elm - willow floodplain swamp	S2
Too maple on mile willouplain swamp	52

Terrestrial Woodlands	
CONIFEROUS WOODLANDS	
Pitch pine - heath woodland	S2
Pitch pine - scrub oak woodland	S2S3
Red spruce rocky summit	S1
Pitch pine - rhodora - scrub oak woodland	S1
CONIFER – BROADLEAF TERRESTRIAL WOODLANDS	
Pitch pine - mixed hardwood woodland	S2S3
Virginia pine - mixed hardwood shale woodland	S2
Red-cedar - mixed hardwood rich shale woodland	S1S2
BROADLEAF – TERRESTRIAL WOODLANDS	
Dry oak - heath woodland	S3
Birch (black-gum) rocky slope woodland	S2
Yellow oak - redbud woodland	S2
Great Lakes Region scarp woodland	S1S2
Great Lakes Region bayberry - cottonwood community	S1
Palustrine Woodlands	
CONIFEROUS PALUSTRINE WOODLANDS	
Pitch pine - leatherleaf palustrine woodland	S1
Black spruce - tamarack palustrine woodland	S2
Red spruce palustrine woodland	S2S3
BROADLEAF PALUSTRINE WOODLANDS	
Red maple - highbush blueberry palustrine woodland	S4
Red maple - sedge palustrine woodland	S4
Red maple - mixed shrub palustrine woodland	S4
Terrestrial Shrublands	
CONIFEROUS TERRESTRIAL SHRUBLANDS	
Red-cedar - prickly pear shale shrubland	S2
Red-cedar - pine serpentine shrubland	S1
CONIFER – BROADLEAF TERRESTRIAL SHRUBLANDS	
Red-cedar - redbud shrubland	S2
BROADLEAF TERRESTRIAL SHRUBLANDS	
Low heath shrubland	S 1
Low heath - mountain ash shrubland	S2
Scrub oak shrubland	S3
Rhodora - mixed heath - scrub oak shrubland	S1
Palustrine Shrublands	
BROADLEAF PALUSTRINE SHRUBLANDS	
Buttonbush wetland	S4
Alder - ninebark wetland	S3
Alder - sphagnum wetland	S4
Highbush blueberry - meadow-sweet wetland	S5
Highbush blueberry - sphagnum wetland	S5
Leatherleaf - sedge wetland	S3
Leatherleaf - bog rosemary peatland	S2
Leatherleaf -cranberry peatland	S2S3
Water-willow (Decodon verticillatus) shrub wetland	S3

River birch - sycamore floodplain scrub	S4
Black willow scrub/shrub wetland	S4
Poison sumac - red-cedar - bayberry fen	S 1
Buckthorn - sedge (Carex interior) - golden ragwort fen	S 1
Great Lakes Region scarp seep	S 1
Great Lakes Region bayberry - mixed shrub palustrine shrubland	S1
Terrestrial Herbaceous Openings	
Little bluestem - Pennsylvania sedge opening	S2
Side-oats gramma calcareous grassland	S1
Calcareous opening/cliff	S2
Serpentine grassland	S1
Serpentine gravel forb community	S1
Great Lakes Region dry sandplain	S1
Great Lakes Region sparsely vegetated beach	S 1
Herbaceous Wetlands	
PERSISTENT EMERGENT WETLANDS	
Bluejoint - reed canary grass marsh	S5
Cattail marsh	S5
Tussock sedge marsh	S3
Mixed forb marsh	S3
Herbaceous vernal pool	S3S4
Wet meadow	S5 NOT TRACKED
Bulrush marsh	S3
Great Lakes Region palustrine sandplain	S1
Prairie sedge - spotted joe-pye-weed marsh	S1S2
Open sedge (Carex stricta, C. prairea, C. lacustris) fen	S1
Golden saxifrage - sedge rich seep	S2
Skunk cabbage - golden saxifrage forest seep	S4S5
Serpentine seepage wetland	S 1
Golden saxifrage - Pennsylvania bitter-cress spring run	S3S4
Sphagnum - beaked rush peatland	S3
Many fruited sedge - bladderwort peatland	S2
Water-willow (Justicia americana)- smartweed riverbed community	S4
Riverside ice scour community	S1S2
Big bluestem - Indian grass river grassland	S3
NON-PERSISTENT EMERGENT WETLANDS	
Pickerel-weed - arrow-arum - arrowhead wetland	S4
Spatterdock - water lily wetland	S4

Community Complexes

ACIDIC GLACIAL PEATLAND COMPLEX
GREAT LAKES REGION SCARP COMPLEX
ERIE LAKESHORE BEACH - DUNE - SANDPLAIN COMPLEX
MESIC TILL BARRENS COMPLEX
SERPENTINE BARRENS COMPLEX
RIDGETOP ACIDIC BARRENS COMPLEX
RIVER BED - BANK - FLOODPLAIN COMPLEX

APPENDIX III: Federal and State Status, and PNHP Program Ranks

FEDERAL STATUS

U.S. FISH AND WILDLIFE SERVICE CATEGORIES OF ENDANGERED AND THREATENED PLANTS AND ANIMALS

The following definitions are extracted from the September 27, 1985 U.S. Fish and Wildlife Service notice in the Federal Register:

- **LE** <u>Listed Endangered</u> Taxa in danger of extinction throughout all or a significant portion of their ranges.
- **LT** <u>Listed Threatened</u> Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.
- **PE** <u>Proposed Endangered</u> Taxa proposed to be formally listed as endangered.
- **PT** <u>Proposed Threatened</u> Taxa proposed to be formally listed as threatened.
- C1 Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.
- C2 Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules.
- C3 Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three categories, depending on the reason(s) for removal from consideration.
 - 3A--Taxa for which the Service has persuasive evidence of extinction.
 - 3B--Names that, on the basis of current taxonomic understanding, usually as represented in published revisions and monographs, do not represent taxa meeting the Act's definition of "species".
 - 3C--Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.
- N Taxa not currently listed by the U.S. Fish and Wildlife Service

APPENDIX III (continued)

STATE STATUS-NATIVE PLANT SPECIES

Legislative Authority: Title 25, Chapter 82, Conservation of Native Wild Plants, amended June 18, 1993, Pennsylvania Department of Environmental Resources.

- PE Pennsylvania Endangered Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.
- **PT** Pennsylvania Threatened Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent further decline in this Commonwealth, or if the species is greatly exploited by man.
- **PR** Pennsylvania Rare Plant species which are uncommon within this Commonwealth. All species of native wild plants classified as Disjunct, Endemic, Limit of Range and Restricted are included within the Pennsylvania Rare classification.
- PX Pennsylvania Extirpated Plant species believed by the Department to be extinct within this Commonwealth. These plant species may or may not be in existence outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.
- **PV** Pennsylvania Vulnerable Plant species which are in danger of population decline within Pennsylvania because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.
- TU <u>Tentatively Undetermined</u> Plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.
- N <u>None</u> Plant species which are believed to be endangered, rare, or threatened, but which are being considered by the required regulatory review processes for future listing

APPENDIX III (continued)

STATE STATUS-ANIMALS

The following state statuses are used by the Pennsylvania Game Commission for (1990, Title 34, Chapter 133 pertaining to wild birds and mammals) and by the Pennsylvania Fish and Boat Commission (1991, Title 30, Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms):

PE - Pennsylvania Endangered

Game Commission - Species in imminent danger of extinction or extirpation throughout their range in Pennsylvania if the deleterious factors affecting them continue to operate. These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat has been so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherality places them in potential danger of precipitous declines or sudden extirpation throughout their range in Pennsylvania; or 3) species that have been classified as "Pennsylvania Extirpated", but which are subsequently found to exist in Pennsylvania as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87 Stat. 884), as amended.

