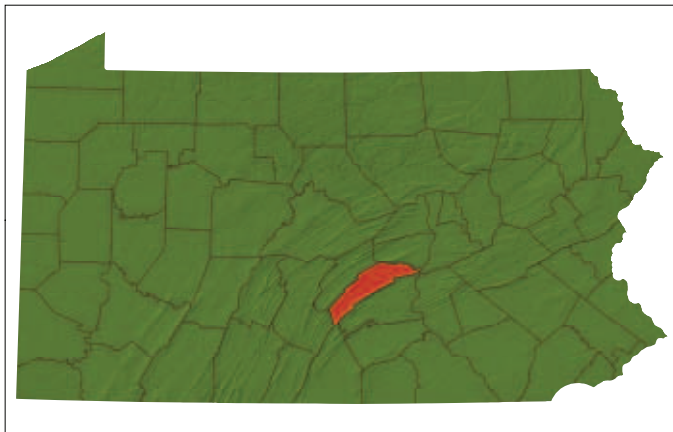


JUNIATA COUNTY

NATURAL HERITAGE INVENTORY

2007



Photos (clockwise): Blacklog Creek Headwaters; Beardtongue; Ruby Meadowhawk; Looking north across the Juniata County Landscape; Elktoe Mussel; Juniata River looking into Walker Township;

photo source: PNHP



Pennsylvania Natural Heritage Program
information for the conservation of biodiversity



A NATURAL HERITAGE INVENTORY OF JUNIATA COUNTY, PENNSYLVANIA

October 2007

Submitted to:

Juniata County Planning Commission

Courthouse Annex, 30 Main Street
Mifflintown, PA 17059
Phone: (717) 436-7729
Fax (717) 436-7756

Prepared by:

Pennsylvania Natural Heritage Program

Western Pennsylvania Conservancy
Middletown Office
208 Airport Drive
Middletown, Pennsylvania 17057



Copies of this document may be obtained from:

Juniata County Planning Commission

or

from the web in electronic format at:

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

This project was funded in part by a state grant from the Department of Conservation and Natural Resources Wild Resource Conservation Program. Additional support was provided by the Department of Community & Economic Development. Funding was also 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.

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.



A NATURAL HERITAGE INVENTORY OF JUNIATA COUNTY, PENNSYLVANIA

June 2007

Donna Bowers, Administration
Lucy Boyce, Seasonal Field Ecologist
Anthony (Tony) Davis, Senior Ecologist
Jeremy Deeds, Aquatic Zoology Coordinator
Alice Doolittle, Conservation Assistant
Charlie Eichelberger, Herpetologist
Kathy Derge Gipe, Herpetologist
William (Rocky) Gleason, County Inventory Coordinator
Jim Hart, Mammalogist
Rita Hawrot, Terrestrial Zoology Coordinator
Denise Johnson, County Inventory Ecologist
Susan Klugman, Conservation Information Manager
John Kunsman, Senior Botanist
Betsy Ray Leppo, Invertebrate Zoologist
Trina Morris, County Inventory Ecologist
Betsy Nightingale, Aquatic Ecologist
Stephanie Perles, Ecologist
Greg Podniesinski, Inventory and Assessment Manager
Sally Ray, Seasonal Pools Ecologist
Erika Schoen, Conservation Information Assistant
Bud Sechler, County Inventory Ecologist
Stephanie Seymour, Seasonal Field Ecologist
Andrew Strassman, Ecologist
Christopher Tracey, Ecologist
Amanda Treher, Seasonal Field Ecologist
Jeff Wagner, Director PNHP
Mary Walsh, Aquatic Ecologist

PREFACE

The Juniata County Natural Heritage Inventory is a document compiled and written by the Pennsylvania Natural Heritage Program (PNHP) of the Western Pennsylvania Conservancy (WPC). 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 the Western Pennsylvania Conservancy 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 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 Juniata County Planning Commission (see address on cover page).

The results presented in this report represent a snapshot in time, highlighting the sensitive natural areas within Juniata County. The sites in the Juniata County Natural Heritage Inventory have been identified to help guide wise land use and county planning. The Juniata County Natural Heritage Inventory is a planning tool, but is *not* meant to be used as a substitute for environmental review, since information is constantly being updated as natural resources are both destroyed and discovered. Applicants for building permits and Planning Commissions 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 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.

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. Funding was also 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 to all the help and support given by:

Steve Johnson, Entomologist
Larry Klotz, Botanist
Dale Schweitzer, Entomologist
Greg Turner, Wildlife Biologist
Jamie Flickinger, Biologist

Thanks to the many other private citizens who contacted our office with information on natural areas.

Sincerely,
Andrew Strassman
Pennsylvania Natural Heritage Program

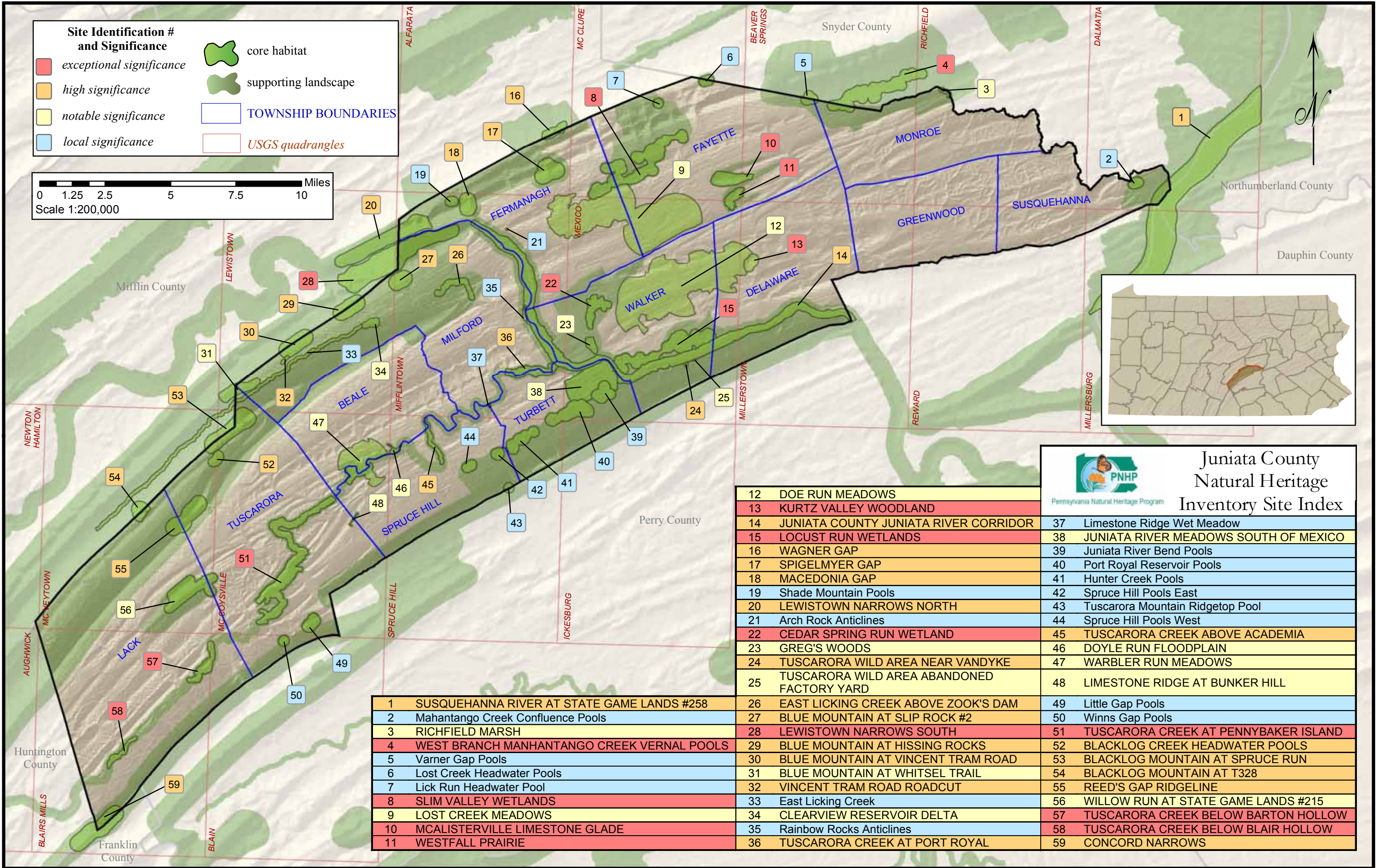
Many thanks to everyone who participated in the Technical Advisory Committee by reviewing the draft Natural Heritage Inventory Report:

Don Bashore, Juniata County Conservation District
Steve Bernardi, PA Game Commission
C. Edward Bortzfield, PA Bureau of Forestry
Debra Bowman, Central Pennsylvania Conservancy
John Briel, SEDA-COG
Andrew Hartwell, Mifflin/Juniata County Planning and Development Department
Cynthia Iberg, Local Naturalist and Juniata County Resident
Theresa J. O'Neal, Juniata County Commissioners; Chairperson
Mark Partner, Juniata County Commissioners
Chris Snyder, Juniata County Conservation District
Bill Stong, Juniata County Planning Commission
Chris Urban, PA Fish & Boat Commission
Tom Walker, Juniata County Cooperative Extension

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

This reference may be cited as:

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



 Juniata County Natural Heritage Inventory Site Index	
12	DOE RUN MEADOWS
13	KURTZ VALLEY WOODLAND
14	JUNIATA COUNTY JUNIATA RIVER CORRIDOR
15	LOCUST RUN WETLANDS
16	WAGNER GAP
17	SPIGELMYER GAP
18	MACEDONIA GAP
19	Shade Mountain Pools
20	LEWISTOWN NARROWS NORTH
21	Arch Rock Anticlines
22	CEDAR SPRING RUN WETLAND
23	GREG'S WOODS
24	TUSCARORA WILD AREA NEAR VANDYKE
25	TUSCARORA WILD AREA ABANDONED FACTORY YARD
26	EAST LICKING CREEK ABOVE ZOOK'S DAM
27	BLUE MOUNTAIN AT SLIP ROCK #2
28	LEWISTOWN NARROWS SOUTH
29	BLUE MOUNTAIN AT HISSING ROCKS
30	BLUE MOUNTAIN AT VINCENT TRAM ROAD
31	BLUE MOUNTAIN AT WHITSEL TRAIL
32	VINCENT TRAM ROAD ROADCUT
33	East Licking Creek
34	CLEARVIEW RESERVOIR DELTA
35	Rainbow Rocks Anticlines
36	TUSCARORA CREEK AT PORT ROYAL
37	Limestone Ridge Wet Meadow
38	JUNIATA RIVER MEADOWS SOUTH OF MEXICO
39	Juniata River Bend Pools
40	Port Royal Reservoir Pools
41	Hunter Creek Pools
42	Spruce Hill Pools East
43	Tuscarora Mountain Ridgetop Pool
44	Spruce Hill Pools West
45	TUSCARORA CREEK ABOVE ACADEMIA
46	DOYLE RUN FLOODPLAIN
47	WARBLER RUN MEADOWS
48	LIMESTONE RIDGE AT BUNKER HILL
49	Little Gap Pools
50	Winns Gap Pools
51	TUSCARORA CREEK AT PENNYBAKER ISLAND
52	BLACKLOG CREEK HEADWATER POOLS
53	BLACKLOG MOUNTAIN AT SPRUCE RUN
54	BLACKLOG MOUNTAIN AT T328
55	REED'S GAP RIDGELINE
56	WILLOW RUN AT STATE GAME LANDS #215
57	TUSCARORA CREEK BELOW BARTON HOLLOW
58	TUSCARORA CREEK BELOW BLAIR HOLLOW
59	CONCORD NARROWS

Table 1:

Alphabetical Site Index Numbered Roughly East to West by Township

Natural areas with species of concern are in capital letters while locally significant sites without species of concern are in proper case letters throughout the document

Site #	Site Name	Municipality(ies)	USGS Quadrangle(s)	Page #
21	Arch Rock Anticlines	Fermanagh	Mifflintown	101
52	BLACKLOG CREEK HEADWATER POOLS	Tuscarora	McCoysville, McVeytown	145
53	BLACKLOG MOUNTAIN AT SPRUCE RUN	Tuscarora Township and Mifflin County	Lewistown, McCoysville, McVeytown	146
54	BLACKLOG MOUNTAIN AT T328	Lack Township and Mifflin County	McVeytown	109
29	BLUE MOUNTAIN AT HISSING ROCKS	Milford Township and Mifflin County	Lewistown	115
27	BLUE MOUNTAIN AT SLIP ROCK #2	Milford	Lewistown	116
30	BLUE MOUNTAIN AT VINCENT TRAM ROAD	Milford Township and Mifflin County	Lewistown	116
31	BLUE MOUNTAIN AT WHITSEL TRAIL	Milford and Tuscarora Townships and Mifflin County	Lewistown	116, 146
22	CEDAR SPRING RUN WETLAND	Walker	Mexico	153
34	CLEARVIEW RESERVOIR DELTA	Milford	Lewistown	118
59	CONCORD NARROWS	Lack Township and Franklin, Huntington and Perry Counties	Blairs Mills	109
12	DOE RUN MEADOWS	Delaware, Walker	Mexico, Millerstown	82, 155
46	DOYLE RUN FLOODPLAIN	Beale	McCoysville, Spruce Hill	74
33	East Licking Creek	Milford, Tuscarora	Lewistown, McCoysville, McVeytown	119, 148
26	EAST LICKING CREEK ABOVE ZOOK'S DAM	Milford	Mifflintown	117
23	GREG'S WOODS	Walker	Mexico	155
41	Hunter Creek Pools	Turbett	Spruce Hill	138
14	JUNIATA COUNTY JUNIATA RIVER CORRIDOR	Delaware, Fermanagh, Milford, Turbett, and Walker Townships	Mifflintown, Mexico, Millerstown	81, 97, 117, 137, 154
39	Juniata River Bend Pools	Turbett	Mexico	139
38	JUNIATA RIVER MEADOWS SOUTH OF MEXICO	Turbett	Mexico	138
13	KURTZ VALLEY WOODLAND	Delaware	Millerstown	79
20	LEWISTOWN NARROWS NORTH	Fermanagh Township and Mifflin County	Lewistown, Mifflintown	98
28	LEWISTOWN NARROWS SOUTH	Milford Township and Mifflin County	Lewistown, Mifflintown	115

Table 1:

Alphabetical Site Index Numbered Roughly East to West by Township

Natural areas with species of concern are in capital letters while locally significant sites without species of concern are in proper case letters throughout the document

Site #	Site Name	Municipality(ies)	USGS Quadrangle(s)	Page #
7	Lick Run Headwater Pool	Fayette	McClure	91
48	LIMESTONE RIDGE AT BUNKER HILL	Spruce Hill, Tuscarora,	McCoysville	126, 147
37	Limestone Ridge Wet Meadow	Spruce Hill, Turbett	Mifflintown	127, 139
49	Little Gap Pools	Tuscarora	McCoysville	148
15	LOCUST RUN WETLANDS	Delaware, Walker	Mexico	80, 153
6	Lost Creek Headwater Pools	Fayette Township and Snyder County	McClure	92
9	LOST CREEK MEADOWS	Fayette, Fermanagh	Alfarata, Mifflintown, McClure, Mexico	91, 100
18	MACEDONIA GAP	Fermanagh	Alfarata, Mifflintown	99
2	Mahantango Creek Confluence Pools	Susquehanna	Dalmatia	133
10	MCALISTERVILLE LIMESTONE GLADE	Fayette	McClure, Beaver Springs	87
40	Port Royal Reservoir Pools	Turbett	Mifflintown, Mexico, Spruce Hill, Ickesburg	140
35	Rainbow Rocks Anticlines	Milford	Mifflintown	119
55	REED'S GAP RIDGELINE	Lack, Tuscarora	McVeytown	110, 146
3	RICHFIELD MARSH	Monroe Township and Snyder County	Richfield	122
19	Shade Mountain Pools	Fermanagh	Mifflintown	101
8	SLIM VALLEY WETLANDS	Fayette, Fermanagh	McClure, Mexico	89, 97
17	SPIGELMYER GAP	Fermanagh	Alfarata	99
42	Spruce Hill Pools East	Spruce Hill	Spruce Hill	128
44	Spruce Hill Pools West	Spruce Hill	Spruce Hill	128
1	SUSQUEHANNA RIVER AT STATE GAME LANDS #258	Susquehanna Township and Perry, Snyder, Dauphin, and Northumberland Counties	Dalmatia, Millersburg, Pillow	132
45	TUSCARORA CREEK ABOVE ACADEMIA	Beale, Spruce Hill	Spruce Hill	74, 126
51	TUSCARORA CREEK AT PENNYBAKER ISLAND	Tuscarora	McCoysville	145
36	TUSCARORA CREEK AT PORT ROYAL	Milford, Turbett	Mifflintown	118, 137
57	TUSCARORA CREEK BELOW BARTON HOLLOW	Lack	Blairs Mills, Blain	107
58	TUSCARORA CREEK BELOW BLAIR HOLLOW	Lack	Blairs Mills	107
43	Tuscarora Mountain Ridgetop Pool	Spruce Hill	Spruce Hill	129

Table 1:

Alphabetical Site Index Numbered Roughly East to West by Township

Natural areas with species of concern are in capital letters while locally significant sites without species of concern are in proper case letters throughout the document

Site #	Site Name	Municipality(ies)	USGS Quadrangle(s)	Page #
25	TUSCARORA WILD AREA ABANDONED FACTORY YARD	Walker	Mexico	156
24	TUSCARORA WILD AREA NEAR VANDYKE	Walker	Mexico	155
5	VARNER GAP POOLS	Fayette and Monroe Townships and Snyder County	Beaver Springs	92, 123
32	VINCENT TRAM ROAD ROADCUT	Milford	Lewistown	119
16	WAGNER GAP	Fermanagh Township and Mifflin County	Alfarata	100
47	WARBLER RUN MEADOWS	Beale, Spruce Hill	McCoysville	75, 127
4	WEST BRANCH MANHANTANGO CREEK VERNAL POOLS	Monroe Township and Snyder County	Beaver Springs, Richfield	122
11	WESTFALL PRAIRIE	Fayette	McClure, Beaver Springs, Mexico	90
56	WILLOW RUN AT STATE GAME LANDS #215	Lack, Tuscarora	McCoysville, McVeytown	110, 148
50	Winns Gap Pools	Tuscarora	Blain, McCoysville	149

EXECUTIVE SUMMARY

Introduction

A County Natural Heritage Inventory 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, Natural Heritage sites were designated in the county and ranked for 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 or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity. Sites are mapped to include both the immediate habitat and surrounding lands important in the support of these special elements.