Fish and Boat Commission - Endangered Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species list published in the Federal Register; or, (2) declared by the Executive Director (PFBC) to be threatened with extinction and appear on the Pennsylvania Endangered Species List published in the Pennsylvania Bulletin.

PT - Pennsylvania Threatened

Game Commission - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the causal factors affecting the organism are abated. These are: 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered, are still in critical condition; or 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87-Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

Fish and Boat Commission - Threatened Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on a Threatened Species List published in the Federal Register; or, (2) have been declared by the Executive Director (PFBC) to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published in the Pennsylvania Bulletin.

APPENDIX III (continued)

PNHP GLOBAL ELEMENT RANKS

- **G1** = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- **G2** = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- **G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
- **G4** = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- **GH** = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's Warbler).
- **G**U = Possibly in peril range wide but status uncertain; need more information.
- **GX** = Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered.

PNHP STATE ELEMENT RANKS

- **S1** = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.
- **S2** = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
- S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).
- **S4** = Apparently secure in state, with many occurrences.
- **S5** = Demonstrably secure in state and essentially ineradicable under present conditions.
- **SA** = Accidental in state, including species which only sporadically breed in the state.
- **SE** = An exotic established in state; may be native elsewhere in North America (e.g., house finch).
- **SH** = Of historical occurrence in the state with the expectation that it may be rediscovered.
- **SN** = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state.
- **SR** = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.
- **SRF** = Reported falsely (in error) from the state but this error persisting in the literature.
- **SU** = Possibly in peril in state but status uncertain; need more information.
- SX = Apparently extirpated from the state.

APPENDIX IV: Pennsylvania Element Occurrence Quality Ranks

Quality Rank*

Explanation

- A Excellent occurrence: all A-rank occurrences of an element merit quick, strong protection. An A-rank community is nearly undisturbed by humans or has nearly recovered from early human disturbance; further distinguished by being an extensive, well-buffered occurrence. An A-rank population of a sensitive species is large in area and number of individuals, stable, if not growing, shows good reproduction, and exists in natural habitat.
- B Good occurrence: protection of the occurrence is important to the survival of the element in Pennsylvania, especially if very few or no A-rank occurrences exist. A B-rank community is still recovering from early disturbance or recent light disturbance, or is nearly undisturbed but is less than A-rank because of significantly smaller size, poorer buffer, etc. A B-rank population of a sensitive species is at least stable, in a minimally disturbed habitat, and of moderate size and number.
- C Fair occurrence: protection of the occurrence helps conserve the diversity of a region's or County's biota and is important to statewide conservation if no higher-ranked occurrences exist. A C-rank community is in an early stage of recovery from disturbance, or its structure and composition have been altered such that the original vegetation of the site will never rejuvenate, yet with management and time partial restoration of the community is possible. A C-rank population of a sensitive species is in a clearly disturbed habitat, small in size and/or number, and possibly declining.
- D small occurrence: protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrences exist. A D-rank community is severely disturbed, its structure and composition been greatly altered, and recovery to original conditions, despite management and time, essentially will not take place. A D-rank population of a sensitive species is very small with a high likelihood of dying out or being destroyed, and exists in a highly disturbed and vulnerable habitat.
- E Verified as extant, but has not been given a rank; additional information needed to evaluate quality.

^{*} Intermediate ranks may also be assigned.

APPENDIX V: Plants, Animals and Natural Communities of Special Concern in Snyder County

Plants

Scientific Name	Common Name	
Bouteloua curtipendula	Tall gramma	
Carex buxbaumii	Brown sedge	
Carex typhina	Cattail sedge	
Corydalis aurea	Golden corydalis	
Cystopteris tennesseensis	Bladder fern	
Dodecatheon meadia	Jeweled shooting-star	
Leucothoe racemosa	Swamp dog-hobble	
Lithospermum canescens	Hoary puccoon	
Lupinus perennis	Wild Lupine	
Schoenoplectus acutus	Hard-stemmed bulrush	
Scirpus ancistrochaetus	Northeastern bulrush	

Animals

Scientific Name	Common Name	
Alasmidonta marginata	Elktoe	
Alasmidonta undulata	Triangle Floater	
Alasmidonta varicosa	Brook Floater	
Apharetra purpurea	A Noctuid Moth	
Aplectoides condita	A Noctuid Moth	
Caripeta aretaria	Southern Pine Looper Moth	
Cerastis fishii	A moth	
Citheronia sepulcralis	Pine Devil Moth	
Clemmys guttata	Spotted Turtle	
Elaphria georgei	A Midget Moth	
Eueretagrotis attenta	Attentive Dart	
Haliaeetus leucocephalus	Bald Eagle	
Lampsilis cariosa	Yellow Lampmussel	
Lasmigona subviridis	Green Floater	
Metaxaglaea semitaria	Footpath Sallow Moth	
Myotis leibii	Eastern Small-footed Myotis	
Myotis septentrionalis	Northern Myotis	
Sideridis maryx	A Moth	
Sphinx gordius	Gordian Sphinx	
Thamnophis sauritus	Eastern Ribbon Snake	
Tyto alba	Barn Owl	
Xylotype capax	Broad Sallow Moth	
Zale obliqua	Oblique Zale moth	
Zale submediana	A Zale Moth	
Zanclognatha martha	Pine Barrens Zanclognatha	

Natural Communities

Natural Community Name	
Acidic Broadleaf Swamp	
Calcareous opening/cliff	
Ephemeral/fluctuating Natural Pool	
Graminoid Marsh	
Hemlock (white pine) – northern hardwood forest	
Ridgetop dwarf-tree forest	
Side-oats gramma calcareous grassland	

APPENDIX VI: PA NOXIOUS WEED AND AQUATIC NUISANCE SPECIES LISTS

Legal Reference: Pennsylvania Noxious Weed Control List

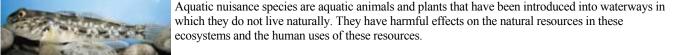
IT IS ILLEGAL TO PROPAGATE, SELL OR TRANSPORT THE FOLLOWING WEEDS IN THE COMMONWEALTH

- 1. Cannabis sativa, commonly known as Marijuana
- 2. Cirsium arvense, commonly known as Canadian thistle
- 3. Rosa multiflora, commonly known as Multiflora rose
- 4. *Sorghum halepense*, commonly known as Johnson grass
- 5. Polygonum perfoliatum, commonly known as Mile-a-minute
- 6. Pueraria lobata, commonly known as Kudzu-vine
- 7. Cirsium vulgare, commonly known as Bull or Spear Thistle
- 8. Carduus nutans, commonly known as Musk or Nodding Thistle
- 9. Sorghum bicolor, commonly known as Shattercane
- 10. Datura stramonium, commonly known as Jimsonweed
- 11. Lythrum salicaria, commonly known as Purple Loosestrife, including all cultivars
- 12. Heracleum mantegazzianum, commonly known as Giant Hogweed
- 13. *Galega officinalis*, commonly known as Goatsrue (Amended November 18, 2000)
 - o The first four weeds were included in the Pennsylvania Noxious Weed Control Act in 1982-74.
 - o Weeds numbered 5-10 were added by regulations on May 20, 1989.
 - o Purple loosestrife was added by regulations on April 12, 1997.
 - Purple loosestrife cultivars, Giant hogweed and Goatsrue were added by regulations on November 18, 2000.

http://www.agriculture.state.pa.us >noxious weed law, accessed April 18, 2007

APPENDIX VI(cont.) Pennsylvania Fish and Boat Commission Regulations

Aquatic Nuisance Species (ANS)



Some of the least-wanted ANS in Pennsylvania are European ruffe, sea lamprey, hydrilla, spiny water flea, purple loosestrife, Eurasian watermilfoil, Asian clam, and red-eared slider (turtle). In 2004, Northern snakehead were first found in Pennsylvania waters.

It's not always "foreign invaders" that are the problem. White perch and flathead catfish are other examples of species that have turned up where they don't belong. While native to some PA watersheds, they have been introduced to other areas.

Aquatic species banned in Pennsylvania (sale, barter, possession or transportation)

Bighead carp (Hypophtalmichtys nobilis)
Black carp (Mylopharyngodon piceus)
European rudd (Scardinius erythropthalmus)
Quagga mussel (Dreissena bugensis)
Snakehead (all species)
Round goby (Neogobius melanostomus)
Ruffe (Gymnocephalus cernuus)
Rusty crayfish (Orconectes rusticus)
Silver carp (Hypophtalmichtys molitrix)
Tubenose goby (Proterothinus marmoratus)
Zebra mussel (Dreissena polymorpha)

DEFINITIONS

- Biodiversity -- The variety of species, their genetic makeup, and the natural communities in which they occur.
- *Introduced species* -- A species living outside of its natural geographic range. Can be deliberately or accidentally introduced or brought into the new ecosystem. Also called *exotic*, *non-native*, *nuisance or invasive species*.
- Invasive -- Spreading or taking over. Invasive species often take over or dominate a habitat.
- Native -- An animal or plant originating in a region or geographic range. For example, brook trout are native to Pennsylvania.

STOP the spread of ANS

- When retrieving your boat for the day, check the boat, motor and trailer for weeds and other things "tagging along."
- Wash your boat's hull with hot water or with a high-pressure spray.
- Drain livewells, bilges and other compartments.
- Drain all standing water from your boat.
- Don't dump leftover bait into the water you're fishing, unless you collected the bait there.

http://sites.state.pa.us/PA Exec/Fish Boat/ans.htm, accessed April 18, 2007.

APPENDIX VII: Sustainable Forestry Information Sources

The *Pennsylvania Forest Stewardship Program* is a voluntary program that assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. Participation in the program is open to private landowners who own between 5 and 1,000 acres of forestland. Visit

http://www.cas.psu.edu/docs/CASDEPT/FOREST/Stewardship/1page.html for more information or contact:

Jim Finley, Assistant Director for Extension The Pennsylvania State University School of Forest Resources 7 Ferguson Building University Park, PA 16802 814-863-0401; E-mail: fj4@psu.edu

The *Forest Land Enhancement Program* complements the Forest Stewardship Program by providing landowners with costshare dollars to implement their management plans and follow-up technical assistance to encourage the achievement of their long-term forest management goals. For more information, contact:

Jim Stiehler, Forest Stewardship Coordinator DCNR - Bureau of Forestry 6th Floor, Rachel Carson State Office Building P.O. Box 8552 Harrisburg, PA 17105-8552 717-787-4777

The *Forest Legacy Program* acts to purchase conservation easements or title from willing private landowners. In this program, federal funding is administered through the state Bureau of Forestry to foster protection and continued use of forested lands that are threatened with conversion to non-forest uses. Emphasis is given to lands of regional or national significance. For more information, go to http://www.fs.fed.us/spf/coop/programs/loa/flep.shtml or contact:

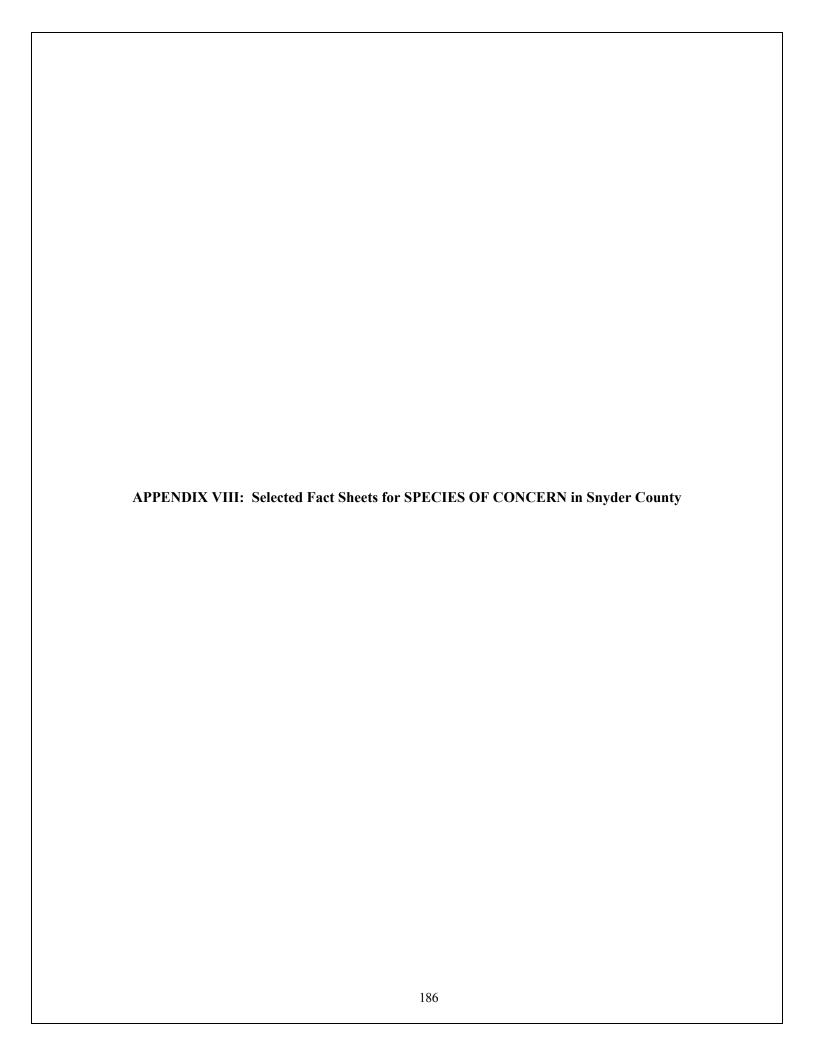
Gene Odato, Chief, Rural & Community Forestry Station DCNR – Bureau of Forestry 6th Floor, Rachel Carson State Office Building P.O. Box 8552 Harrisburg, PA 17105-8552 717-787-6460; E-mail: godato@state.pa.us