Conservation Planning Application: 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 Landscape**” include areas that maintain vital ecological processes or secondary habitat that may be able to accommodate some types of low-impact activities.

Methods

Fifty-four of sixty-seven county inventories have been completed in Pennsylvania to date. The Juniata County Natural Heritage Inventory followed the same methodologies as previous inventories, which proceeded in the following stages:

Information Gathering

A review of various databases determined where locations for special concern species and important natural communities were known to exist in Juniata County. Knowledgeable individuals were consulted concerning the occurrence of rare plants and unique

natural communities in the county. Geological maps, United States Geological 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 over chosen areas of the county were conducted.

Field Work

Areas identified as potential inventory sites were scheduled for ground surveys. After obtaining 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 community, 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 2004 through 2006 field seasons was 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-nine sites of ecological significance are recognized in the Juniata County Natural Heritage Inventory (Site Index page xii), including important geologic and ecological features in the county. Spatial distribution of Natural Heritage sites across the county is shown in Figure 1 (pg. vii) and Table 1 (pg. ix). 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 in Table 2 (pg xvi).

EXECUTIVE SUMMARY

Conservation Recommendations

Juniata 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 Juniata 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 surrounding landscapes
6. Encourage the formation of grassroots organizations
7. Manage for control of invasive species
8. Promote community education
9. Incorporate County Natural Heritage Inventory information into planning efforts

Discussion and Recommendations

Planning for biodiversity and ecological health:

Provision for the future health of ecological resources in Juniata County will require action on many fronts. Special consideration should be given to steward 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.

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 or 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 connectedness by encouraging residential or commercial projects to redevelop in existing town centers or reuse previously altered landscapes, rather than creating new infrastructure through unfragmented natural landscapes.

Wetland/Aquatic Communities: Juniata County's waterways, ranging from headwater mountain streams to the Juniata 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 along waterways 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 increase human welfare by ensuring 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.

Evaluating proposed activity within Natural Heritage sites: A very important part of encouraging conservation of the Natural Heritage sites identified within the Juniata County Natural Heritage Inventory 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 Juniata 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 and Planning Commissions 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 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.

EXECUTIVE SUMMARY

Depending upon the resources contained within the Natural Heritage Area, the agencies/entities responsible for the resource 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:

- *U.S. Fish and Wildlife Service* for all federally listed plants and animals.
- *Pennsylvania Game Commission* for all state and federally listed terrestrial vertebrate animals.
- *Pennsylvania Fish and Boat Commission* for all state and federally listed reptiles, amphibians, and aquatic vertebrate and invertebrate animals.
- *Pennsylvania Bureau of Forestry* for all state and federally listed plants.
- *Pennsylvania Department of Conservation and Natural Resources (DCNR)* for all natural communities, terrestrial invertebrates, and species not falling under the above jurisdictions.

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

Using the Natural Heritage Inventory in Juniata County
The following are specific recommendations that will serve to incorporate the information in this report into planning and land conservation activities in Juniata County.

1. Work to incorporate the Juniata County Natural Heritage Inventory into the implementation of the comprehensive plan and to use the NHI to guide future planning, subdivision review, acquisition, development, and conservation initiatives.
2. Incorporate the NHI into the joint Mifflin/Juniata Greenway and Open Space Network Plan, in progress.
3. Apply the results to county land use planning by incorporating the NHI core sites into parameters used for designating the Natural Resource Protection Area and the Rural Development Area. Also work to incorporate steep slopes, 100 Year Floodplain, wetlands, and public lands into the comprehensive planning process. Some of the Natural Heritage sites, such as pastoral features, can be compatible with rural land uses, given that appropriate management practices are encouraged, and could be incorporated into the Rural Development Area. Other sites would be more consistent with the Natural Resource Protection Areas.
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 Juniata County Planning Department.
5. Provide the NHI report to local watershed organizations, such as the Juniata Cleanwater Partnership, and conservation organizations, such as the Central Pennsylvania Conservancy for prioritizing conservation actions.
6. Update the Juniata NHI after a period of 10 years or 2 years prior to any planned review of the Juniata County Comprehensive Plan.

EXECUTIVE SUMMARY

Table 2:

The sites of significance for the protection of biological diversity in Juniata County categorized by significance. More in-depth information on each site including detailed site descriptions and management recommendations where appropriate can be found in the text of the report following the maps for each municipality. Quality ranks, legal status, and last observation dates for species of special concern and natural communities are located in the table that precedes each map page. Appendix IV gives an explanation of the PA Heritage and Global vulnerability ranks. Note that “Species of Special Concern*” denotes a species not named at the request of the agency overseeing its protection

Site #	Site Name <i>Municipality (ies)</i> USGS Quadrangle(s)	Description	Pages
Exceptional Significance Sites			
22	CEDAR SPRING RUN WETLAND <i>Walker Township</i> Mexico Quad	Potentially the largest remaining intact wetland complex in Juniata County, this site supports a diverse range of wetland plants rare to the area including Shumard’s oak (<i>Quercus shumardii</i>), a species of concern. Together, the species at this location combine to form a red maple – black ash palustrine forest community that is influenced by the inflow of calcareous groundwater.	153
46	DOYLE RUN FLOODPLAIN <i>Beale Township</i> McCoysville, Millerstown Quad	At several points along Tuscarora Creek there are wonderful examples of the silver maple floodplain forest . Yellow water-crowfoot (<i>Ranunculus flabellaris</i>) is a plant species of concern that was document in calm backwater channels of the creek. The rich plant community at this location contains many species considered uncommon in this part of the state.	74
13	KURTZ VALLEY WOODLAND <i>Delaware Township</i> Millerstown Quad	Situated atop limestone, the thin soils of Kurtz Valley Woodland support a community type uncommon to the state: red cedar – redbud shrubland . Side-oats grama (<i>Bouteloua curtipendula</i>) and grooved yellow flax (<i>Linum sulcatum</i>) are plant species of concern found at this site. This uncommon plant community also supports a diverse butterfly and moth population including Juniper Hairstreak (<i>Callophrys gryneus</i>) and Henry’s Elfin (<i>Callophrys henrici</i>).	79
28	LEWISTOWN NARROWS SOUTH <i>Milford Township and Mifflin County</i> Lewistown, Mifflintown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located along the talus slopes of the Lewistown Narrows during regular surveys. During surveys in 2001, a population of Northern Myotis (<i>Myotis septentrionalis</i>) was found feeding along the Juniata River and open areas at this site. The Lewistown Narrows is also an exceptionally interesting geological, topographic, and scenic feature of Juniata and Mifflin counties.	115
15	LOCUST RUN WETLANDS <i>Delaware and Walker Townships</i> Mexico Quad	Two large complexes of ephemeral/fluctuating natural pools community are found at this site along with several permanent pools. Additionally, there are many pool remnants found in the surrounding agricultural fields. This pool community needs further surveys to properly evaluate its status.	80, 153
10	MCALISTERVILLE LIMESTONE GLADE <i>Fayette Township</i> Beaver Springs, McClure Quad	McAlisterville Limestone Glade supports a very important natural community: side-oats grama calcareous grassland . The prairie-like environment includes remnant populations of side-oats grama (<i>Bouteloua curtipendula</i>), southern wild senna (<i>Senna marilandica</i>), and hoary puccoon (<i>Lithospermum canescens</i>). Additionally, the butterfly species of concern Henry’s Elfin (<i>Callophrys henrici</i>) is known from this site.	87
8	SLIM VALLEY WETLANDS <i>Fayette and Fermanagh Townships</i> McClure, Mexico Quad	This location contains several pools grouped along Slim Valley Road. Clearly seasonal, these pools are an ephemeral/fluctuating natural pools community . The isolated pools offer an important breeding location for the surrounding amphibian community. Additionally, spotted pondweed (<i>Potamogeton pulcher</i>) occurs in two different pools.	89
57	TUSCARORA CREEK BELOW BARTON HOLLOW <i>Lack Township</i> Blain, Blairs Mills Quad	Barton Hollow supports a Species of Special Concern* and Carey’s sedge (<i>Carex careyana</i>). Additionally, a population of Tawny Emperor butterfly (<i>Asterocampa clyton</i>) is found in this area. Towards the floodplain there is short-leaf pine (<i>Pinus echinata</i>). Finally, the creek supports a population of Triangle Floater (<i>Alasmidonta undulata</i>), a freshwater mussel.	107

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name Municipality(ies) USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
Exceptional Significance Sites cont.			
58	TUSCARORA CREEK BELOW BLAIR HOLLOW Lack Township Blairs Mills Quad	Running unimpeded for ~40 miles through western Juniata County, Tuscarora Creek is a very important feature. Tuscarora Creek exhibits a broad, shallow, and braided appearance with a very wide floodplain. This environment supports Short's sedge (<i>Carex shortiana</i>). The richness of this site is exemplified by the approximately 350 plant and 50 animal species identified over several surveys.	107
51	TUSCARORA CREEK AT PENNYBAKER ISLAND Tuscarora Township McCoysville Quad	The steep slopes at this site support a community of a Species of Special Concern* along with other species common to shale barrens. The river valley below supports pineland pimpernel (<i>Samolus parviflorus</i>) and Shumard's oak (<i>Quercus shumardii</i>) along with other riverine/floodplain species.	145
4	WEST BRANCH MAHANTANGO CREEK VERNAL POOLS Monroe Township and Snyder County Beaver Springs, Richfield Quad	This site contains a cluster of ephemeral/fluctuating natural pools . Several dozen vernal pools occur at this site, clustered along the base of the forested ridge. This site also contains a population of a Species of Special Concern* . At two of the vernal pools swamp dog-hobble (<i>Leucothoe racemosa</i>) was located. This pool community needs further surveys to properly evaluate its status.	122
11	WESTFALL PRAIRIE Fayette Township Beaver Springs, McClure, Mexico Quad	Westfall Prairie is an important site with many rare species. It is an excellent example of the side-oats grama calcareous grassland community . Within this site false gromwell (<i>Onosmodium molle</i> var. <i>hispidissimum</i>), hoary puccoon (<i>Lithospermum canescens</i>), and side-oats grama (<i>Bouteloua curtipendula</i>) are found. Additionally, Henry's Elf (<i>Callophrys henrici</i>) is found in abundance at this site.	90
High Significance Sites			
42	BLACKLOG CREEK HEADWATER POOLS Tuscarora Township McCoysville, McVeytown Quad	This topographic saddle at the headwaters of Blacklog Creek contains over 18 pools spread in a line over 2000ft. This site is an excellent example of an ephemeral/fluctuating natural pools community . These isolated pools offer an important breeding location for the surrounding amphibian community.	145
53	BLACKLOG MOUNTAIN AT SPRUCE RUN Tuscarora Township and Mifflin County McCoysville, McVeytown, Lewistown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rock outcrops on Blacklog Mountain during surveys in 1992. This species has been located at several locations along the Blacklog Mountain.	146
54	BLACKLOG MOUNTAIN AT T328 Lack Township and Mifflin County McVeytown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in a sandstone talus field during surveys in 1992. The woodrat has been located at several sites along the Blacklog Mountain.	109
27	BLUE MOUNTAIN AT SLIP ROCK #2 Milford Township Lewistown, Mifflintown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rock outcrops on Shade Mountain during surveys in 1987. This species has been located at several locations along Shade Mountain.	116
30	BLUE MOUNTAIN AT VINCENT TRAM ROAD Milford Township and Mifflin County Lewistown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rock outcrops on Blue Mountain during surveys in 1993. This species has been located at several locations along Blue Mountain.	116

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name Municipality(ies) USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
High Significance Sites cont.			
59	CONCORD NARROWS <i>Lack Township & Franklin, Huntington and Perry Counties</i> Blairs Mills Quad	This site contains a good quality population of Virginia mallow (<i>Sida hermaphrodita</i>). Also included in this site on a talus slope is a fair population of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>).	109
26	EAST LICKING CREEK ABOVE ZOOK'S DAM <i>Milford Township</i> Mifflintown Quad	A Species of Special Concern is found at this site. Originally found before the removal of the Zook's dam, this species has not been documented from this location since 1994.	117
29	BLUE MOUNTAIN AT HISSING ROCKS <i>Milford Township and Mifflin County</i> Lewistown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located at the crest of this mountain during surveys in 1992. This species has been located at several locations along the Blue Mountain.	115
14	JUNIATA COUNTY JUNIATA RIVER CORRIDOR <i>Delaware, Fermanagh, Milford, Turbett, and Walker Townships</i> Mexico, Mifflintown, Millerstown Quad	The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery, the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. In Juniata County the river supports populations of Yellow Lampmussel (<i>Lampsilis cariosa</i>), Triangle Floater (<i>Alasmidonta undulata</i>), and Elktoe (<i>Alasmidonta marginata</i>), all freshwater mussels. The various sandbars, island edges, and river scours provide excellent habitat for Silvery Checkerspot (<i>Chlosyne nycteis</i>). The wet, shaded river edges are home to white trout-lily (<i>Erythronium albidum</i>). Many dragonflies and damselflies are also found along this stretch including a historic record of Common Sanddragon (<i>Progomphus obscurus</i>).	81, 97, 117, 137, 154
20	LEWISTOWN NARROWS NORTH <i>Fermanagh Township and Mifflin County</i> Lewistown, Mifflintown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located along the talus slopes of the Lewistown Narrows during regular surveys over the past three decades. During surveys in 2001, a population of Northern Myotis (<i>Myotis septentrionalis</i>) was found feeding along the Juniata River and open areas at this site. The Lewistown Narrows is also an exceptionally interesting geologic, topographic, and scenic feature of Juniata and Mifflin counties.	98
18	MACEDONIA GAP <i>Fermanagh Township</i> Alfarata, Mifflintown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rocky habitats in the water gap during surveys in 1992. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.	99
55	REED'S GAP RIDGELINE <i>Lack and Tuscarora Townships</i> McVeytown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located at the crest of this mountain during surveys in 1993. This species has been located at several locations along Shade Mountains.	110, 146
17	SPIGELMYER GAP <i>Fermanagh Township</i> Alfarata Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rock outcrops on Shade Mountain during surveys in 1992. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.	99
1	SUSQUEHANNA RIVER AT STATE GAME LANDS #258 <i>Susquehanna Township and Perry, Snyder, Dauphin, and Northumberland Counties</i> Dalmatia, Millersburg, Pillow Quad	This site consists of an archipelago of islands in the Susquehanna River. Four animal species of concern were found in this habitat: Yellow Lampmussel (<i>Lampsilis cariosa</i>), Triangle Floater (<i>Alasmidonta undulata</i>), Elktoe (<i>Alasmidonta marginata</i>), and a Species of Special Concern *. This presence of these mussel populations indicates the importance of the shoals around the islands to the overall water quality of the Susquehanna River at this site. Breeding is also known from this site for a Pennsylvania threatened Species of Special concern *.	132