The *Sustainable Forestry Initiative* (SFI) program is a voluntary, industry-driven effort developed to ensure that future generations will have the same abundant, healthy, and productive resources we enjoy today. Created in 1995 by the American Forest and Paper Association (the national trade organization representing the United States forest products industry), SFI is a program of comprehensive forestry and conservation practices. Through the SFI of PA program, landowners receive the information they need to enhance their ability to make good forest management decisions, and loggers learn safer, more productive skills and proper environmental practices. For more information, go to http://www.sfiofpa.org/ or contact:

SFI® of PA 315 S. Allen Street, Suite 418 State College, PA 16801 814-867-9299 or 888- 734-9366; E-mail: sfi@penn.com

The *Forest Stewardship Volunteer Initiative Project* has an excellent Web site providing general information and links to publications on sustainable forestry.

http://vip.cas.psu.edu/index.html



Caves and Cave Animals

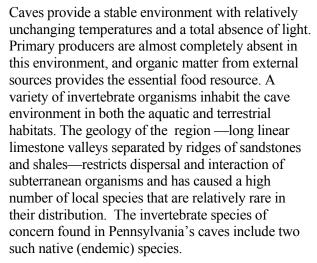


Stalactite and Flowstone photo source: Rocky Gleason (PNHP)

Price's Cave Isopod (Caecidotea pricei) G3G4 S2S3 Allegheny Cave Amphipod (Stygobromus allegheniensis) G5 S2S3 Stellmack's Cave Amphipod (Stygobromus stellmacki) G1G2 S1 Refton Cave Planarian (Sphalloplana pricei) G2G3 S1 Eastern Small-footed Myotis (Myotis leibii) G3 S1B, S1N Northern Myotis (Myotis septentrionalis) G4 S3B, S3N Indiana Bat (Myotis sodalis) G2 SUB, S1N

The Cave Environment

Karst is defined as a landscape with sinkholes, springs, and streams that sometimes disappear into subsurface conduits and caverns. Organisms that make their homes exclusively in this subsurface world are a unique group called troglobites. Troglobites are typically blind and unpigmented, with larger sensory appendages (e.g., antennae) than their surface-dwelling counterparts. It is likely that troglobites evolved from organisms living on the surface that were partially adapted to the cave environment. Some of these subterranean species have survived in caves long after their surface-dwelling relatives have gone extinct or relocated because of dynamic changes on the surface.



Amphipods and isopods are crustaceans, though the genus Stygobromus, an amphipod, has no relatives among surface-dwelling amphipods. Stygobromus is considered a relict genus that may have been in the cave



A cave amphipod of the genus Stygobromus, magnified approximately 8x.

General Locations of Caves Across the **United States**

environment for millions of years. Stellmack's cave amphipod (Stygobromus stellmacki) and the Refton cave planarian (Sphalloplana pricei) are species known only to a few caves in Pennsylvania. Price's Cave Isopod (Caecidotea pricei) and the Allegheny Cave Amphipod (Stygobromus allegheniensis) have a broader distribution in the mid-Atlantic region but have only been found in a handful of caves in Pennsylvania. All of these animals are dependent on the quality of the groundwater in caves and on the influx of organic material for food.

Other animals are associated with caves but also use aboveground habitats. Bats and caves are inextricably related. Different bats throughout the United States use caves for hibernation, rearing young (maternity sites), migratory stopovers, night roosts, and swarming sites.

Caves and Cave Animals

Many of the caves in central Pennsylvania have been identified as hibernacula for multiple species of bats, including three species of concern, but no cave in Pennsylvania has been found to contain maternity colonies. The Pennsylvania Game Commission, over the past 20 years, has been conducting regular monitoring of many sites throughout Pennsylvania with the cooperation of landowners and organized cavers. The loss of bat species in Pennsylvania could greatly affect our ability to protect agricultural crops from pests as well as our continued enjoyment of outdoor recreation.

Threats and Conservation

Many human activities threaten caves and the fauna that depend on them. Pollution in caves due to the nature of karst terrains results in a very real threat. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. Porous carbonate rocks easily pass solid and



Hibernating bats in a Pennsylvania Cave photo source: Rocky Gleason (PNHP)

liquid wastes into caves and groundwater. Pollution of water in caves negatively impacts the aquatic and terrestrial species within, possibly causing localized extinctions. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, affect climatic conditions in the cave, including airflow, temperature, and humidity.

Another major threat to cave biodiversity is increased human visitation, which spans the spectrum from commercialized tourism to recreational caving and can alter temperature, disturb hibernating bats, and introduce pollutants. When bats are disturbed, they use up much of their fat reserves and may not survive through the winter. Hibernacula throughout Pennsylvania are being gated with special entranceways that allow air, bats and other wildlife to come and go, while excluding access by humans. Protection of caves is vital for all fauna that depend on them, especially those populations that depend on the groundwater within. Landowners, state agencies and local cave clubs of the National Speleological Society have been cooperating for more than 10 years to limit human impacts to caves either through the gating of caves or through self-imposed moratoriums on entering caves during significant times of the year.

The Pennsylvania Cave Protection Act 1990 makes it unlawful to disturb or remove natural and cultural features of caves as well as gates or other structures intended to protect caves. However, these protections are dependent on the cooperation of the landowner. Landowners can easily help conserve cave animals by avoiding littering or dumping in sinkholes or cave entrances, buffering karst features from runoff from agriculture or industrial land uses, and working with state agencies and local cave clubs to determine the need for controlling access to caves in winter months when bats may be hibernating.

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- Catherman, C.W. 2004. General Locations of America's Caves. CAVR Website: www.geocities.com/cavevader/caving.
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- National Speleological Society. http://www.caves.org/ (Consult for information regarding organized caving and clubs located throughout Pennsylvania as well as cave management and conservation).
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- Zokaites, C., ed. 1997. Living on Karst. Cave Conservancy of the Virginias. Accessed at http://www.dcr.virginia.gov/dnh/livingonkarst.htm.



Ephemeral/fluctuating Natural Pools

Pennsylvania Natural Community Type

State Rank: S3 Global Rank: GNR

General Description

Ephemeral/flucting Natural Pools, more commonly refered to as vernal pools or seasonal pools, are shallow natural depressions within the forest that seasonally fill with water during spring and fall rains, and dry during the summer months. Vernal pools soley rely on precipitation, groundwater and runoff for sources of water input. These pools are void of fish species because of the cyclic pattern of alternating wet/dry periods. For this reason, vernal pools support a wide array of organisms that are specially adapted to the varying hydroperiod. The life histories of several invertebrate species and amphibian species are tied to the fluctuating conditions of vernal pools for breeding and development of young. Many other species are known to use these pools as foraging grounds and for hibernation.

No other group of organisms has their life history tied to vernal pools more than the Ambystomatid salamanders. These species are considered



a spring season view of a vernal pool photo source: PNHP

vernal pool obligates, meaning their life histories are directly linked to the alternating wet/dry cycle of vernal pools. Pennsylvania's three species of Ambystomatid salamanders, commonly known as mole salamanders, spend the majority of their lives underground, sometimes up to nearly 10 feet below the surface! Because of their secretive lifestyles, the mole salamanders are rarely seen by most people. In fact, the only reliable way to see these creatures is to be at a vernal pool, at night, while it's raining, during the breeding season!

The Cycle of Vernal Pools

Beginning in late February through March, the first warm rains of the year cause the ice that has covered the vernal pools to melt, initiating the mole salamander breeding migrations. The first species to enter the pools is the Jefferson Salamander, *Ambystoma jeffersonianum*. The Jefferson salamander is gray with blue flecking on the sides. The extremely long toes of the Jefferson salamander distinguish it from all other species of salamander in Pennsylvania. Jeffersons arrive at the pools, often crawling over snow, and slip into the water through small gaps and openings in the ice. For the next several days, the male Jefferson salamanders will court the females. Eggs are then deposited in jelly-like masses, usually attached to vegetation or sticks and limbs that have fallen into the pool. After the eggs are laid, Jeffersons will migrate out of the pools and back onto land where they will spend the rest of the year in subterranean retreats.

The migration of the Jefferson salamander usually overlaps with the breeding migrations of the Spotted salamander, *Ambystoma maculatum*. This robust salamander can grow to be nearly 8 inches long! The spotted salamander is brown to black with brilliant yellow or orange spots on the head and back. These salamanders have been known to form aggregations, known as breeding balls, where dozens of males will cluster around one or two females. Once spotted salamanders have laid their eggs on submerged vegetation and twigs, like the Jeffersons, they will migrate back into the surrounding forest.

Wood frogs (*Rana sylvatica*), spring peepers, (*Pseudacris crucifer*), and gray treefrogs (*Hyla versicolor*), extensively use vernal pools for breeding as well. The calls of these species can sometimes be used to locate vernal pools. The wood frog, which produces a call that sound



a gray treefrog calling at a vernal pool photo source: Charlie Eichelberger

similar to squabbling ducks, are vernal pool obligates. Wood frogs are pinkish-brown, moderately sized frogs reaching lengths of about three to four inches and have dark brown masks under the eyes. The spring peeper is a small tree frog, which will rarely exceed an inch in length. Spring peepers are light brown with a darker brown "X" across their backs. The call is a high-pitched "peep!" and large deafening choruses are a sure sign that spring is on the way. The gray treefrog is greenish gray with bright yellow patches beneath the legs. Their call is a fluttering musical chirp. Vernal pools can also support many other frogs and toads, including the green frog (*Rana clamitans*), the bullfrog (*Rana catesbeiana*), the American toad (*Bufo americanus*), and the state endangered Eastern spadefoot toad (*Scaphiopus holbrookii*).

The vernal pools, now laden with amphibian eggs, are converged upon by a host of other species, which feed on the egg masses, larvae and tadpoles. The spotted turtle (*Clemmys guttata*) and red spotted newt (*Notophthalmus viridescens*) are frequent visitors of

Ephemeral/fluctuating Natural Pools

vernal pools. These species gorge themselves on the nutrient rich salamander and frog egg masses as well as some of the vernal pool invertebrates. Eastern garter snakes (*Thamnophis sirtalis*) and Eastern hognose snakes (*Heterodon platirhinos*) can be found hunting for salamanders and toads along the pool margins, and northern water snakes (*Nerodia sipedon*) will feed on the amphibians within the pools.

As the spring rains end and summer begins, the water level in the pools drops considerably, often drying up completely. This decrease in water level coincides with the metamorphosis of the larval salamanders and tadpoles into adult salamanders, frogs and toads. These young salamanders and froglets begin their terrestrial lives, returning to the pools to breed once they attain sexual maturity.



a marbled salamander migrating to a vernal pool photo source: Charlie Eichelberger

During the summer, drying, vernal pool basins provide a unique habitat for an array of plants, some of which are specially adapted to the same cyclic wet/dry pattern upon which the amphibians rely. Vernal pools provide habitat for several rare plant species, including the federally listed Northeastern Bulrush, (*Scirpus ancistrochaetus*).

The onset of fall rains begins to refill the dried pool basins. It is during these rain episodes that the third species of mole salamander in Pennsylvania, the marbled salamander (*Ambystoma opacum*) breeds. The marbled salamander is a stout species, with a jet-black body patterned with unmistakable dazzling white bands. This species breeds in the shallows of the pools with the females laying their eggs under leaf litter and wood within the pool basin. As fall rains fill the pools and inundate the eggs, the marbled salamander eggs will hatch and the larvae spend the winter months beneath the ice, feeding on the aquatic vernal pool insects. For this reason,

the marbled

salamander larvae are much larger than the larvae of the Jefferson and spotted salamanders in the spring.

Status and Threats

Currently, Pennsylvania tracks Ephemeral/fluctuating Natural Pools as important natural communities within the forest. Besides providing critical habitat for unique plants, per square inch, vernal pools provide the largest biomass production of vertebrates of any other community in the northeast!

Only within the last few decades have we begun to understand the importance of vernal pools to the ecology of Pennsylvania's forests. Temporary pools have historically been viewed as mosquito breeding pools, of little importance to forest ecology. As a result, a long history of vernal pool destruction exists. Many people have treated vernal pools with pesticides to control mosquitoes. Although mosquitoes will use vernal pools to breed, the animals specially adapted to vernal pools use the mosquito larvae as a food source. Most mosquito eggs laid in vernal pools don't survive to metamorphosis because the vernal pool species feed on the mosquito larvae. Unfortunately, pesticide application to vernal pools can be detrimental to the vernal pool obligates that rely on this unique natural community. Amphibians as a whole are highly sensitive to



vernal pool salamander egg masses and tadpoles
photo source: PNHP

poisons and the application of chemicals can destroy the intricate food webs in vernal pool communities.

Despite the recent awareness of the importance of vernal pools to forest ecology, vernal pools are not federally protected from modification or destruction. However, vernal pools are protected in the state under the Pennsylvania Department of Environmental Protection's Title 25 Pa. Code Chapter 105. Vernal pools provide critical habitat for a number of species of plants and animals that are specially adapted to the cyclic patterns exhibited by Ephemeral/fluctuating Natural Pools. It is important to protect these ecological gems to conserve the rich biodiversity of the community.