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name Municipality(ies) USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
High Significance Sites cont.			
45	TUSCARORA CREEK ABOVE ACADEMIA <i>Beale and Spruce Hill Townships</i> Spruce Hill Quad	This reach, above Academia, features a high gradient area surrounded by nearly flat water. This area of Tuscarora Creek supports a population of Eastern Lampmussel (<i>Lampsilis radiata</i>).	74, 126
36	TUSCARORA CREEK AT PORT ROYAL <i>Milford and Turbett Townships</i> Mifflintown Quad	This location, along Tennis Run, contains over two dozen pools spread over a large area making it an excellent example of the ephemeral/ fluctuating natural pools community . The isolated pools offer an important breeding location for the surrounding amphibian community. Additionally, twining screw-stem (<i>Bartonia paniculata</i>) occurs at this site. This pool community needs further surveys to properly evaluate its status.	118, 137
24	TUSCARORA WILD AREA NEAR VANDYKE <i>Walker Township</i> Mexico Quad	This secluded draw is home to a Species of Special Concern* . The area is also rich in spring ephemerals.	155
32	VINCENT TRAM ROAD ROADCUT <i>Milford Township</i> Lewistown Quad	This population of purple bedstraw (<i>Galium latifolium</i>) is found situated and expanding along a logging road on Blue Mountain.	119
16	WAGNER GAP <i>Fermanagh Township and Mifflin County</i> Alfarata Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rocky habitats in the water gap during surveys in 1995. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.	100
Notable Significance Sites			
31	BLUE MOUNTAIN AT WHITSEL TRAIL <i>Milford & Tuscarora Townships and Mifflin County</i> Lewistown Quad	Active signs of PA-threatened Allegheny Woodrat (<i>Neotoma magister</i>) were located in rock outcrops on Blue Mountain during surveys in 1992. This species has been located at several locations along the Blue and Blacklog Mountains.	146
34	CLEARVIEW RESERVOIR DELTA <i>Milford Township</i> Lewistown Quad	The manmade delta of Clearview Reservoir supports one plant species of concern. Short hair sedge (<i>Carex crinita brevicrinis</i>) favors the wet forest of the floodplain. The delta area also provides ample feeding and nesting habitat for various ducks and herons.	118
12	DOE RUN MEADOWS <i>Delaware and Walker Township</i> Mexico, Millerstown Quad	This site encompasses a large area of pastoral landscape around the town of Van Wert. At this location many individuals of a Species of Special Concern* are successfully reproducing. The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge.	82, 155
23	GREG'S WOODS <i>Walker Township</i> Mexico Quad	The Gregory Alan Grening Nature Preserve is a mixture of upland and floodplain forest owned and managed by the Central Pennsylvania Conservancy. Within the preserve false hop sedge (<i>Carex lupuliformis</i>) is found. Also found in the woods are Silvery Checkerspot (<i>Chlosyne nycteis</i>) and Tawny Emperor (<i>Asterocampa clyton</i>) butterflies.	155
38	JUNIATA RIVER MEADOWS SOUTH OF MEXICO <i>Turbett and Walker Township</i> Mexico Quad	This site encompasses an area of pastoral landscape south of Mexico between the Juniata River and Tuscarora Mountain. At this location many individuals of a Species of Special Concern* are successfully reproducing. The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge.	138

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name Municipality(ies) USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
Notable Significance Sites cont.			
48	LIMESTONE RIDGE AT BUNKER HILL <i>Spruce Hill and Tuscarora Townships</i> McCoysville Quad	At Bunker Hill the limestone bedrock supports a large area of redbud (<i>Cercis canadensis</i>) and other calcium loving plants. While redbud is very common in the county, Henry's Elfin (<i>Callophrys henrici</i>) is not. The caterpillar of this small butterfly feeds exclusively on redbud and depends on the close proximity of flowers to feed the adults.	126, 147
9	LOST CREEK MEADOWS <i>Fayette, Fermanagh, and Walker Townships</i> Alfarata, McClure, Mexico, Mifflintown Quad	This site encompasses a large area of pastoral landscape around the town of Oakland Mills. At this location many individuals of a Species of Special Concern* are successfully reproducing. The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge.	91, 100
3	RICHFIELD MARSH <i>Monroe Township and Snyder County</i> Richfield Quad	This site is a small wetland along the West Branch Mahantango Creek. The State endangered hard-stemmed bulrush (<i>Schoenoplectus acutus</i>) was recorded from this site in 1987.	122
25	TUSCARORA WILD AREA ABANDONED FACTORY YARD <i>Walker Township</i> Mexico Quad	As the name of the site would suggest, the waterpod (<i>Ellisia nyctelea</i>), prefers a disturbed landscape. Historically found colonizing moist, disturbed, riverbanks, this species has been relegated to other disturbed areas such as hiking paths, road cuts, and here, an abandoned industrial area.	156
47	WARBLER RUN MEADOWS <i>Beale and Spruce Hill Townships</i> McCoysville Quad	This site encompasses an area of pastoral landscape south of Doyles Mills where a Species of Special Concern* is successfully reproducing. The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge.	75, 127
56	WILLOW RUN AT STATE GAME LANDS #215 <i>Lack and Tuscarora Townships</i> McCoysville, McVeytown Quad	State Game Lands #215, situated along Willow Run, is a recorded breeding location for Northern Myotis (<i>Myotis septentrionalis</i>). During the summers it frequents wooded streams and trails where it forages, while spending the day roosting in natural cavities and hollow trees.	110, 148
Locally Significant Sites			
21	Arch Rock Anticlines <i>Fermanagh Township</i> Mifflintown Quad	This geological feature is unique to the Ridge and Valley region. Formed by the compression of the differing layers of stone over long periods, anticlines appear as an arch in the rock layers.	101
33	East Licking Creek <i>Milford and Tuscarora Townships and Mifflin County</i> McCoysville, McVeytown, Lewistown Quad	The upper parts of the East Licking Creek drainage are characterized by several wet meadow openings interspersed throughout the drainage in an otherwise hemlock-dominated floodplain. The seeps and wetlands also provide habitat for several reptile and amphibian species. East Licking Creek is designated as a High Quality stream.	119, 148
41	Hunter Creek Pools <i>Turbett Township</i> Spruce Hill Quad	This location is occupied by an extensive complex of the ephemeral/ fluctuating natural pools community. Though the pools are widely spaced, their condition appears good and they lie in a relatively undisturbed setting. This pool community needs further surveys to properly evaluate its status.	138
39	Juniata River Bend Pools <i>Turbett Township</i> Mexico Quad	This location is occupied by an extensive complex of the ephemeral/ fluctuating natural pools community. Though the pools are small and widely spaced, their condition appears good. This pool community needs further surveys to properly evaluate its status.	139

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name <i>Municipality(ies)</i> USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
Locally Significant Sites cont.			
7	Lick Run Headwater Pool <i>Fayette Township</i> McClure Quad	This small topographic saddle contains one pool comprising an ephemeral/fluctuating natural pools community. This very large, isolated pool offers an important breeding location for the surrounding amphibian community. This pool community needs further surveys to properly evaluate its status.	91
37	Limestone Ridge Wet Meadow <i>Spruce Hill And Turbett Townships</i> Mifflintown Quad	This small wet meadow in the Tuscarora Creek floodplain is an excellent example of a wet meadow community. While no rare plants or animals were found during the survey, the site does support three species of interest: the thicket sedge (<i>Carex abscondita</i>), Davis' sedge (<i>Carex davisii</i>), and Leavenworth's sedge (<i>Carex leavenworthii</i>).	127, 139
49	Little Gap Pools <i>Tuscarora Township</i> McCoysville Quad	This site is occupied by a complex of the ephemeral/fluctuating natural pools community. Though the pools are small, their condition appears good and they lie in an undisturbed setting. This pool community needs further surveys to properly evaluate its status.	148
6	Lost Creek Headwater Pools <i>Fayette Township and Snyder County</i> McClure Quad	This small topographic 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 condition of the pool appears good. This pool community needs further surveys to properly evaluate its status.	92
2	Mahantango Creek Confluence Pools <i>Susquehanna Township</i> Dalmatia Quad	This site contains an ephemeral/fluctuating natural pools community. This pool community needs further surveys to properly evaluate its status.	133
40	Port Royal Reservoir Pools <i>Turbett Township</i> Ickesburg, Mexico, Mifflintown, Spruce Hill Quad	This site is occupied by an extensive complex of the ephemeral/fluctuating natural pools community. Though the pools are small and widely spaced, their condition appears good. This pool community needs further surveys to properly evaluate its status.	140
35	Rainbow Rocks Anticlines <i>Milford Township</i> Mifflintown Quad	This geological feature is unique to the Ridge and Valley region. Formed by the compression of the differing layers of stone over long periods, anticlines appear as an arch in the rock layers. At Rainbow Rocks the anticlines have been exposed by weathering and are easily viewed from the river.	119
19	Shade Mountain Pools <i>Fermanagh Township</i> Mifflintown Quad	This site harbors a small group of the ephemeral/fluctuating natural pools community. Though the pools are small and few, their condition appears good despite close proximity to a forest access road. This pool community needs further surveys to properly evaluate its status.	101
42	Spruce Hill Pools East <i>Spruce Hill Township</i> Spruce Hill Quad	This site is occupied by a very small complex of the ephemeral/fluctuating natural pools community. Though the pools are small and few, their condition appears good. This pool community needs further surveys to properly evaluate its status.	128
44	Spruce Hill Pools West <i>Spruce Hill Township</i> Spruce Hill Quad	This site is occupied by a very small complex of the ephemeral/fluctuating natural pools community. Though the pools are small and widely spaced, their condition appears good. This pool community needs further surveys to properly evaluate its status.	128
43	Tuscarora Mountain Ridgetop Pool <i>Spruce Hill Township</i> Spruce Hill Quad	This relatively flat area of the Tuscarora Mountain ridgetop contains one pool comprising an ephemeral/fluctuating natural pools community. This large, isolated pool offers an important breeding location for the surrounding amphibian community. The condition of the pool appears good. This pool community needs further surveys to properly evaluate its status.	129
5	Varner Gap Pools <i>Fayette and Monroe Townships and Snyder County</i> Beaver Spring Quad	This site contains an ephemeral/fluctuating natural pools community. This pool community needs further surveys to properly evaluate its status.	92, 123

EXECUTIVE SUMMARY

Table 2: continued

Site #	Site Name <i>Municipality(ies)</i> USGS Quadrangle(s)	PA Heritage Ranks and Site Importance	Page(s)
Locally Significant Sites cont.			
50	Winns Gap Pools <i>Tuscarora Township</i> Blain Quad	This small topographic saddle on Tuscarora Mountain is occupied by a very small group of the ephemeral/fluctuating natural pools community. Though the pools are small and few, their condition appears good and they lie in an undisturbed and remote setting. This pool community needs further surveys to properly evaluate its status.	149

TABLE OF CONTENTS

PREFACE	V
ACKNOWLEDGEMENTS.....	VI
INTRODUCTION.....	1
NATURAL HISTORY OVERVIEW OF JUNIATA COUNTY	3
PHYSIOGRAPHY AND GEOLOGY	3
WATERSHEDS	3
SOILS AND BEDROCK.....	3
UNIQUE NATURAL COMMUNITIES OF JUNIATA COUNTY.....	7
TERRESTRIAL COMMUNITIES	7
WETLAND COMMUNITIES	11
DISTURBANCES IN JUNIATA COUNTY	15
OVERVIEW	15
DAMS	16
INVASIVE SPECIES	17
MAMMALS OF JUNIATA COUNTY	23
HABITATS	23
HUNTING AND TRAPPING	23
GENERALISTS AND SPECIALISTS	24
BATS	25
SUMMARY	25
IMPORTANT MAMMAL AREAS IN JUNIATA COUNTY.....	26
BIRDS OF JUNIATA COUNTY	28
FOREST INTERIOR SPECIES	28
MARSH, WETLAND, AND RIPARIAN DEPENDENT BIRDS.....	29
GRASSLAND BIRDS.....	30
IMPORTANT BIRD AREAS IN JUNIATA COUNTY.....	31
CONSERVATION	31
REPTILES AND AMPHIBIANS OF JUNIATA COUNTY.....	33
INSECTS OF JUNIATA COUNTY.....	38
BUTTERFLIES AND MOTHS	38
DRAGONFLIES AND DAMSELFLIES	39
CONSERVATION RECOMMENDATIONS FOR INSECTS	40
AQUATIC COMMUNITY CLASSIFICATION FOR JUNIATA COUNTY	44
METHODS.....	59
PNHP DATA SYSTEM.....	59
INFORMATION GATHERING	60
MAP AND AIR PHOTO INTERPRETATION	60
FIELD WORK.....	61
DATA ANALYSIS.....	61
LANDSCAPE ANALYSIS.....	61
FOREST BLOCK ANALYSIS	62
RIPARIAN BUFFER ANALYSIS.....	63
SPECIES RANKING	63
SITE MAPPING AND RANKING	63
RESULTS.....	65
PRIORITIES FOR PROTECTION	65
SITE RANKING	65
CORE AND SUPPORTING HABITATS.....	65
GENERAL FOREST BLOCK RECOMMENDATIONS	65

TOWNSHIP DESCRIPTIONS.....	71
BEALE TOWNSHIP	72
DELAWARE TOWNSHIP & THOMPSONTOWN BOROUGH	76
FAYETTE TOWNSHIP.....	84
FERMANAGH TOWNSHIP & MIFFLINTOWN BOROUGH.....	94
GREENWOOD TOWNSHIP	102
LACK TOWNSHIP	104
MILFORD TOWNSHIP AND MIFFLIN & PORT ROYAL BOROUGH	112
MONROE TOWNSHIP.....	120
SPRUCE HILL TOWNSHIP	124
SUSQUEHANNA TOWNSHIP.....	130
TURBETT TOWNSHIP.....	134
TUSCARORA TOWNSHIP	142
WALKER TOWNSHIP.....	150
GENERAL CONSERVATION RECOMMENDATIONS	157
GLOSSARY	160
REFERENCES AND LITERATURE CITED	163
GIS DATA SOURCES	168
APPENDICES	169
APPENDIX I: SITE SURVEY FORM	170
APPENDIX II: COMMUNITY CLASSIFICATION.....	171
APPENDIX III: FEDERAL AND STATE STATUS, AND PNHP PROGRAM RANKS	174
APPENDIX IV: PENNSYLVANIA ELEMENT OCCURRENCE QUALITY RANKS	177
APPENDIX V: PLANTS, ANIMALS AND NATURAL COMMUNITIES OF SPECIAL CONCERN IN JUNIATA COUNTY	178
APPENDIX VI: LEPIDOPTERA (BUTTERFLIES) COLLECTED DURING FIELD SURVEYS OR KNOWN FROM JUNIATA COUNTY.....	179
APPENDIX VII: LEPIDOPTERA (MOTHS) COLLECTED DURING JUNIATA COUNTY FIELD SURVEYS	180
APPENDIX IIX: ODONATES COLLECTED DURING JUNIATA COUNTY FIELD SURVEYS.....	182
APPENDIX IX: SUSTAINABLE FORESTRY INFORMATION SOURCES	183
APPENDIX X: JUNIATA COUNTY CONSERVATION RESOURCES	184
APPENDIX XI: SELECTED FACTS SHEETS FOR SPECIES AND COMMUNITIES OF SPECIAL CONCERN IN JUNIATA COUNTY	185

TABLE OF TABLES

TABLE 1: ALPHABETICAL SITE INDEX	IX
TABLE 2: RANKING OF SITES OF SIGNIFICANCE.....	XVI
TABLE 3: SURFACE GEOLOGY DESCRIPTION.....	5
TABLE 4: SOIL ASSOCIATION DESCRIPTIONS	6
TABLE 5: SIGNIFICANT INVASIVE PLANT SPECIES	18
TABLE 6: SIGNIFICANT INVASIVE ANIMAL SPECIES	20
TABLE 7: PENNSYLVANIA NOXIOUS SPECIES LIST.....	21
TABLE 8: COMPARISON OF ACC AND DEP STREAM CLASSIFICATIONS	46
TABLE 9: SUBWATERSHED CLASSIFICATION	48

TABLE OF FIGURES

FIGURE 1: MAP OF SITES IN JUNIATA COUNTY BY TOWNSHIP AND USGS QUADRANGLE	VII
FIGURE 2: SURFACE GEOLOGY	4
FIGURE 3: SOIL ASSOCIATIONS.....	6
FIGURE 4: IMPORTANT MAMMAL AREAS	27
FIGURE 5: IMPORTANT BIRD AREAS.....	32
FIGURE 6: DEP RIVER CLASSIFICATION	46
FIGURE 7: SUBWATERSHEDS.....	47
FIGURE 8: JUNIATA COUNTY FOREST BLOCKS	66
FIGURE 9: STATE FOREST BLOCKS	67

INTRODUCTION

The Juniata River was named by the Seneca Indians and roughly translates as “standing stone”. Juniata County, formed in 1831 from Mifflin County, is named for that river which flows through its heart. The county has historically been an important region for trade and travel, related to its position among historic trails, highways, canals, and railroads. Its shape reflects the patterns created by the mountains of the Ridge and Valley physiographic province. Bordering to the east are Snyder and Northumberland County; Mifflin County to the northwest, Huntingdon County to the west, and Perry County along the southeast. Mifflintown, founded in 1791, is the county seat.

Juniata County’s population experienced significant growth in the last decade, growing from 20,625 in 1990 to 22,821 in 2000 (~11% per decade). This growth can be expected to increase development pressure on some of the sensitive natural areas of the county. Economically unsustainable farms are in danger of being 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 natural areas that comprise the natural heritage of Juniata County can be easily lost without careful planning of growth and development. Ironically, the scenic and remote nature of these areas makes 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 the flora and fauna, rare and otherwise. Planning for long-term sustainability can maintain open space, including natural environments and the plants and animals associated with them. Using a 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 government, the public, developers, and planners know the location of environmentally sensitive areas in order to maintain 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 to the most vulnerable areas. The Pennsylvania Natural Heritage Program, in cooperation with the Juniata County Planning

Commission, has undertaken this project to provide a document and maps that will aid in the identification of these important areas.

This Natural Heritage Inventory (NHI) report presents the known outstanding natural features, floral, faunal, and geologic, in Juniata County. The NHI provides maps of the best natural communities (habitats) and the locations of animal and plant species of special concern (endangered, threatened, or rare) in Juniata County. Due to project constraints, some high-quality 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 landscape). A written description and a summary table of the sites, including quality, degree of rarity, and last-observed date, accompany each map.

Particular species names, common and scientific, are provided in coordination with the appropriate jurisdictional agency. Plants and terrestrial invertebrates 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). Some species governed by the PGC and the PFBC are especially vulnerable to disturbance or unauthorized collection and are therefore not identified in the text of this report, at the request of the agencies, in order to provide some measure of protection.