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Northern Myotis (Myotis septentrionalis)

Pennsylvania Mammal Species of Concern

State Rank: S3B (vulnerable, breeding), S3N (vulnerable, non-breeding) Global Rank: G4 (apparently secure)

Identification

The Northern Myotis (*Myotis septentrionalis*), also known as the Northern Longed-eared Myotis, is characterized by its long-rounded ears that when folded forward, extend beyond the tip of the nose. Also, the shape of the tragus, the flap of skin inside the ear area, is long and dagger shaped compared to the little brown bats curved and blunted tragus. This species has a longer tail and larger wing area than other similar sized bats in this genus. The fur is dull yellow/brown above and a pale gray on the belly. Another characteristic of this species is that the calcar, a spur extending from the foot, lacks a keel. These bats weigh only 6 to 8 grams and have a wingspan of 9 to 10 inches.



photo source: Aura Stauffer

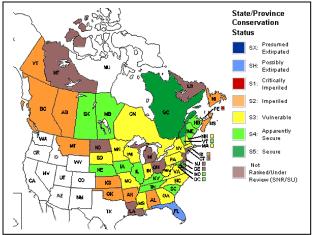
Habitat/Behavior

In the more northern parts of their range the northern long-eared bat is associated with boreal forests. In Pennsylvania, this bay is found in forests around the state. Northern Myotis hunt at night over small ponds, in forest clearings, at tree top level and along forest edges. They eat a variety of night-flying insects including caddisflies, moths, beetles, flies, and leafhoppers. This species uses caves and underground mines for hibernation and individuals may travel up to 35 miles from their summer habitat for hibernation. Maternity roosts are located in tree cavities, under exfoliating tree bark and in buildings.

Status

The status of the Northern Myotis in Pennsylvania is uncertain. The state status of this species currently is candidate rare (CR). More information is needed before adequate management decisions can be made. It occurs throughout Pennsylvania, but has been found in relatively low numbers.

Traditionally, bats have been unpopular with the public because of a misunderstanding of their ecology and due to their presence as pests in homes and barns. However, bats play a very important role in the environment by eating large amounts of insects. For example, a single little brown bat (*Myotis lucifugus*) can eat up to 1,200 mosquito-sized insects in just one hour!



More than 50% of American bat species are rapidly declining or already listed as endangered. The loss of bat species in Pennsylvania could greatly affect our ability to protect our plants from pests and enjoy the outdoors. For more information on bats and bat houses visit the Bat Conservation International website at http://www.batcon.org/.

References

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- Ollendorff, J. 2002. "Myotis septentrionalis" (On-line), Animal Diversity Web. Accessed February 25, 2004 at

Http://animaldiversity.ummz.umich.edu/site/accounts/information/Myotis septentrionalis.htm.



Barn Owl (Tyto alba)

Bird Species of Concern

State Rank: S3B (vulnerable, breeding), S3N (vulnerable, non-breeding) Global Rank: G5 (secure)

Identification

The Barn Owl (*Tyto alba*) is a member of the family Tytonidae, the only representative of that family occurring in the United States. Barn Owls are on average 14 inches long with a wingspan of 44 inches. It is a large, nocturnal and predatory bird with a large rounded head. It has pale facial disks with a dark frame. This species has tawny and gray upperparts with small black and white spots, and white underparts with scattered dark spots. The two sexes are similar to each other. The Barn Owl is easily distinguished from other owls by its face pattern. Flight patterns are similar to Long-eared and Shorteared Owls but lacks dark wrist marks.

Range

Barn Owls have a nearly worldwide distribution, being absent from only the high latitudes. It is found throughout most of the United States and it frequents open areas with suitable nesting areas in Pennsylvania.

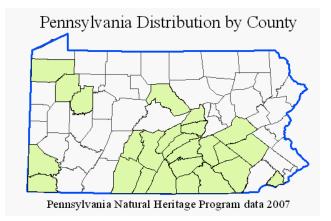




photo source: Jim Malone

<u>Habitat</u>

Barn Owls require open areas with cavities for nesting. These cavities can be natural tree cavities or human-made structures such as church steeples, barns, abandoned buildings, or even nest boxes. This species needs a good population of small rodents, especially meadow voles (*Microtus pennsylvanicus*). In winter, Barn Owls will sometimes roost in dense conifer trees, even plantations.

Conservation/Status

Barn Owls were undoubtedly rare in Pennsylvania before the cutting of the primeval forests. This species became common in the early 20th century, with many open farmlands containing optimum habitat for this species and their major prey, meadow voles. Changing land-use and agricultural practices have led to a decline in Barn Owl populations. Shifting from pasture to row crops and a loss of nesting sites are the most serious problems for this species, which also result in lower meadow vole populations. This species, despite populations being secure globally, should be monitored to ensure that the Barn Owl continues to be a breeder in Pennsylvania.

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Timber Rattlesnake (Crotalus horridus)

Reptile Species of Concern

State Rank: S3S4 (vulnerable /apparently secure) Global Rank: G4 (apparently secure)

Identification

Timber rattlesnakes (*Crotalus horridus*) are easily distinguished from other snakes in Pennsylvania. Timber rattlesnakes are stout-bodied, large snakes reaching lengths of up to 5 feet. Color is extremely variable but usually consists of brown or black bands on bright yellow to black coloration. The head is triangular in shape and a rattle is present at the end of the black tail. This species may be confused with the less common eastern Massasauga (*Sistrurus catenatus catenatus*) only present in the western portion of the state. The timber rattlesnake can be distinguished from the Massasauga by the lack of white facial lines, the black tail forward of the rattle, and numerous small head-scales.

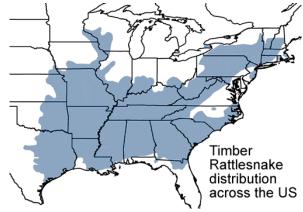


Habitat

Crotalus horridus is associated with deciduous forests and rocky outcrops. Hibernacula are usually found on south-facing rocky slopes with adequate crevices to provide shelter during the winter months. Males may travel far from the den site in the summer, moving into valleys and low-lying areas. Gravid females are far less mobile and tend to stay within a short distance of the den. Timber rattlesnakes are venomous, however are generally mild-mannered and not likely to strike.

Conservation/Status

Timber rattlesnake numbers have decreased significantly from historic records. This species was once widespread across the state. The remaining populations are usually found in remote, isolated areas. Collection and destruction of habitat are likely the main reasons for reductions in population size. Den sites have been targets for collection and should be the focus of conservation efforts for this species. The state status of the timber rattlesnake is candidate at risk (CA). Though this species is still relatively abundant across the state, it remains vulnerable to exploitation.



Permits are now required to collect rattlesnakes and only one snake can be taken each year. Snake hunts still occur in the state but after capture, snakes must be marked and release and the site of capture. Biologists are gathering information from collectors and individual studies to determine the current status of this species in the state.



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Yellow Lampmussel (Lampsilis cariosa)

Freshwater Mussel Species of Concern State Rank: S2 (imperiled) Global Rank: G5 (secure)

Identification

The yellow Lampmussel (*Lampsilis cariosa*) is a bright yellow, medium-size freshwater mussel that can reach lengths of up to five inches. The mussel has an ovate to elliptical shell and the valves appear inflated in cross section. The shell is thick and strong (Connecticut DEP 2003; Nedeau 2000). The yellow coloration makes it fairly easy to distinguish from other freshwater mussels in Pennsylvania, but it may be confused with the tidewater mucket (*Leptodea ochracea*) and other *Lampsilis* species. The presence of fine green rays on the outer shell of the tidewater mucket is usually a key to distinguishing it from the yellow Lampmussel. The yellow Lampmussel is also more ovate and is more inflated in cross section than the tidewater mucket (Strayer and Jirka 1997).

Habitat

The yellow Lampmussel inhabits medium to large rivers throughout most of its range, but is known from lakes and ponds in the north. In Pennsylvania, the yellow Lampmussel is found within the Susquehanna and Delaware River drainages. This species occurs in a variety of substrate types including sand, silt, cobble, and gravel (Parmalee 1998; Strayer and Jirka 1997; NatureServe 2005).

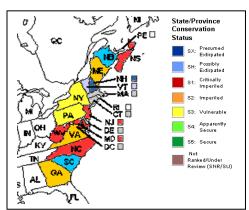
Host Fish

The only known larval hosts are the white perch and yellow perch (Wick and Huryn 2002).

Status

The Yellow Lampmussel ranges from Nova Scotia south to Georgia and west to West Virginia. The state status of the Yellow Lampmussel is vulnerable to apparently stable (S3S4) (NatureServe 2005). Though it appears to be relatively abundant in the Susquehanna River, it is

less common in tributaries and other river systems in the state. More surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.



In an assessment of the conservation status of the freshwater mussels of the United States by the American Fisheries Society (Williams et al. 1993), the Yellow Lampmussel was listed as threatened. It has been reported in New York in the Delaware River basin; sightings have not been confirmed because this mussel can be easily confused with *Lampsilis ovata*. The Yellow Lampmussel has declined over large portions of its habitat in New York and is currently listed as threatened even though it appears to be wide ranging throughout the state (Strayer and Jirka 1997). Abundance seems to be declining in many parts of its range in the United States. However, this species appears to be mildly tolerant of eutrophication (nutrient addition to water bodies) and siltation, but is affected by toxins. Competition by the introduced zebra mussel has negatively impacted the abundance of the Yellow Lampmussel, particularly in slow moving waters of larger streams and in lakes (North Carolina Mussel Atlas). This species is thought to be hybridizing with *Lampsilis ovata* and *Lampsilis cardium* through the westernmost parts of its range (Nedeau 2000).

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photos source: PNHP





Hoary Puccoon (Lithospermum canescens)

Plant Species of Concern

State Rank: S2 (imperiled), Global Rank: G5 (secure)

Identification

Hoary puccoon is a showy perennial with a stout taproot. It can grow from 4 to 15 inches tall. Short white hairs cover almost all of the plant including the flowers. The genus Lithospermum means, "stone-seeded." Therefore, the seeds, or nutlets produced by this plant are very hard, shiny, and smooth like stones.

Leaves are alternate, narrowly oblong, and attach directly to the stem without a petiole. Flowers are grouped in clusters that have a flat or rounded top; however, single blossoms are common. The individual flowers are tubular, with 5 lobes, and about a third of an inch across. They bloom in shades of vibrant yellow and orange from late April through May.

North American State/Province Conservation Status

Map source: NatureServe 2007

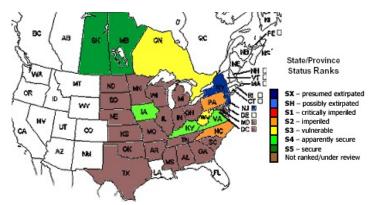
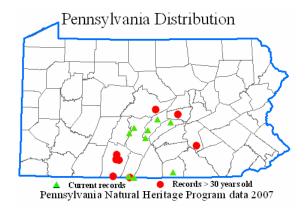




Photo source: PNHI



Habitat

Hoary Puccoon is found throughout the Eastern United States. In Pennsylvania, it is found on river bluffs, dry rocky hillsides, and barrens, with a preference for limestone substrate.

Status

Throughout the range of this species, habitat loss, land conversion for development, and displacement by invasive species have all played a part in its decline. In some cases, the communities where this species grows are themselves rare or have succeeded into a different community types due to the overgrowth of woody species and invasive species. Some of these preferred community types, like the xeric prairies, depend on fire to "weed out" atypical species.

Conservation

Maintenance of known populations and preservation of the rare communities where hoary puccoon grows will be crucial to its survival. Removal of overgrowth and invasive species with the integration of fire regimes when appropriate, will help to preserve the integrity of the sites. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

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Northeastern Bulrush (Scirpus ancistrochaetus)

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Plant Species of Concern

State Rank: S3 (vulnerable), Global Rank: G3 (vulnerable)

Identification

Northeastern bulrush is a tall sedge with short thick underground rhizomes from where the leaves emerge in May. Superficially, sedges seem to be "grass like" plants; however, there are many differences between sedges and grasses. With practice, the two families are easily distinguished from each other. Leaves are three angled, narrow, green to whitish or brown, and have basal sheaths. Flowers are individually difficult to see without magnification. The grouping of flowers or the inflorescences are more obvious, sometimes resembling the exploding of a fire work. The branches holding the inflorescence droop with age. The fruits, or achenes in this case, are very small, about 1/30 of an inch across.

Habitat

Populations of northeastern bulrush are recorded from Quebec south to West Virginia. Throughout its range including in Pennsylvania, it is found growing on the edges of seasonal pools, wet depressions, beaver ponds, wetlands, and small ponds.

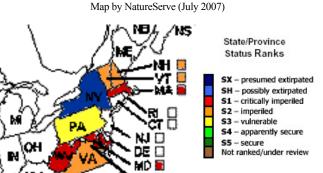
Status

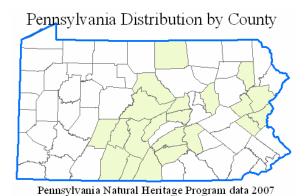
Only 50-60 populations exist throughout its entire range. Pennsylvania has the largest number of occurrences. The decline of this species is attributed to multiple threats: degradation of habitat from road construction and upland runoff, destruction by off road vehicles, and conversion of land for other uses.



photo source: PNHP

North American State/Province Conservation Status





Conservation

Slight variations in the natural fluctuation in the water level can harm this plant. Therefore, activities that impact the water table and degrade the plant's habitat such as development, ATV use, agriculture, quarrying, and dredging have been known to destroy several historic locations. Other potential threats to the species include deer browsing, fire, and natural succession.