Potential threats and some suggestions for protection of the rare plants or animals at the site are included in many of the individual site descriptions. Selected geologic features of statewide significance are also noted. In addition, the inventory describes areas that are considered ecologically significant, but where no species of concern were documented. 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 proper 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 (Table 2, pg. xvi) 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, or are potential sites for low-impact passive recreation, nature observation, and/or environmental education.

This NHI will be provided to each municipality through the Juniata County Planning Commission. The NHI 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. Juniata County, its municipalities, land trusts, and other organizations can also use the NHI to identify potential protection projects that may be

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.

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 Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, assists landowners in creating management plans. This plan incorporates 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 Pennsylvania Natural Heritage Program (PNHP) in an effort to avoid potential conflicts in areas with species of special concern and/or identify ways of enhancing or

protecting this resource. Users of this document are encouraged to contact the Middletown office of the Western Pennsylvania Conservancy (717-948-3962) or visit www.naturalheritage.state.pa.us or www.paconserve.org/rc/nh.html for additional information.



Meinhart Run headwaters

photo source: Andrew Strassman (PNHP)

NATURAL HISTORY OVERVIEW OF JUNIATA COUNTY

Juniata County's climate, topography, geology, and soils have been particularly important in development of its ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains). Many disturbances, both natural and human, have been influential in forming and altering many of the County's ecosystems, causing extirpation of some species and the introduction of 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 vegetation of Juniata County.

Physiography and Geology

Physiography is the relationship between 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 plants and plant communities would be expected to occur within some provinces and not in others. Physiographic and geologic information was obtained from many sources including The Geology of Pennsylvania (PA Geological Survey and Pittsburgh Geological Survey 1999), Soil Survey of Juniata and Mifflin Counties, Pennsylvania (USDA 1981), and Physiographic Provinces of Pennsylvania (Sevan 2000).

Physiographic provinces are characterized by distinctive landscapes, geology, and history. Juniata County is in the center of the Ridge and Valley physiographic province. Created by the collision of two continental plates, the Earth's crust in this area has been compressed, folded, and uplifted over millions of years. The County's bedrock is mostly composed of sedimentary sandstone, shale, and limestone from the Devonian (360-408 Million Years Ago (MYA)), Silurian (408-438 MYA), and Ordovician (438-505 MYA) eras with each individual layer having unique characteristics (Table 3, pg. 5). These characteristics cause differing erosion rates and patterns for each layer. Regions with limestone and shale valleys (soft, porous, reactive stones) eroded much faster than the very durable sandstone ridgetops. Additionally, various mixtures of the different stones combined with

their level of exposure to the elements have produced the diverse geology of the area (Fig. 2, pg. 4). This is what allowed the formation of many subterranean caverns and streams and their associated seeps and springs that add to the geologic diversity.

Watersheds

Juniata County is completely within the Susquehanna River basin and almost entirely in the Lower Juniata subbasin. A small portion of the county is along the Susquehanna River and lies in the Lower Susquehanna-Penns subbasin. The major watercourses of the County are the Susquehanna River along the very eastern edge, the Juniata River through the center, and Tuscarora Creek through the west. A detailed breakdown of the county's subwatersheds is contained in the Aquatic Community Classification section on page 44.

Soils and Bedrock

The soils of Juniata County are the result of long periods of erosion of old bedrock. Because of the diverse geology of the area there is necessarily a diverse array of soils. Depending on the parent material (bedrock), slope, and hydrology at the time of formation these soils are amendable to many different land uses.

Juniata County is divided into seven different soil associations (Table 4 and Fig. 3, pg. 6). A soil association is a group of soils with a distinctive, proportional pattern of occurrence in the landscape. While the soils within an association are generally similar, they can vary greatly. Each soil association should be looked at as a great simplification of the actual characteristics. For example, the Berks-Weikert-Bedington association represents a collection of 53 different soil series (with many more subsoils) in Juniata County. These associations can be used to gauge the general character of the land where they occur, but that is all. For detailed descriptions of each individual soil type it is recommended that a USDA soil survey for the county be consulted. These are available in most public libraries and online at http://soils.usda.gov/survey/printed_surveys/. These descriptions of the soils of Juniata County come from The Soil Survey of Juniata and Mifflin Counties (USDA, 1981) and more recent information provided by the USDA:NRCS Geospatial Data Gateway (<http://datagateway.nrcs.usda.gov/>).

Figure 2:
Surface Geology of Juniata County

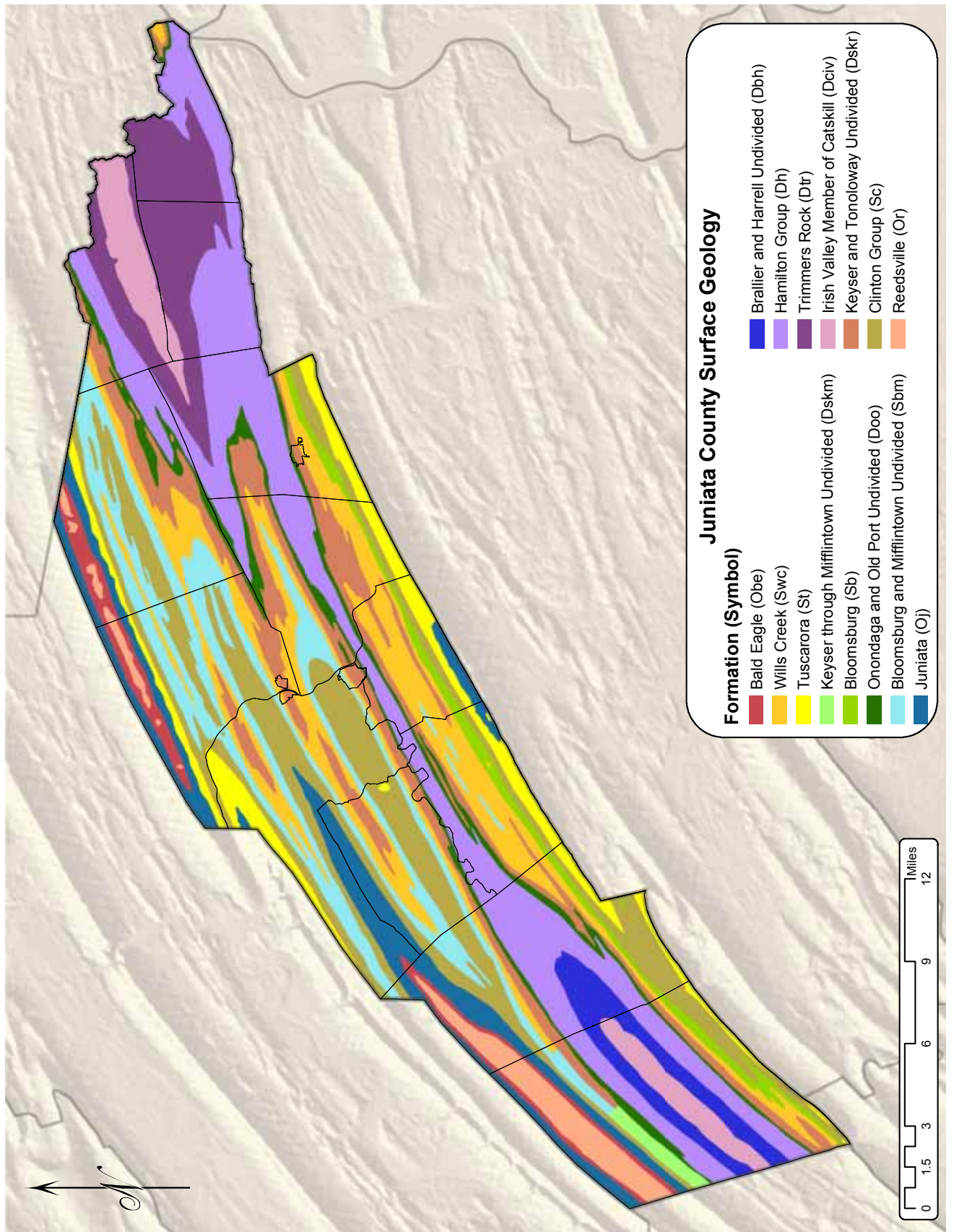


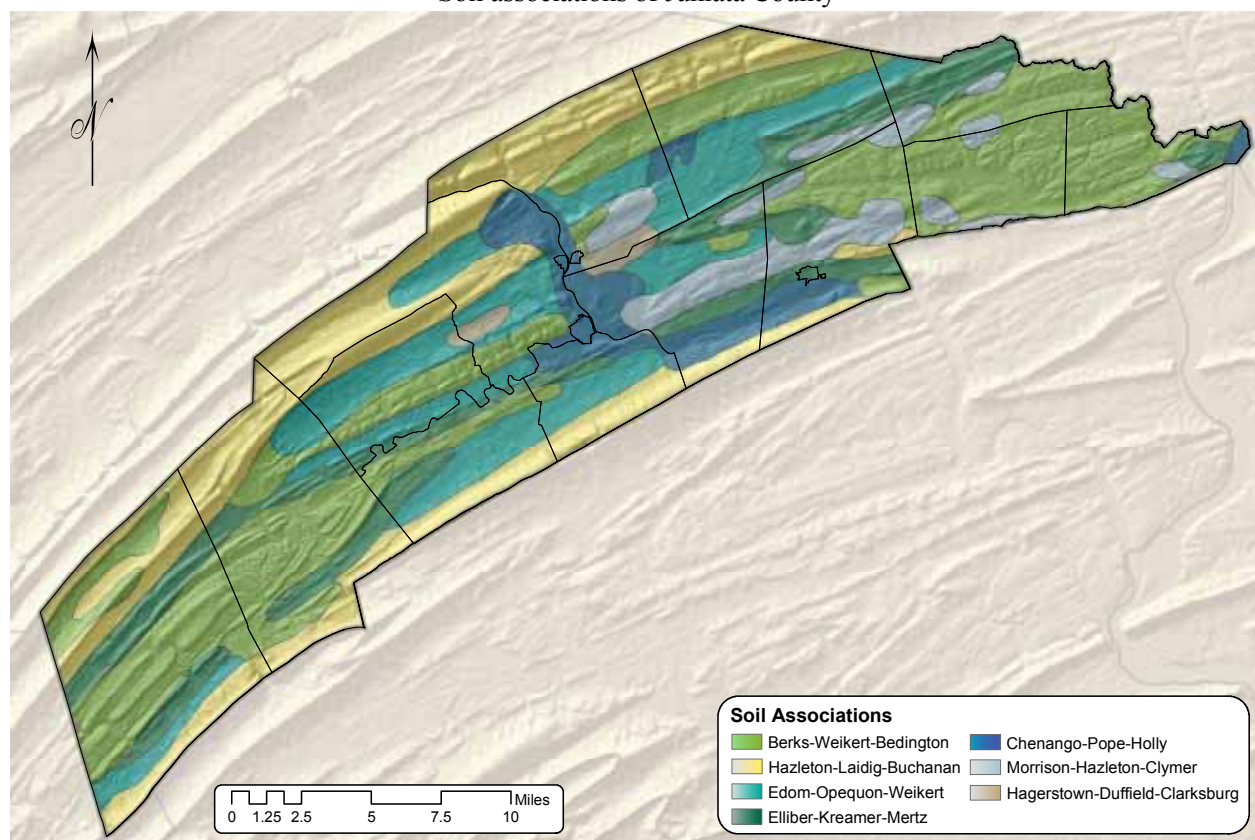
Table 3:
Surface Geology Descriptions of Juniata County

Formation	Symbol	Description
Bald Eagle	Obe	Gray to olive-gray and grayish-red, fine- to coarse-grained, crossbedded sandstone, siltstone, and shale; some conglomerate.
Bloomsburg	Sb	Grayish-red and greenish-gray shale, siltstone, and very fine to coarse-grained sandstone; some calcareous mudstone in central Pennsylvania.
Bloomsburg and Mifflintown, undivided	Sbm	Includes: Bloomsburg Formation (Sb), described above, and Mifflintown Formation – interbedded dark-gray shale and medium-gray fossiliferous limestone.
Brallier and Harrell, undivided	Dbh	Includes: Brallier Formation – medium-gray, planar-bedded siltstone interbedded with light-olive shale; sparse marine fauna; Harrell Formation – black shale and dark-gray shale.
Clinton Group	Sc	Predominantly Rose Hill Formation – light-olive-gray to brownish-gray, fossiliferous shale; locally, limestone near top; includes dark-reddish-gray, very fine to coarse-grained, ferruginous sandstone; Keefer Formation – light- to dark-gray, fossiliferous, hematitic, and oolitic sandstone, and shale.
Hamilton Group	Dh	Includes: Mahantango (Dmh) Formation – gray, brown, and olive shale and siltstone; marine fossils and Marcellus (Dmr) Formation – black shale; sparse marine fauna and siderite concretions with local limestone formations
Irish Valley Member of Catskill	Dciv	Nonmarine, grayish-red siltstone and mudstone, and gray and grayish-red sandstone interbedded with minor, thin, light-olive-gray marine siltstone.
Juniata	Oj	Grayish-red, very fine to medium-grained, crossbedded sandstone, and grayish-red siltstone and shale.
Keyser and Tonoloway, undivided	DSkt	Includes: Keyser Formation – medium-gray, crystalline to nodular, fossiliferous limestone; upper part laminated and mud cracked. Tonoloway Formation – medium-gray, laminated, mud-cracked limestone containing some medium-dark- or olive-gray shale interbeds.
Keyser Formation through Mifflintown, undivided	DSkm	Includes: Keyser Formation – limestone; Tonoloway Formation – limestone and interbedded shale; Wills Creek Formation – interbedded shale, siltstone, limestone, and dolomite; Bloomsburg Formation – grayish-red and greenish-gray shale, siltstone, sandstone, and mudstone; Mifflintown Formation – interbedded shale and limestone.
Onondaga and Old Port, undivided	Doo	Includes: Onondaga (Don) Formation – medium-gray calcareous shale; marine fossils; medium-gray argillaceous limestone, Ridgeley Member of Old Port (Dor) Formation – fine- to very coarse grained, light-gray sandstone, and Shriver, Mandata, Corriganville, and New Creek Members of Old Port Formation, undivided (Dosn) – limestone, chert, shale, and siliceous siltstone.
Reedsville	Or	Olive-gray to dark-gray shale, siltstone, and fine-grained, thin-bedded sandstone having graded bedding; upper sandstone is very fossiliferous.
Trimmers Rock	Dtr	Olive-gray siltstone and shale, characterized by graded bedding; marine fossils; some very fine grained sandstone in northeast.
Tuscarora	St	Light- to medium-gray quartzite and quartzitic sandstone and minor interbedded shale and siltstone, locally conglomeratic in lower part; includes (to the northwest) interbedded red and non-red sandstone (Castanea Member) at top.
Wills Creek	Swc	Variegated gray, grayish-red, yellowish-gray and greenish-gray, interbedded calcareous shale, siltstone, shaly limestone, and dolomite

Table 4:
Soil Association Descriptions of Juniata County

Soil Association	Description	County Coverage	Land Use
Berks-Weikert-Bedington	Moderately deep to shallow, well drained, nearly level to steep soils on secondary ridges and hills; weathered from gray sandstone and shale	33%	Primarily cropland with some pasture and woodlands
Hazleton-Laidig-Buchanan	Deep, well drained to moderately well drained, nearly level to very steep soils on primary ridges and on benches and foot slopes; weathered from acid sandstone and shale	24%	Primarily forested
Edom-Opequon-Weikert	Deep to shallow, well drained, nearly level to very steep soils on ridges and in valleys on uplands; weathered from shaly limestone and acidic red and gray sandstone	17%	Primarily cropland with some woodland
Elliber-Kreamer-Mertz	Deep, well drained to moderately well-drained, nearly level to very steep soils on secondary ridges; weathered from very cherty limestone and siltstone	12%	Primarily cropland with some pasture and woodland
Chenango-Pope-Holly	Deep, poorly drained, moderately well drained, and well drained, nearly level to gently sloping alluvial soils on flood plains and terraces; weathered from acidic siltstone, sandstone, and shale	7%	Primarily cropland and pasture with some woodland
Morrison-Hazleton-Clymer	Deep, well drained, gently sloping to moderately steep soils on secondary ridges; weathered from sandstone	6%	Mixed used of cropland, pasture, orchards, and woodland
Hagerstown-Duffield-Clarksburg	Deep to shallow, well drained, nearly level to moderately steep soils in upland valleys ; weathered from limestone, sandstone, and siltstone colluviums overlaying limestone	1%	Primarily cropland with some pasture and woodland

Figure 3:
Soil associations of Juniata County



UNIQUE NATURAL COMMUNITIES OF JUNIATA COUNTY

Terrestrial 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 basically no mature chestnuts left standing. Estimates vary, but approximately four *billion* mature American chestnut trees were killed by the blight. Today, some young sprouts and shoots still remain, but very few will ever reach maturity due to the blight. Those few trees that have survived and continue to produce viable seeds are being used to breed disease resistant trees. The American Chestnut Foundation (www.acf.org) is leading this cause and eventually hopes to use disease resistant trees to repopulate American forests.

The loss of the chestnut left huge breaks in the canopy 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 oak species comprise the Appalachian Oak Forest. Found on a broad range of soils, this community is the dominant vegetation type in the uplands of Juniata County (Cuff et al 1989).



Once the most common tree in the 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

Appalachian Oak Forest characteristic species

Trees:

American beech	<i>Fagus grandifolia</i>
bitternut hickory	<i>Carya cordiformis</i>
black birch	<i>Betula lenta</i>
black oak	<i>Quercus velutina</i>
chestnut oak	<i>Quercus montana</i>
eastern white pine	<i>Pinus strobus</i>
northern red oak	<i>Quercus rubra</i>
scarlet oak	<i>Quercus coccinea</i>
scrub oak	<i>Quercus ilicifolia</i>
tulip poplar	<i>Liriodendron tulipifera</i>
white oak	<i>Quercus alba</i>

Shrubs:

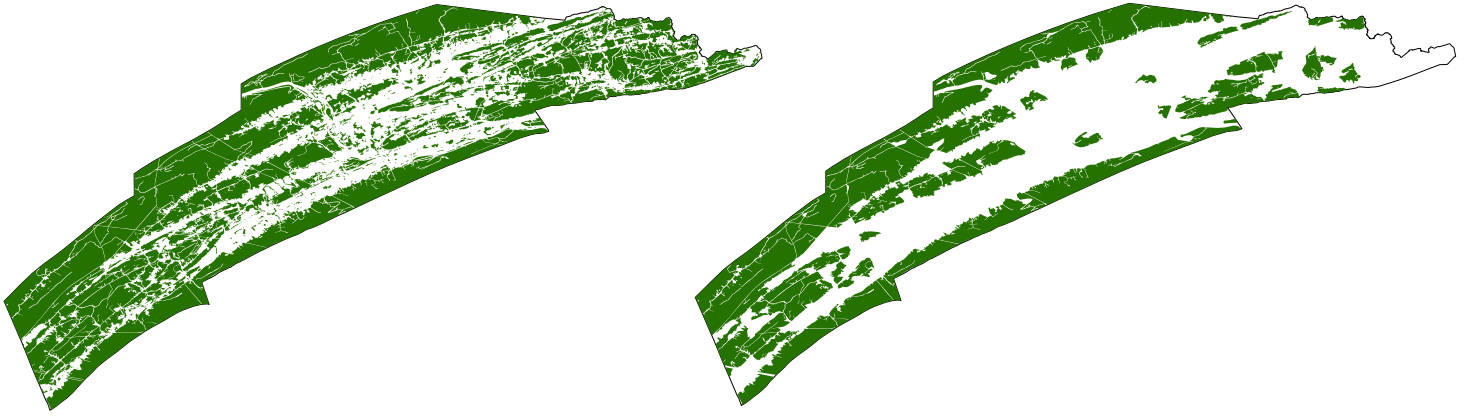
black huckleberry	<i>Gaylussacia baccata</i>
low sweet blueberry	<i>Vaccinium angustifolium</i>
lowbush blueberry	<i>Vaccinium pallidum</i>
mountain-laurel	<i>Kalmia latifolia</i>
witch hazel	<i>Hamamelis virginiana</i>

Herbaceous Vegetation:

bracken fern	<i>Pteridium aquilinum</i>
Canada mayflower	<i>Maianthemum canadense</i>
false Solomon's seal	<i>Smilacina racemosa</i>
May apple	<i>Podophyllum peltatum</i>
Pennsylvania sedge	<i>Carex pensylvanica</i>
teaberry	<i>Gaultheria procumbens</i>
wild sarsaparilla	<i>Aralia nudicaulis</i>
wood ferns	<i>Dryopteris</i> spp.



a pre and post chestnut blight forest



At first glance, most of Juniata County appears forested (left). Unfortunately much of the county's forested areas are in small fragmented blocks with a low area-to-perimeter ratio. When forest blocks of at least 250 acres with a high area to perimeter ratio are selected from the county's forested areas, the most important forest blocks become more apparent (right). 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-way. Note that the largest forest blocks also coincide with the county's mountains and ridges. For more detailed information on forest blocks see the methods (pg. 62) and results (pg. 65).

Within the dominant Appalachian Oak forest are pockets of other communities considered much less common, frequently harboring the most interesting plants, animals, and communities. Some of the communities of interest in Juniata County are briefly described in the following sections.

Hemlock (White Pine) Forest

In 1681, when William Penn 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 were once widespread throughout the state, with stands of giant trees that towered over 200 feet tall and covered thousands of square miles. 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:

- large trees for species and site
- wide variation in tree size and spacing

- accumulation of large, dead trees (snags, logs)
- tree decadence (a process of deterioration)
- tree canopy structure (layers, gaps)

Characteristic Hemlock (white pine) forest species

Trees:

American beech	<i>Fagus grandifolia</i>
black birch	<i>Betula lenta</i>
black oak	<i>Quercus velutina</i>
eastern hemlock	<i>Tsuga canadensis</i>
eastern white pine	<i>Pinus strobus</i>
red maple	<i>Acer rubrum</i>
red oak	<i>Quercus rubra</i>
sugar maple	<i>Acer saccharum</i>
tuliptree	<i>Liriodendron tulipifera</i>
yellow birch	<i>Betula alleghaniensis</i>

Shrubs:

maple leafed viburnum	<i>Viburnum acerifolium</i>
rosebay	<i>Rhododendron maximum</i>
witch hazel	<i>Hamamelis virginiana</i>
witch hobble	<i>Viburnum lantanoides</i>

Herbaceous Vegetation

Canada mayflower	<i>Maianthemum canadense</i>
Christmas fern	<i>Polystichum acrostichoides</i>
ground pine	<i>Lycopodium</i> spp.
Indian cucumber root	<i>Medeola virginiana</i>
New York fern	<i>Thelypteris noveboracensis</i>
partridge-berry	<i>Mitchella repens</i>
teaberry	<i>Gaultheria procumbens</i>



Hemlock (White Pine) forest

photo source: Andrew Strassman (PNHP)

The old growth characteristics reflect the process known as gap formation. Gap formation occurs when old trees die and/or fall over, creating an opening in the otherwise closed canopy. Smaller shaded trees that have been waiting in the understory (sometimes for centuries) are suddenly released and able to take advantage of the newly available light, water, and nutrients. Gap formation implies the presence of large trees, some of which have died and fallen over, creating a mixed layer of dead woody material (called coarse woody debris) on the forest floor, and the naturally spaced sub-canopy trees filling the gap and growing skyward into the canopy.

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 and a few are found nowhere else. 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 higher than that 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, are exceptionally scenic locations, and are incredibly

unique natural communities that shape the character of the Commonwealth.

Floodplain forests

There are two general types of floodplain forest found in the county. Depending on the richness of the soil and the duration of inundation one of two trees generally dominates a floodplain. Much more tolerant of inundation and preferring richer soils, the silver maple (*Acer saccharinum*) is primarily a riparian-edge species. Conversely, the sycamore (*Platanus occidentalis*) thrives in sandier soils that are flooded for less than two weeks, but have a good year-round water source. Depending on the physiography of the floodplain, either a silver maple floodplain forest or a sycamore – (river birch) – box elder floodplain forest will dominate.

These forests are extremely important for river health. Having the floodplain healthy and connected to the river greatly reduces the impact and severity of flooding events. Forested floodplains also act as filtration systems for surface water entering the river system. Their shade helps to cool the river water, which in turn increases oxygen levels in the water and river health. Finally, a forested riverine corridor acts as a connection for plant and animal dispersal over long distances and greatly adds to its aesthetic quality.



Floodplain forest along Tuscarora Creek

photo source: Andrew Strassman (PNHP)

Historically, the County's rivers would have run through intact floodplain forest, excepting a few openings maintained by beavers. Today, many of the valley rivers have small to no forested floodplain remaining, which has greatly reduced river health.

Side-oats grama 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, grasslands such as those he described could be found throughout the Ridge and Valley Province.

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. While their existence was certainly enhanced by the fires of these peoples, Pennsylvania naturally had grassland openings maintained for millennia by the grazing of large ungulates including the Pleistocene megafauna, and later the Pennsylvania populations of the American Bison (*Bison bison*) and American Elk (*Cervus elaphus*).



hoary puccoon (*Lithospermum canescens*)

photo source: PNHP

Today, the remaining grasslands have been 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. Pennsylvania's prairies have soil features that are typically thought of as poor quality for farming or pasturing. The soils of side-oats grama calcareous grasslands are typically thin (rarely more than a few inches thick), and are frequently composed of Opequon soil series, part of the Elliber-Kreamer-Mertz association. Today, grassland remnants are typically found on south to southwest facing slopes, restricted to areas thought to be too poor for

Characteristic side-oats grama calcareous grassland species

Trees			
common name	Scientific name	common name	Scientific name
dwarf hackberry	<i>Celtis tenuifolia</i>	red cedar	<i>Juniperus virginiana</i>
flowering dogwood	<i>Cornus florida</i>	white ash	<i>Fraxinus americana</i>
redbud	<i>Cercis canadensis</i>	yellow oak	<i>Quercus muhlenbergii</i>
Shrubs			
downy arrow-wood	<i>Viburnum rafinesquianum</i>	fragrant sumac	<i>Rhus aromatica</i>
Grasses and Sedges			
big bluestem	<i>Andropogon gerardii</i>	side-oats grama	<i>Bouteloua curtipendula</i>
Indian grass	<i>Sorghastrum natans</i>	switchgrass	<i>Panicum virgatum</i>
little bluestem	<i>Schizachyrium scoparium</i>	Pennsylvania sedge	<i>Carex pensylvanica</i>
Forbs			
bush clover	<i>Lespedeza</i> spp.	silver-rod	<i>Solidago bicolor</i>
false gromwell	<i>Onosmodium molle hispidissimum</i>	tick-trefoil	<i>Desmodium</i> spp.
green milkweed	<i>Asclepias viridiflora</i>	whorled milkweed	<i>Asclepias verticillata</i>



Red cedar – redbud shrubland in Juniata County
Photo source: PNHP

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 prevent natural succession to woody vegetation. Succession of these habitats to forest would shade out the unique species at these sites. Today, most of Pennsylvania's grasslands are threatened with woody succession, and a lack of management could threaten the viability of these communities in the state. Removal of woody vegetation, and in some cases the thick layers of soil that have developed, could help to maintain the character of these grasslands and help maintain the habitats needed by the rare species that exist at these sites.

Red cedar – redbud shrubland

Red cedar (*Juniperus virginiana*) and redbud (*Cercis canadensis*) are both early successional trees. Common in abandoned fields and along roadsides they generally do not persist in an area for long periods of time. However, given a combination of thin, limestone soils, a southern exposure, and the occasional fire, these species can persist indefinitely.

The red cedar – redbud community is typified by stunted trees in a matrix of drought-tolerant forbs and grasses and is closely associated with the side-oats grama calcareous grassland community. With soils too hot, dry, and thin to support many other tree species, succession to a mature woodland or forest is

often prevented. Additionally, because of the flammable nature of red cedar, fire regularly swept through this community type promoting the early-successional species. The fires also maintained an open environment and promoted the regeneration of many other grassland species such as hoary puccoon and side-oats grama grass.

In recent times this community has fared better than most. Because of the poor quality of the soil, the land cannot be farmed, makes very poor pastureland, and does not grow valuable timber well. However, in the absence of fire many of these communities are maturing well beyond their prime, creating a closed canopy

environment. When this occurs, the prairie species die out, leaving the community open to invasion by non-native plants.

In order for this community to be maintained, the older trees and built-up leaf-litter need to be removed. This is the historical job of fire, and fire continues to be the best tool. If controlled burns are not practiced, mechanical removal of large, old trees may help to open the canopy and encourage the growth of latent prairie seeds.

Wetland Communities

Because of the mountains and ridges, the glaciers of the last several ice ages never penetrated Juniata County. This limits distribution of large wetland



side-oats grama (*Bouteloua curtipendula*) in bloom

photo source: PNHP

systems within the county that are so common in glaciated areas. However, the slopes and river valleys do sustain many smaller examples. These systems, left unaltered, provide highly unique habitats that can support many distinctive plants and animals.

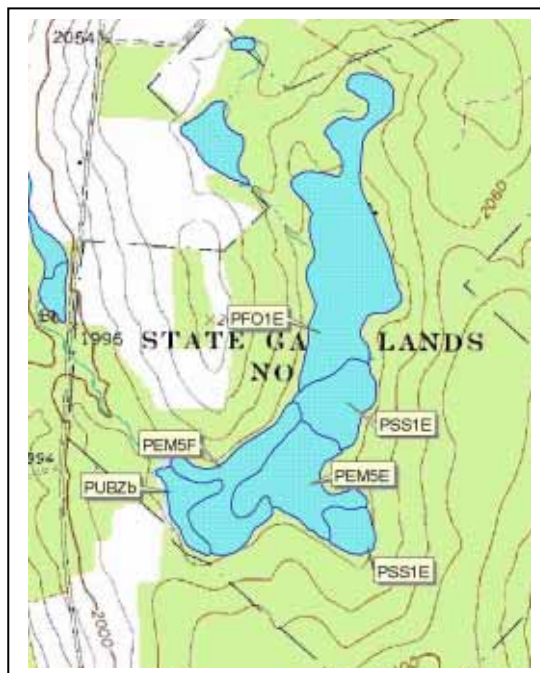
Wetlands are the key to the survival of many species of plants and animals considered rare in the state. Even though wetlands account for only two percent total of Pennsylvania's area, they are home to a diverse array of rare plants and animals and are an extremely productive part of the landscape as a whole (Cuff et al. 1989). 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, fens, floodplain forests, forested wetlands, wet meadows, and seeps. Wetlands differ also in vegetative species cover. Tree species such as red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*) and ash (*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.

Beyond their role as the only habitat for many species, wetlands also play a critical part in water purification, ground water recharge, and floodwater retention and mitigation. Plant species present in wetlands process and remove many nutrients and toxins as water flows through a healthy wetland. Because of the longer retention times, a substantial amount of water flows into the ground entering the water table. Finally, during times of high flow wetlands act as excellent retention systems, both slowing down and impounding storm waters.

Shrub Swamps

These 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 less than 20 feet tall dominate this type of wetland. Shrub swamps in the county often include highbush blueberry, chokeberry (*Aronia* spp.), alder (*Alnus* spp.), leatherleaf (*Chamaedaphne calyculata*),



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. An example 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>

swamp rose, meadowsweet and stepplebush (*Spiraea* spp.), and sedges (*Carex* spp.).

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 virtually 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 arundinacea*), 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 Juniata County and Pennsylvania in general, all good examples of these habitats should be preserved whenever possible. These wetlands provide valuable habitat for breeding and migrating birds, mammals, reptiles, amphibians and insects and also provide a refuge for many species of wetland-dependent rare plants.

Communities of vernal pools have historically received negative attention because they have been thought of as mosquito breeding waste grounds, 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 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 many mosquito eggs are laid in vernal pools, few of them survive to adulthood in healthy pools due to predation by highly specialized amphibians and insects adapted to the unique growing conditions provided by vernal pools. These species prey on mosquito larvae and eat the majority of them before they hatch, greatly reducing the population of these annoying creatures.



Vernal pools: spring (above) and fall (below)

photo source: PNHP

Pennsylvania's vernal pool origins are commonly rooted in the glacial advances of the Illinoian and Wisconsin glaciations, but the correct physiography can produce them almost anywhere. 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 (oxygen-free) soil. Paleobotany studies from some pools in Pennsylvania have identified tamarack pollens from a few feet down, indicating that that portion of the Commonwealth was covered by a boreal forest about 30,000 years ago. 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 on page 186.

Mixed Forb Marsh

Also known as emergent marshes, wetlands dominated by grass-like (graminoid) plants such as cattails, sedges, rushes, and grasses are commonly referred to as mixed forb marshes. This type of wetland may be found in association with headwaters, 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. Given their rarity and importance within the county, any example of this wetland type should be preserved regardless of its quality.

This plant community was once very common, but has drastically declined since European colonization due to wetland draining and stream channel modification. This community is highly variable, but is generally 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. As such, they excel at absorbing rainwater, buffering against flooding, and at water filtration.

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,



Shrub swamp, Cedar Spring Run Wetland

photo source: PNHP

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.

Unfortunately, this plant community is very susceptible to invasions by exotic species. Among these are the exotic purple loosestrife (*Lythrum salicaria*), exotic 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. Additionally, once established these species are almost impossible to remove. The best method is to prevent their original colonization by monitoring the wetland for their presence and then removing any individuals as they are found.



Graminoid marsh, Cedar Spring Run Wetland

photo source: PNHP

DISTURBANCES IN JUNIATA COUNTY

Overview

Disturbances, whether natural or man-made, have played a key role in shaping many of the county's natural communities and their associated species. The frequency and scale of these disturbances is formative 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 barrens and limestone glades, allowing new growth of the characteristic species and keeping out other successional species. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same time, streamside wetland communities retain excess water, thus reducing the scale of flooding downstream.

Another natural disturbance (exacerbated by human mismanagement), over-browsing 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 by preferential feeding. 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.

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 renders 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 now rare wetland habitats and jeopardize many of the



This photograph showcases the destruction possible from an overpopulation of deer. While many people are attracted to the park-like atmosphere in a forest like this, there is *very limited habitat* in this type of forest and it is representative of a very unhealthy ecosystem. Increasing hunting pressure on lands could eventually allow this forest to recover, but this particular stand may require hands-on management to restore the understory.

photo source: PNHP

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.

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 are unable to 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.