Management of this species may include enhanced protection from nearby road construction, the implantation of practices to alleviate pollution from upland runoff, and continued protection of current sites from development. Surveys of potential habitat for new populations have been proven to be successful and should be continued. Habitat restoration projects are possible for sites that have suffered degradation. The northeastern bulrush became the second plant in Pennsylvania to be listed as a federally endangered species. Because of this special status, activities that pose a direct harm to the species would be subject to regulation by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

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Tall Grama; Side-oats Grama (Bouteloua curtipendula)

Plant Species of Concern

State Rank: S2 (imperiled), Global Rank: G5 (secure)

Identification

Tall grama is a perennial grass that grows from 20 to 40 inches (0.5 to 1 meter) tall. This attractive species grows from slender rhizomes. The leaves are linear and elongate, rough above and on the edges, smooth or finely hairy beneath, and about 1/4 inch (2 to 7 mm) wide. The flowers are arranged on a narrow, unbranched inflorescence which has 15 to 50 spikelets that tend to hang down to one side. When the flowers bloom in August and September, bright orange anthers may be seen dangling from the spikelets.



photo source: PNHP

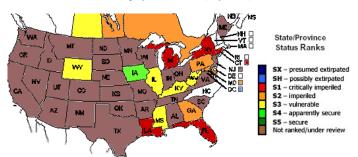
Habitat

Tall grama can be found throughout most of the United States.

In Pennsylvania, most of the known occurrences are in the central and southeastern counties. The species grows in dry, open, rocky, places, especially on limestone and serpentine geology.

photo source: Andrew Strassman (PNHP)

North American State/Province Conservation Status Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers tall grama to be a species of special concern, based on the relatively few occurrences that have been confirmed, the specialized habitat, and the management required to retain the proper successional stage at its occurrences. It has been assigned a rarity status of Threatened.

Conservation

Maintenance of known occurrences of tall grama usually require special management, such as prescribed burning or regular mowing, in order to prevent succession and keep exotic species and woody plants in check.



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Brown Sedge (Carex buxbaumii)

Plant Species of Concern State Rank: S3 Global Rank: G5

Identification

Brown sedge is a grass-like plant that grows from long creeping rhizomes. The stems are 20 to 40 inches (0.5 to 1 meter) tall and are redtinged at the base. The leaves are linear and elongate and about 3/16 inch (1.5 to 4) mm wide. The individual flowers are tiny, either male or female, and are clustered in cylindrical spikes near the top of flowering stems. Female flowers are enclosed by pale green sac-like structures, called perigynia, each of which is subtended by a strongly contrasting

North American State/Province Conservation Status Map by NatureServe (July, 2007)



brown to dark purple scale that has a bristle-tip.

Habitat

Brown sedge has a transcontinental range across North America. In Pennsylvania, it occurs mostly in the southern half of the state. The species grows in wetlands, including marshes, swales, meadows, and swamps, especially on calcareous substrate.

Status

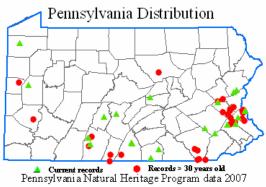
The PA Biological Survey considers brown sedge to be a species of special concern, based on the relatively few occurrences that have been confirmed and its wetland habitat. It has been assigned a rarity status of Rare.

Conservation

Creating buffers around wetlands, controlling of invasive species, and protecting of wetland hydrology will help to maintain occurrences of brown sedge.



photo source: Emmet J. Judziewicz Robert W. Freckmann Herbarium





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Cattail sedge (Carex typhina)

Plant Species of Concern
State Rank: S2 (imperiled), Global Rank: G5 (secure)

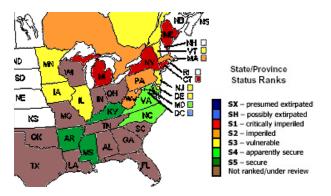
Identification

Cattail sedge is a grass-like perennial that grows from 30 to 90 centimeters tall. The leaves are long and narrow, with parallel veins and a pronounced midrib. The lowest leaves grow from a point on the stem well above the ground, rather than at the base of the stem, a feature described as aphyllopody. Flowers are small, simple, and unisexual, grouped in a spike-like head at the apex of the stem. Pistillate (female) flowers form a cylindrical head above the smaller cluster of staminate (male) flowers.

Habitat

Cattail sedge tolerates shade and acidic soil, but requires very moist conditions. It grows in wet woods, along occasionally flooding streams, and in marshes from Québec south to Florida and Texas.

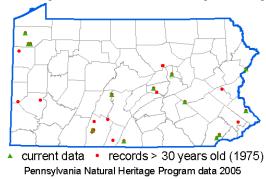
North American State/Province Conservation Status Map by NatureServe (July, 2007)





Robert H. Mohlenbrock, USDA-NRCS PLANTS Database - from *Midwest wetland flora: Field office illustrated guide to plant species.* (USDA SCS, Midwest National Technical Center, Lincoln, NE., 1989)

Pennsylvania Distribution by County



Status

Cattail sedge populations have been harmed most by disturbance and alteration of their wet, wooded habitats, whether in the form of logging, draining for use in agriculture or development, or changes created by flood control regimes.

Conservation

Conservation of cattail sedge will require preservation and protection of its wetland habitat, particularly wooded areas along rivers. Prevention of wetland draining and flood regime alterations is also expected to help this species recover.

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Golden Corydalis (Corydalis aurea)

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Plant Species of Concern State Rank: S3 Global Rank: G5

Identification

Golden corydalis is an annual or biennial herb with upright or trailing, fleshy stems that are $\frac{1}{2}$ to 2 feet (1.5-6 dm) long. This spring wildflower belongs to the same family as bleeding-heart. The leaves grow both from the base of the plant and alternately along the stems. The leaves are pale green, smooth and finely divided. The flowers are yellow and $\frac{1}{2}$ to $\frac{3}{4}$ inch (12-20 mm) long. They are irregular, made of 4 unequal petals that are partly fused near the base. The uppermost petal has a sac-like projection near the base and is not crested at the tip. Flowers are held in small clusters and bloom from May to July.

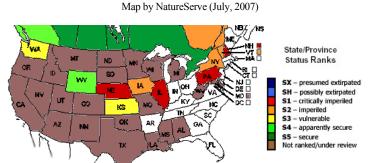
Habitat

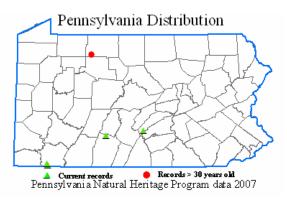
Golden corydalis occurs throughout the western United States. In the eastern U. S. its range extends from Vermont and New Hampshire south to West Virginia. It grows in rocky or sandy soil in open woods or along roadsides.



photo source: Derek Anderson Robert W. Freckmann Herbarium

North American State/Province Conservation Status





Status

The PA Biological Survey considers golden corydalis to be a species of special concern, based on the very few occurrences that have been confirmed and the specialized and infrequent habitat. It has been assigned a rarity status of Endangered. Throughout the range of this species, habitat loss, land conversion for development, and displacement by invasive species have all played a part in its decline. In some cases, the communities where this species grows are themselves rare or have succeeded into a different community types due to the overgrowth of woody species and invasive species.

Conservation

Maintenance of known populations and preservation of the rare communities where golden corydalis grows will be crucial to its survival. Removal of overgrowth and invasive species will help to preserve the integrity of the sites. Management of known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.



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