The recent beaver activity at this site is beginning to flood the hemlock palustrine forest.

photo source: PNHP

From a historical perspective, human disturbance to the natural communities of the county has been occurring for hundreds, if not thousands, 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 Juniata County supported the growing human population by providing prime farming conditions. Juniata 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 Juniata 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. As such, the proportional amount of old-growth forest in Pennsylvania is virtually zero despite increasingly longer cutting rotations.

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 increased efforts have been made to protect our remaining wetlands, these often rely on wetland mitigation, where artificial wetlands are

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

As farming remains a central industry in Juniata 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, residential development, 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 Juniata 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=1>)

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>.

*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

The introduction of non-native species into Pennsylvania began with the initial European settlement in the 17th century (Thompson 2002) and continues as you read this. 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

Invasive plants reproduce rapidly, spread quickly over the landscape, and have few, if any, natural controls such as herbivores and diseases to keep them in check (Table 5, pg. 18). 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. This initial impact is worsened by the tendency for native wildlife to prefer native species over invasive species for food. 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 nonnative bush honeysuckles (*Lonicera* spp.), 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).



mile-a-minute smothering native vegetation

photo source: 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. The decrease in plant biodiversity can, in turn, impact the mammals, birds, 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).

Control with herbicide 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 ‘wetland-safe’ herbicide should be used to avoid indirect effects on other organisms. It should be noted that several popular herbicides have severe adverse affects on amphibians and reptiles and should not be used in or around wetlands under any circumstances. Also, 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/>

Table 5:
Significant invasive plant species found or with colonization potential in Juniata County.

Species	Description and Threat
Tree-of-heaven (<i>Ailanthus altissima</i>)	Introduced to Philadelphia from China in the early 1800s, 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, outcompeting native vegetation.
Norway maple (<i>Acer platanoides</i>)	Introduced and still sold as an ornamental tree, it has spread throughout Pennsylvania invading many rich upland woodlands and is commonly found along roadsides.
Japanese stiltgrass (<i>Microstegium vimineum</i>)	A fast-spreading grass that is typically found along forest roads, stream banks and other cool moist habitats. Outcompetes native vegetation and may have an effect on animal species that use streamside microhabitats.
Japanese and Giant Knotweed (<i>Polygonum cuspidatum</i> and <i>P. sachalinense</i>)	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 (<i>Polygonum perfoliatum</i>)	A vine that invades open and disturbed areas and scrambles over native vegetation, smothering them. This species is listed as a noxious weed in Pennsylvania.
Purple Loosestrife (<i>Lythrum salicaria</i>)	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 (<i>Alliaria petiolata</i>)	An increasingly common invasive biennial herb spreading through natural areas throughout the region that is known to disrupt mycorrhizal relationships that trees depend on for their growth.
Japanese Honeysuckle (<i>Lonicera japonica</i>), Oriental Bittersweet (<i>Celastrus orbiculatus</i>)	These species of vines cover and outcompete native vegetation as well as girdle trees by twining up them.
Nonnative Bush Honeysuckles (<i>Lonicera tatarica</i> , <i>L. morrowii</i> , <i>L. maackii</i> , and <i>L. xylosteum</i>)	Found in a variety of environments from wetlands to uplands. These compete with native plants for moisture, nutrients, and pollinators. Fruits do not provide high-energy food for migrating birds.
Canada Thistle (<i>Cirsium arvense</i>)	A Pennsylvania listed noxious weed common in many habitats.
Spotted Knapweed (<i>Centaurea stoebe</i>)	Competes with native species by capturing moisture and nutrients. Poses a high threat to shale barrens and other dry habitats.
Autumn Olive (<i>Elaeagnus umbellata</i>)	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 (<i>Berberis thunbergii</i>)	Commonly planted ornamental that escapes and forms dense stands in a variety of habitats, including forests and wetlands, displacing native vegetation.
Burning Bush (<i>Euonymus alatus</i>)	A shrub that can form dense thickets that displace native woody and herbaceous plants.
Multiflora Rose (<i>Rosa multiflora</i>)	Widely planted shrub that invades a variety of habitats excluding most native shrubs and herbs. May be detrimental to the nests of native birds.
Jetbead (<i>Rhodotypos scandens</i>)	A shrub that forms dense thickets displacing native woody plants and herbaceous groundcover.
Privet (<i>Ligustrum</i> spp.)	A shrub that forms dense thickets in floodplains, forests, wetlands, and fields.

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.

Invasive Animal Species

In addition to invasive plants, Pennsylvania is now home to several exotic species of animals including mammals, birds, fish, and reptiles along with a suite of invertebrates, fungi, and bacteria (Table 6, pg. 20). 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*), are all too common pests of our homes and developed areas.

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 to the Mississippi River. 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 beautiful, yet durable wood. Today, only stump sprouts from killed trees remain and the canopy composition has been filled by the chestnut's associate species of oaks and hickories.

Arguably, one of the most visible threats to the biodiversity of Juniata 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, some exclusively. Several control options are currently being tested, but these have met with very limited success. 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



Hemlock Woolly Adelgid infestation along a hemlock branch.

photo source: Connecticut Agricultural Experiment Station Archive

Maine to Georgia and can be found in most of the counties in Pennsylvania (PA DCNR 2007).

The Gypsy Moth (*Lymantria dispar* L.) 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 failed commercial silk production venture. Its main impact is that it defoliates trees, concentrating on 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 and it has since spread throughout the US. In addition to competing with native bird species for food and space, large flocks of this species destroy fields of crops. The House Sparrow (*Passer domesticus*) was introduced to several places in the United States in the late 1800's and has since become ubiquitous with human settlement. In addition to causing crop damage, House Sparrows will kill native adult cavity nesting birds and their young and smash their eggs. The House Sparrow is partially responsible for a decline of Eastern Bluebirds (*Sialia sialis*) in the United States.

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. This mussel poses a great threat to industry, recreation, and native fish and mussel species and should be controlled wherever it occurs. Another non-native bivalve, the Asian Clam (*Corbicula fluminea*), has spread

throughout most of Pennsylvania's waterways including the Juniata and its tributaries. 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 found in the county, the Rusty Crayfish (*Orconectes rusticus*), has been transplanted from its native range in the Midwestern United States to many of Pennsylvania's watersheds in the form of live fishing bait even though it is prohibited from

transport by the state. Potentially, rusty crayfish 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 keep many fish species from feeding on them. Rusty crayfish may also reduce native crayfish, freshwater mussels, and reptile and amphibian populations by out-competing them for food and habitat or by preying directly on young individuals.

Table 6:
Significant invasive animal species found or with colonization potential in Juniata County.

Species	Description and Threat
Hemlock Woolly Adelgid (<i>Adelges tsugae</i>)	Often called simply HWA, this species is causing severe damage to eastern hemlock (<i>Tsuga canadensis</i>) killing up to 90% of infected trees, thus greatly modifying ecosystems.
Gypsy Moth (<i>Lymantria dispar</i>)	Feeding preferentially on oak trees (<i>Quercus</i> spp.) and their relatives, this species will eat almost any plant when forced and can cause severe environmental and economic damage.
Common Pine Shoot Beetle (<i>Tomicus piniperda</i>)	A pest of pine trees (<i>Pinus</i> spp.) this species damages terminal shoots, stunting the growth of trees and thus weakening the trees and increasing their susceptibility to other pests.
Sirex Woodwasp (<i>Sirex noctilio</i>)	A recent invader, this species attacks living pines and is likely to cause great amounts of damage to pine plantations throughout the nation.
Multicolored Asian Ladybird Beetle (<i>Harmonia axyridis</i>)	Preying on native insects and invading houses each winter, this species was likely introduced in an attempt to control non-native aphids.
Zebra Mussel (<i>Dreissena polymorpha</i>)	Introduced from dumped ballast water, this species is not yet known in Juniata County, but must be watched for given its disastrous effects on ecosystems and economies.
Asian Clam (<i>Corbicula fluminea</i>)	Found in extremely high densities along major tributaries and rivers, this species is directly competing with native mussels for food and habitat.
Rusty Crayfish (<i>Orconectes rusticus</i>)	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 (<i>Neogobius melanostomus</i> and <i>Proterothinus marmoratus</i>)	These predatory fish prefer cobbly bottoms in slow moving water. Introduced from dumped ballast water, they feed on macroinvertebrates, small clams and mussels, and fish eggs and are a direct competitor with our many small native darters and minnows.
Grass Carp (<i>Ctenopharyngodon idella</i>)	A voracious herbivore, this species was introduced to control weeds in eutrophied lakes. However, it now causes significant damage to native wetland vegetation that is important for reducing nutrients in water-bodies.
Common Carp (<i>Cyprinus carpio</i>)	Introduced as a food fish, this species is now found anywhere with warm, slow-moving water. As a bottom feeder it greatly increases turbidity and mobilizes large amounts of sediment.
Snakehead (<i>Channa</i> 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 Juniata County, it should be monitored for.
House Sparrow (<i>Passer domesticus</i>)	Generally found any place humans are, this species can cause crop damage, but mainly competes with small, native cavity nesting birds.
European Starling (<i>Sturnus vulgaris</i>)	Competing directly with native cavity-nesting birds, this species also cause severe crop damage.
Rock Dove / European Pigeon (<i>Columba livia</i>)	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 (<i>Cygnus olor</i>)	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 (<i>Mus musculus</i>)	Ubiquitous throughout the world, this species carries many diseases, competes directly with many native species, and can cause significant damage to crops and structures.
Norway Rat (<i>Rattus norvegicus</i>)	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 (<i>Felis silvestris</i>)	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 Juniata County has many sites that are free from non-native species, invasive species are an ever 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 an 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:

- Natural Heritage sites 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.
- 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.
- 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; however several are invasive in non-agricultural settings. 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 (www.fish.state.pa.us/ans.html). This list includes the zebra mussel and the rusty crayfish among others. See table 7 (pg. 21) for the complete list of prohibited species.

Table 7:

Noxious Species List for Pennsylvania. Possession, propagation, transport, barter, and/or sale of these species is prohibited in Pennsylvania.

Common Name	Scientific Name
Plants	
Bull or Spear Thistle	<i>Cirsium vulgare</i>
Canadian thistle	<i>Cirsium arvense</i>
Giant Hogweed	<i>Heracleum mantegazzianum</i>
Goatsrue	<i>Galega officinalis</i>
Jimsonweed	<i>Datura stramonium</i>
Johnson grass	<i>Sorghum halepense</i>
Kudzu-vine	<i>Pueraria lobata</i>
Marijuana	<i>Cannabis sativa</i>
Mile-a-minute	<i>Polygonum perfoliatum</i>
Multiflora rose	<i>Rosa multiflora</i>
Musk or Nodding Thistle	<i>Carduus nutans</i>
Purple Loosestrife	<i>Lythrum salicaria</i>
Shattercane	<i>Sorghum bicolor</i>
Fish	
Bighead carp	<i>Hypophthalmichthys nobilis</i>
Black carp	<i>Mylopharyngodon piceus</i>
European rudd	<i>Scardinius erythrophthalmus</i>
Round goby	<i>Neogobius melanostomus</i>
Ruffe	<i>Gymnocephalus cernuus</i>
Silver carp	<i>Hypophthalmichthys molitrix</i>
Snakehead	<i>Channa spp.</i>
Tubenose goby	<i>Proterothinus marmoratus</i>
Invertebrates	
Quagga mussel	<i>Dreissena bugensis</i>
Rusty Crayfish	<i>Orconectes rusticus</i>
Zebra mussel	<i>Dreissena polymorpha</i>

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. An excellent resource for information on Pennsylvania's native horticulture-friendly plants can be found at: <http://www.dcnr.state.pa.us/forestry/wildplant/native.aspx>.

Selected Invasive Plant Species

The most aggressive introduced plant species in Pennsylvania include 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. Photos: 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 Asiatic bittersweet becomes a snarled, poor quality forest.



Japanese Knotweed (*Polygonum cuspidatum*)



Purple loosestrife (*Lythrum salicaria*)



Japanese honeysuckle (*Lonicera japonica*)

MAMMALS OF JUNIATA COUNTY

Juniata County lies in the Appalachian Mountains Section of the Ridge and Valley Province, a province that is characterized by a limestone karst topography broken up by small hills and valleys. As such, agriculture remains one of the county's primary economic activities. The county is bordered to the north by Blue and Shade Mountains and to the south by Tuscarora Mountain. Centrally bisected by the Juniata River, the county is characterized to the east of the Juniata River by a somewhat rolling landscape of streams, low hills, and agricultural land and to the west of the Juniata River by long, narrow valleys. Generally, public lands are confined to the mountainous borders to the northwest and southeast including Tuscarora State Forest and several PA State Gamelands.

Habitats

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. These habitats often contain 6 species of shrews, 9-10 species of rodents, 4-5 species of weasels, 7-8 species of bats as well as sign of various other medium-and large-sized mammals.

Open lands in the form of meadows and old fields are habitats commonly found along the valleys of Juniata County. The most well known mammal occurring in these open lands is the Meadow Vole (*Microtus pennsylvanicus*). It is this medium-sized rodent that forms the runways through the grass and is spotted



Black Bear (*Ursus americanus*) track

photo source: PNHP



White-Tailed Deer (*Odocoileus virginianus*)

photo source: Charlie Eichelberger

under dense vegetation during the summer months and under the 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 traveled along the forest roads, pipelines, and power right-of-ways to get there. Several other species of mammal are known to occur within open lands including the Eastern Cottontail Rabbit (*Sylvilagus floridanus*), Groundhog or Woodchuck (*Marmota monax*) and Red Fox (*Vulpes vulpes*).

Hunting and Trapping

Hunting is an important factor to the economy of the county, with the presence of several State Game Lands (SGL) and state forests providing many hunting locations during the various deer seasons. Generally, hunters take around 3,000 White-tailed Deer (*Odocoileus virginianus*) annually in Juniata County. While this appears a bit low compared to other central Pennsylvania counties, it is likely a reflection of restricted hunter access combined with difficult terrain on the public lands.

The bear harvest, although low from 1993 to 2002, is likely increasing. The number of Black Bear (*Ursus americanus*) sighted throughout the county continues to rise, increasing the chances of higher harvest numbers in the future. However, increasing development and habitat fragmentation in the county may limit large game hunting opportunities relative to surrounding counties. The hills and valleys, though, provide a great deal of habitat for the many small game species that are important to hunters during the fall and winter seasons. These include the Grey and Fox Squirrel (*Sciurus carolinensis* and *S. niger*), cottontail rabbits, and fur-bearer species such as the Mink (*Mustela vison*) and other weasels.

What is less well known is that these same habitats also support a diverse and important non-game mammal fauna. Historically, several game species have either disappeared from Juniata County or their populations had become so low that they were thought to be gone from the county. Two of these species, the Fisher (*Martes pennanti*) and the Northern River 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 these species may occur in Juniata County, although no known populations exist at present. Although it is unlikely that the Fisher will ever become established in Juniata County because of the vast stands of forest it requires, the River Otter appears to be reestablishing populations along the Juniata River.



River Otter (*Lontra canadensis*)

photo source: John White, California Academy of Sciences



White-footed Mouse (*Peromyscus leucopus*)

photo source: Dick Cooper, Northeast Research Unit USFS

Generalists and Specialists

Many of the species occurring throughout the county are common throughout Pennsylvania and possess the ability to survive in a wide range of habitat types. These species are termed “generalists” and include the Northern Short-tailed Shrew (*Blarina brevicauda*), several other shrew and mole species, White-footed Mouse (*Peromyscus leucopus*), and several other rodent species, Striped Skunk (*Mephitis mephitis*), Virginia Opossum (*Didelphis virginiana*), Coyote (*Canis latrans*) and the ubiquitous Eastern Chipmunk (*Tamias striatus*). All of these species occur throughout the many habitats within Juniata County and are in no jeopardy of disappearing from the landscape.

Other species, termed habitat specialists, are restricted to a fairly narrow set of habitats. 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, Allegheny Woodrat (*Neotoma magister*), Muskrat (*Ondatra zibethicus*), Beaver (*Castor canadensis*), and most bat species.

Habitat availability is just one of a number of factors that determine whether a species is going to persist within a certain area. Food resources are an extremely important factor for reproductive females and dispersing individuals, with metabolic demands on a nursing female three to five-times higher than normal. These individuals require consistent and substantial amounts of food in order to bear young, nurse, and



**Hibernating Eastern Pipistrelle (*Pipistrellus subflavus*)
with frosted fur**

photo source: <http://www.psc-cavers.org/stcc/batphotos.htm>

travel, all activities that burn calories very quickly. Species such as the Allegheny Woodrat have most likely declined due to a possible lack of food resources; 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 acorns and a diverse array of greens in the form of the leaves of many shrubs, they become energy-stressed during times 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. There are more than 20 active woodrat sites located along the Juniata – Mifflin County border (App. XI, Woodrat fact sheet, pg. 188). This makes it a substantial proportion of the Allegheny Woodrat's global population, and connectivity between the sites should be maintained. The mountains along the southern border of Juniata County likely also provide prime habitat, but have not been significantly investigated.

Bats

Bats are a common component of the forests of Juniata 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. The Silver-haired Bat (*Lasionycteris noctivagans*), a rarely encountered bat species in Pennsylvania, may occur within Juniata County during the early spring or late fall months as it migrates through the state on its way to and from its summer habitat in the northern portion of the United States and in Canada. During the winter months, however, most bats disappear into the many caves and mines in surrounding counties to hibernate through the winter. One cave in Juniata County was found to harbor 2 Eastern Pipistrelle bats (*Pipistrellus subflavus*) during a survey conducted in the mid-1990's, but it is likely that other undiscovered hibernacula occur in the county. Several species such as the Hoary Bat (*Lasiurus cinereus*) and Red Bat (*Lasiurus borealis*) do not over-winter in the state at all but migrate further south to states like the Carolinas and Florida. They are thought to spend the winter months in hibernation under deep patches of leaf and forest floor litter.

Summary

Juniata County contains a diverse array of 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 are small blocks within a sea of inhospitable habitat. Development of land, splitting of habitats by un-crossable barriers such as major highways, drainage of wetland areas, and environmental degradation have all served to confine many mammal species to very localized and isolated



Eastern Small-footed Bat (*Myotis leibii*)

photo source: PNHP



Northern Water Shrew (*Sorex palustris albibarbis*)

photo source: PNHP

populations. This greatly limits their ability to survive any major change in food resources, availability of nesting habitat, the invasion of non-native species, or increased predation. These populations may be doomed to what is termed “localized extinction”. If enough of these populations disappear from the landscape, these species’ existence in Pennsylvania may be in jeopardy. Large blocks of forest land and vegetated stream and river corridors serve as avenues of dispersal to the diverse list of mammals noted to occur in Juniata County. 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 in Juniata County

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 (Fig. 4, pg. 27) 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.

Note: The following are Important Mammal Areas (IMAs) that occur in Juniata County. The information is adapted from the IMA Project site descriptions in Murray 2002.

Blacklog Mountain IMA

This large IMA extends over five counties in central PA with approximately 65% located in State Game Lands (SGL) 81 and SGL 107. It is bisected by US 522 at Shade Gap. Dominated by deciduous forest, it includes coniferous and mixed woodlands, as well as some grassland. 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 grassland to swamp and marsh. It includes SGLs 194, 212, 233, 254, 258, 281,



Allegheny Woodrat (*Neotoma magister*)

photo source: John Hall

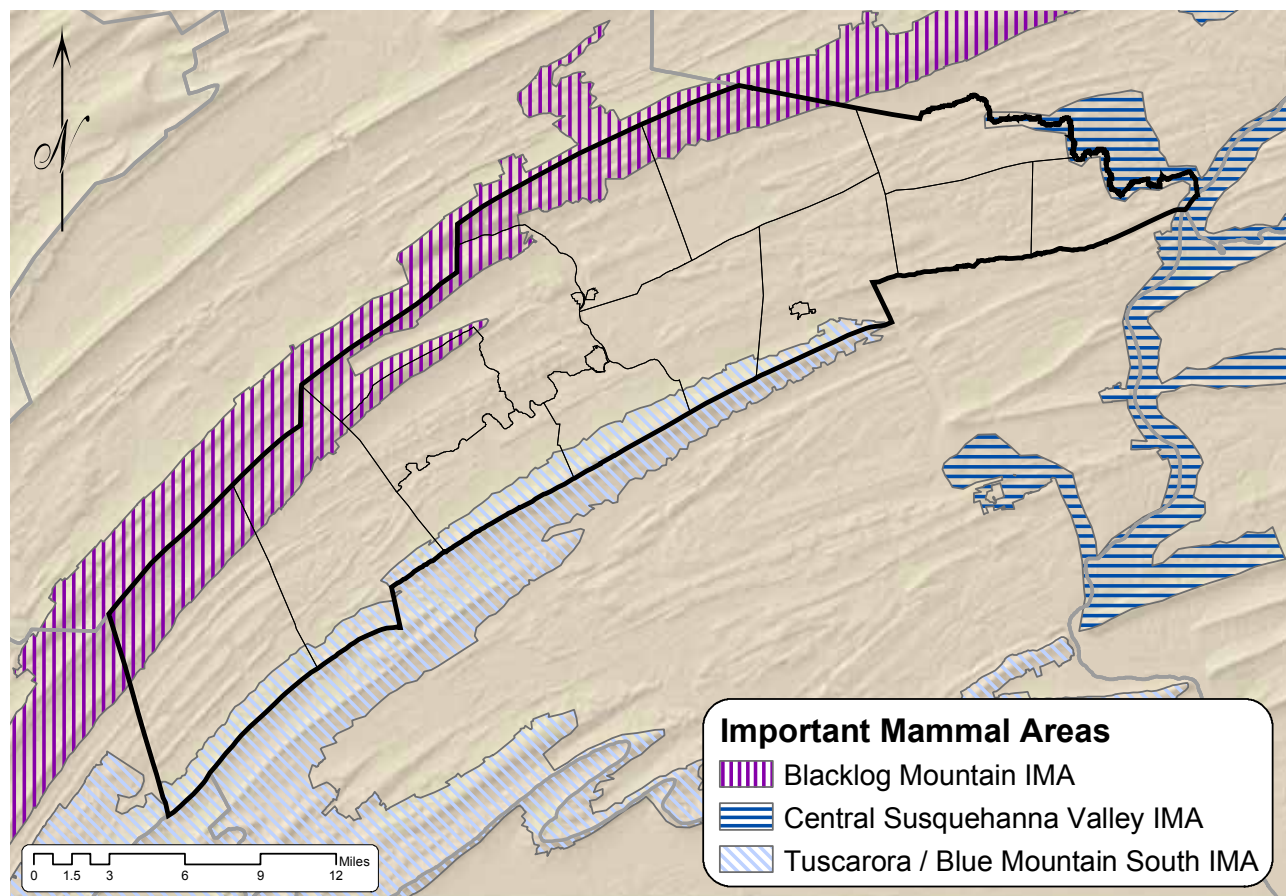
and 290. This area includes a diverse community of mammals, including those of both aquatic and terrestrial habitats. Northern River Otters inhabit the river and its tributaries, and there is a barn located in the floodplain at Mahantango Creek (Dauphin Co.) that houses approximately 30,000 bats. The 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.

Tuscarora and Blue Mountain South IMA

This IMA encompasses a portion of the easternmost ridges of the Allegheny Front, with Blue Mountain being the southern section of the Kittatinny Ridge. Dominated by mixed coniferous-deciduous forests, these ridges have numerous rock outcrops interspersed with forests. Several sites within this IMA are inhabited by Allegheny Woodrats, with the best

known and most actively monitored populations being Waggoner’s Gap and Bowers Mountain. Other confirmed mammal species of interest are Eastern Small-footed Myotis, Indiana Myotis, and Northern Myotis. There is an Appalachian Cottontail record from 1979 and the area was to be resurveyed in 2004. The IMA includes SGL 76, 88, 124, 230, 235, and 251, as well as five state parks. Potential threats to habitat include recreational development or overuse and inappropriate forestry practices.

Figure 4:
Important Mammal Areas in and around Juniata County



BIRDS OF JUNIATA COUNTY

Pennsylvania is an important state for breeding, migrating, and wintering birds (Brauning 1992). Juniata 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 Juniata County resides, is a significant ornithological region as a result of the distinctive geology and topography. The forested ridges of the Allegheny Front rise 2700 feet 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.

Common Forest Interior Bird Species

Acadian Flycatcher	<i>Empidonax virens</i>
Barred Owl	<i>Strix varia</i>
Black and White Warbler	<i>Mniotilta varia</i>
Black-throated Green Warbler	<i>Dendroica virens</i>
Broad-winged Hawk	<i>Buteo platypterus</i>
Hairy Woodpecker	<i>Picoides villosus</i>
Ovenbird	<i>Seiurus aurocapillus</i>
Pileated Woodpecker	<i>Dryocopus pileatus</i>
Scarlet Tanager	<i>Piranga olivacea</i>

Partners In Flight (PIF) Priority Forest Interior Birds

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

Pennsylvania State Listed Forest Interior Specialist Birds

Long-eared Owl	<i>Asio otus</i>
Northern Goshawk	<i>Accipiter gentilis</i>
Northern Saw-whet Owl	<i>Aegolius acadicus</i>
Prothonotary Warbler	<i>Protonotaria citrea</i>
Swainson's Thrush	<i>Catharus ustulatus</i>
Yellow-bellied Flycatcher	<i>Empidonax flavescens</i>



Hooded Warbler (*Wilsonia citrina*)

photo source: Ron Austing

Protected natural areas such as Hawk Mountain Sanctuary, 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 or greater from a road or edge (Whitcomb et al. 1981). This critical habitat is declining. Seventy percent of Pennsylvania's core forest land is found in patches of 5,000 acres or less indicating 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 affects 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). For example, 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.

The ridgetop forests of the Ridge and Valley region retain the greatest amount of interior forests in Juniata County. Forest interiors have high bird diversity. These communities include a variety of warblers, tanagers, vireos, owls, woodpeckers, and hawks.



Cerulean Warbler (*Dendroica caerulea*)

photo source: Ron Austing

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).

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 tracks, keeping larger forest patches closely grouped, harvesting around forest edges, and establishing forested corridors between contiguous blocks (Pashley et al. 2000).



Sora (*Porzana carolina*)

photo source: Ron Austing

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.

Common Wetland Dependent Birds in Juniata County

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

Wetland bird species of special concern in PA

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

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). Many of these birds are also secretive, cryptic, and hard to flush, making marshes difficult areas to survey. 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 Eagles, prefer nesting on top of tall trees with a good view of the surrounding land. The Red-shouldered Hawk (*Buteo lineatus*) forages and nests almost exclusively in



Eastern Meadowlark (*Sturnella magna*)

photo source: Ron Austing

wooded wetlands and streams, a feature common in Juniata County. Wading birds, such as Great Blue Herons and Great Egrets (*Ardea alba*), 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.

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. Juniata County would have had several grasslands present on certain ridge and hill tops 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 Juniata County with their mix of agricultural fields, pastures, and old fields. These species include the Eastern Meadowlark (*Sturnella magna*), various sparrows including the Grasshopper and Savannah Sparrows (*Ammodramus savannarum* and *Passerculus sandwichensis*), Killdeer (*Charadrius vociferous*), American Kestrel (*Falco sparverius*), and swallows (Hirundinidae). There are a number of grassland bird species that are facing extirpation in the state; these include Northern Harrier (*Circus cyaneus*), Dickcissel (*Spiza americana*), Upland Sandpiper (*Bartramia longicauda*), Short-eared Owl (*Asio flammeus*), and Loggerhead Shrike (*Lanius ludovicianus*).

A species of special concern found in Juniata County's pastoral areas is the Barn Owl (*Tyto alba*).

Historically nesting in large tree cavities and small caves, the Barn Owl 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 collision during nocturnal hunting (Marti et al. 2005). More detailed information may be found in the Barn Owl fact sheet in Appendix XI (pg 190).



Barn Owl (*Tyto alba*)

photo source: Jamie Zambo



Barred Owl (*Strix varia*)

photo source: Ron Austing

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 US 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 Juniata County Farm Service Agency in Mifflintown at (717) 436-8953 ext. 4.

Important Bird Areas in Juniata County

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 occurs within Juniata County. Juniata County's IBA highlights what is considered to be the County's critical bird habitat for both common and rare birds. More information about the IBA Program can be found at Audubon PA's website (<http://pa.audubon.org/>).

Juniata County's IBA is Tuscarora Ridge, a linear feature extending the length of the county (Fig. 5, pg. 32). The IBA extends beyond Juniata County; therefore, features described below pertain to the entire IBA and are not necessarily confined to the county.

Tuscarora Ridge – The Pulpit

Tuscarora Summit, known by birders as "The Pulpit," is located inside Buchanan State Forest and lies at the southern end of a ridge system that acts as a major migratory funnel for raptors. Tuscarora Ridge extends from Juniata County into Maryland. Farther east lies Kittatinny Ridge, and many fall migrants from there and other westerly ridges converge near Tuscarora Summit.

This area satisfies the following IBA criteria:

- Seventeen species of raptors counted during fall and spring migrations, including Broad-winged Hawk, Sharp-shinned Hawk, and Red-tailed Hawk.
- Species of concern included in the migration counts are Bald Eagle, Peregrine Falcon, Osprey, and Northern Harrier
- The site has been monitored daily during fall migration for more than 25 years.

Conservation

Conservation of this IBA should be focused on the entire ridge system, not only the immediate site. The hawk-watch site is owned by the Maryland Hang Gliding Association and is used for recreation and birding. The surrounding area includes both state forest and private lands. Forest pests and disease, recreational development/overuse, and excessive or inappropriate forestry practices could potentially affect the use of the larger ridge system by migrants.



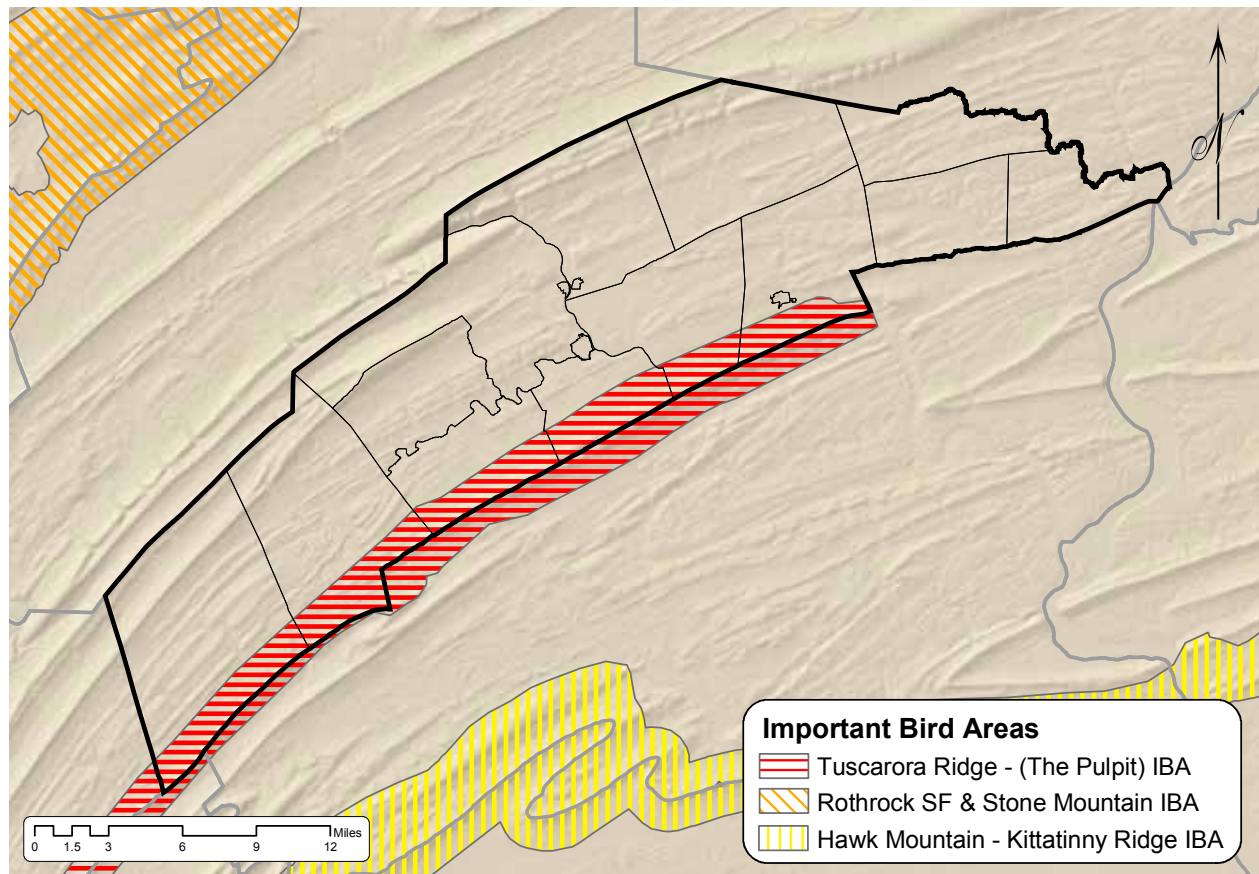
Magnolia warbler (*Dendroica magnolia*)

photo source: Ron Austing



Broad-winged Hawk (*Buteo platypterus*)
photo source: Ron Austing

Figure 5:
Important Bird Areas in and around Juniata County



REPTILES AND AMPHIBIANS OF JUNIATA COUNTY

Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptile and amphibian species. The State'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 herpetile 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.



Young Snapping Turtle (*Chelydra serpentina*)

photo source: PNHP

Juniata 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* and *R. clamitans*), and the Painted and Snapping Turtles (*Chrysemys picta* and *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 species, Juniata County includes several less common species of reptiles and amphibians. 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 conversion and

development. However, a number of large forested tracts remain in Juniata 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.

The 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 Juniata County's forests.



Pickerel Frog (*Rana palustris*)

photo source: PNHP

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

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 in length, this bizarre-looking 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 non-native crayfish. Additionally, amphibians as a whole are particularly sensitive to toxins. Consequently, acid mine drainage is detrimental to the salamanders that inhabit affected streams. While there have been no directed Hellbender surveys in Juniata County in recent years, reports of their continued presence in the Juniata drainage are few.



**Jefferson Salamander (*Ambystoma jeffersonianum*)
migrating over snow to a vernal pool**

photo source: Charlie Eichelberger

Portions of the county support complexes of ephemeral/fluctuating natural pools, more commonly known as vernal pools (App. XI, pg. 186). These wetlands are critical to a group of amphibians that rely on the annual drying of the pools 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 to exist in Juniata 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.

The Four-toed Salamander (*Hemidactylium scutatum*) is not a vernal pool obligate but is often found in association with these habitats. This diminutive



Hellbender (*Cryptobranchus alleganiensis*)

photo source: Tim Maret

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 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 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, particularly, illegal collection.



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

photo source: Charlie Eichelberger



Eastern Box Turtle (*Terrapene carolina*)

photo source: Charlie Eichelberger

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 America's most common frog species, 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 resident of the Juniata River. In Pennsylvania, this species is restricted to 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 enlarged populations 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 or no successful reproduction occurring.

The Northern Fence Lizard (*Sceloporus undulatus*), and the Five-lined Skink (*Eumeces fasciatus*) are the only lizard species present in Juniata 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 triangulum*) 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 Juniata 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, toad-eating 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: Andrew Strassman (PNHP)



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

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 drastically over-exaggerated. In fact, there has never been a human fatality in Pennsylvania from a Rattlesnake or Copperhead bite. The forested ridges of Juniata 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 meters 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.

Timber Rattlesnakes are still considered a game species by the Pennsylvania Fish and Boat Commission and can be collected with an appropriate PAFBC permit. Despite the allowance of rattlesnake hunting, the Timber Rattlesnake is considered a species of special concern because it is declining due to human persecution. The Pennsylvania Natural Heritage Program, along with the majority of the scientific community, believes 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 Juniata County provide a tempting location for housing development; however, housing locations at these sites are not recommended for many reasons, one being the risk of human-snake encounters.

Juniata 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



Northern Water Snake (*Nerodia sipedon*)

photo source: Andrew Strassman (PNHP)

region's forests and wetlands, including the communities of seasonal pools. The rich and diverse herpetofauna of Juniata County is unique to Pennsylvania and should be considered in the long-term plan of the region.

This text has been created by examining 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 for. Therefore, there could be other herptile species that occur in the county that have not yet been recorded.



Slimy Salamander (*Plethodon glutinosus*)

photo source: PNHP

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 with 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://webpace.ship.edu/tjmare/herp.htm>



Wood Frog (*Rana sylvatica*)

photo source: PNHP

INSECTS OF JUNIATA COUNTY

Butterflies and Moths

Butterflies and moths are grouped together in the scientific order called Lepidoptera. Lepidoptera comes from the Greek words ‘lepid,’ 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. Finally, lepidoptera are a group of insects that undergo complete metamorphosis in a life cycle that includes eggs, caterpillars, pupae, and adults.

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 (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, 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.



Zabulon Skipper (*Poanes zabulon*)

photo source: PNHP



Puddling blues, swallowtails, and red-spotted purples

photo source: PNHP

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 45-degree angles (the skippers). Moths are mostly active at night and butterflies fly during the day, but there are also many day-flying moths. Butterfly pupae have a smooth exterior called a chrysalis, while moth pupae form a cocoon, which is typically wrapped in silky fibers.

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* sp.) 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.

Species Diversity in Pennsylvania

In North America north of the Mexican border, there are an estimated 13,000 butterfly and moth species (Wagner, 2005). Pennsylvania's varied habitats



Clouded Sulphur (*Colias philodice*)

photo source: Andrew Strassman (PNHP)

support a large range of butterflies. Altogether, the state has about 156 species of butterflies and the closely related skippers, and probably a minimum of 1,200 species of moths (Wright, 2007; PNHP, 2006). However, no state agency is directly responsible for managing Lepidoptera, and scientists suspect the population trends for many species are decreasing. For a list of butterfly species known to occur in Juniata County see Appendix VI (pg 179) and for a list of moth species known to occur in Juniata see Appendix VII (pg 180).

Dragonflies and Damselflies

Damselflies and dragonflies are grouped together in the scientific order called 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 Habitat

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, seasonal 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 (Westfall and May 1996) over a period of a few months for some species and up to several years for others. 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 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.



Ebony Jewelwing (*Calopteryx maculata*)

photo source: Andrew Strassman (PNHP)



Damselflies ovipositioning on a leaf

photo source; PNHP

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 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, 121 species of dragonflies and 55 species of damselflies are currently known (PNHP, 2006). For a list of odonate species known to occur in Juniata County see Appendix IIX (pg. 182).

Conservation Recommendations for Insects

The specific habitat requirements of many 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.

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 food plants. 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



Meadowhawk (*Sympetrum sp.*)

photo source: Andrew Strassman (PNHP)



Exemplary dragonfly and damselfly habitat

photo source: PNHP

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 prey items 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 the food plants. 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.



Exemplary butterfly and moth habitat

photo source: PNHP



Red-footed Cannibalfly (*Promachus rufipes*)



Dogbane Beetle (*Chrysochus auratus*)



Pleasing Fungus Beetle (*Megalodacne heros*)

Additional Invertebrates of Juniata County

photo source: Andrew Strassman (PNHP)



white-lip globe snail (*Mesodon thyroideus*)



Cow Path Tiger Beetle (*Cicindela purpurea*)



Fly (Family Drosophilidae)



Shamrock Spider (*Araneus trifolium*)



Flower Spider (*Misumena* sp.)



Millipede (*Apheloria virginensis corrugata*)



Orb-weaver Spider (*Araneus* sp.)



Nursery Web Spider (*Pisaurina mira*)

AQUATIC COMMUNITY CLASSIFICATION FOR JUNIATA COUNTY

A statewide project of the PNHP, 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 (Table 9, pg. 48). 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 addressed herein. Aquatic community types such as lakes, wetlands, and ponds, which are closed systems, have not been assessed to date.

Aquatic communities are identified within watersheds. 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, but all land is part of a watershed. Every stream, tributary, and river has an associated watershed, with small watersheds merging to become larger watersheds. In this report, relatively small watersheds (hydrologic unit code 12 or HUC12) are described by their community types. For example, the Mid-Atlantic Region is a HUC1 covering many states, while a small

unnamed headwater would be a HUC14 or higher. For more information on the HUC system see: <http://water.usgs.gov/GIS/huc.html>.

What do fish, macroinvertebrates, and mussels tell me about my 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 leeches, 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. Additionally, these organisms are the major recyclers within any aquatic system.

Fish then 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 the entire watershed environment. For example, fine sediment from unnatural land erosion may enter a stream and cover gravel and cobble habitats where fish lay their eggs. Developing eggs and fry will be smothered by such an event.

As filter-feeders, mussels also require relatively clean water to thrive. These organisms collect food by filtering large volumes of water through their gills. Thus, they are particularly sensitive to even small amounts of industrial discharge, 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 arising on ridges provide a different environment than slow, warm rivers meandering through valleys, and aquatic communities reflect their environment. Geology also varies across Pennsylvania and the chemical composition of flowing water is effected by the rock that it contacts.

Any alteration to the landscape causes variation within the connected aquatic environments. If implemented improperly, timber harvest, agriculture, urban

development, and roads may cause decreases in water quality and stream habitats from both direct and non-point source pollution. Additional point sources include pollutants from sewage treatment plant discharges, mines drainage, and industrial and agricultural sources.

How are communities described?

Communities of fish and macroinvertebrates are given descriptive names and mussel communities are named by the commonly occurring mussels 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.

Species of concern (considered state or globally rare) that may occur within each community type are listed with state and global rank. Definitions of these ranks are available in Appendix III (pg. 174). Environmental and water quality habitats typically associated with the community type are also described.

Each community type occurring in Juniata County has a one-page description. These descriptions include:

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. Size of the stream and watershed, gradient (slope), and elevation are a few habitat characteristics that may be important to the community type. Local conditions are also mentioned. Some water chemistry variables are also valuable in understanding the conditions of the community, including:

- pH – A measure of the concentration of hydrogen ions in a solution with lower numbers indicating more hydrogen ion. A pH >7.4 is basic, a pH <5.5 is acidic, and a pH between 5.5 and 7.4 is circumneutral.
- Water temperature - Important to stream organisms because it influences their metabolism and growth. Each aquatic animal species has a tolerance for a specific temperature ranges and cannot survive outside it.



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

photo source: PNHP

- Conductivity – Defined as the ability of water to conduct an electrical current. It is expressed in micro Siemens (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 by pollution or natural causes. Note that distilled water has no conductivity.
- Alkalinity - This is a measure of how well a water body is buffered against decreases in pH. If a stream has high alkalinity it can neutralize acids with little change in pH. A low alkalinity stream is less resistant to decreases in pH, which may be naturally occurring or may arise from acid precipitation or human other causes.

2) Stream quality rating - Community locations are generally ranked as low, medium, or high quality based on habitat, water chemistry, and sensitivity of organisms to pollution. The more susceptible a community is to human modification, the higher its quality.

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 – Created for the county natural resource managers and land planners to consider in protection and management of the watersheds and communities.

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 (Fig. 6 & Table 8, pg. 46).

Table 8:
Pennsylvania aquatic life uses and 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 Stocking, MF= Migratory Fishes)

Increasing watershed area ↓	Aquatic Community Classification-Fish	EV	HQ	CWF	WWF	TSF	MF
	Coldwater	X	X	X			
	Warmwater 1, Warmwater 2			X	X	X	X
	River & Impoundment				X		X

Figure 6:
DEP river classifications for Juniata County

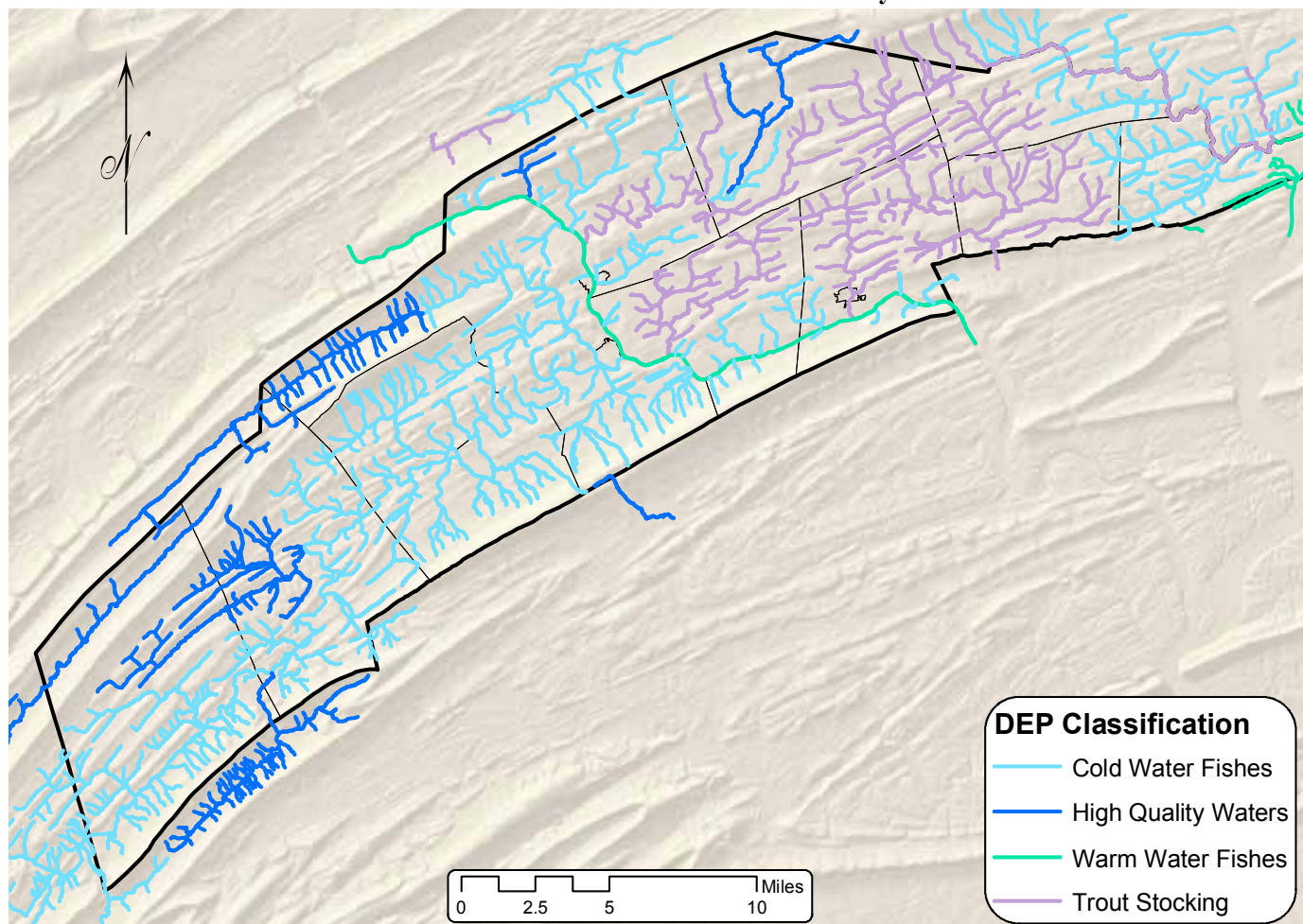


Figure 7:
Subwatersheds of Juniata County

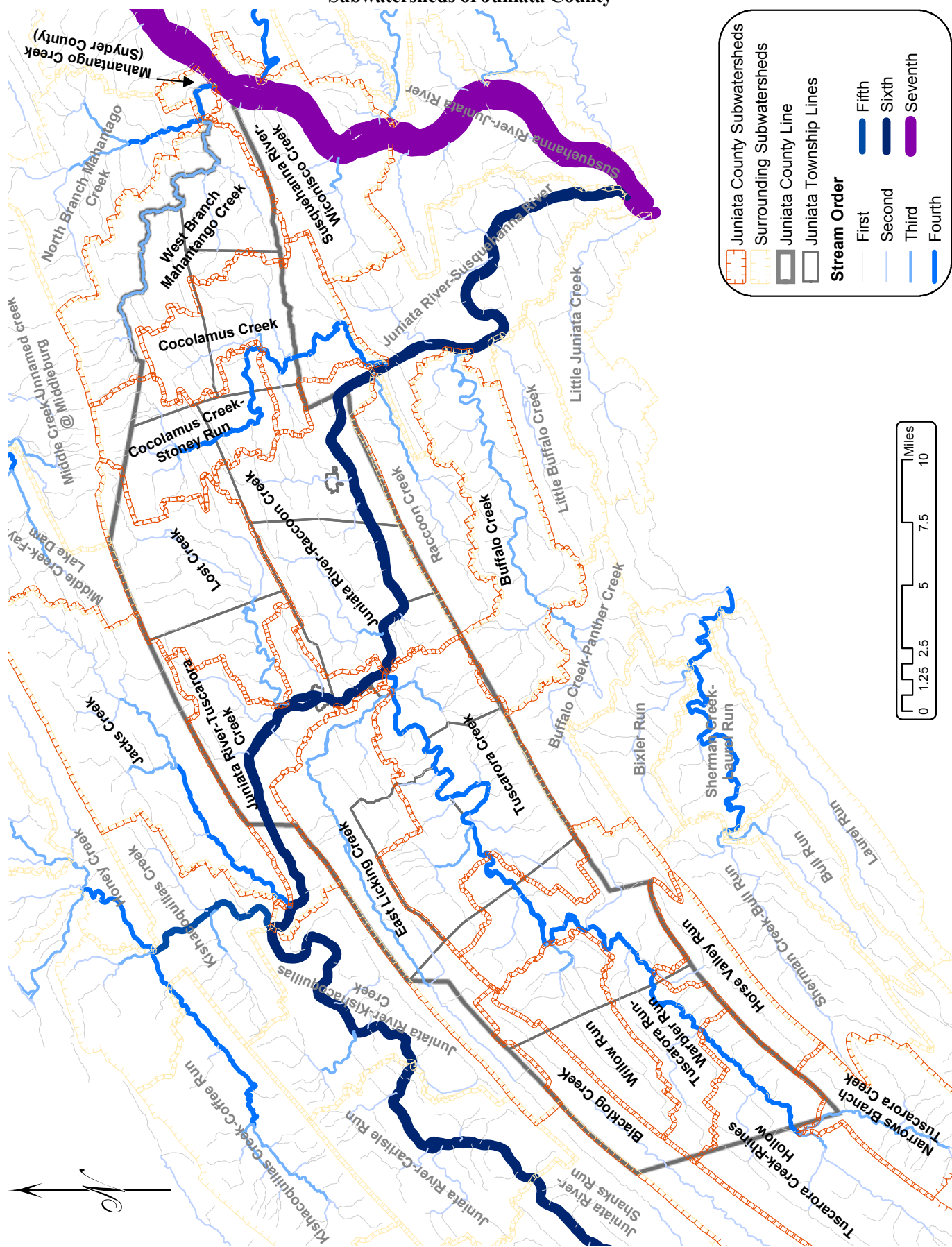


Table 9:
Watersheds in Juniata County and fish, macroinvertebrate, and mussel community types.

Watershed Name[†]	*Stocked Fish Present?	Atlantic Basin Fish Community¹	Macroinvertebrate Community²	Susquehanna Basin Mussel Community
Blacklog Creek	Y	Warmwater Community 1 (pg. 50)	High Quality Small Stream Community (pg. 53)	not yet assessed**
Cocolamus Creek	Y	not yet assessed	not yet assessed	not yet assessed
Cocolamus Creek-Stoney Run	Y	River and Impoundment Community (pg 52)	Low Gradient Valley Stream Community (pg. 55)	not yet assessed
East Licking Creek	Y	River and Impoundment Community	High Quality Small Stream Community	Eastern Elliptio Community (pg. 56)
Horse Valley Run	Y	Coldwater Community (pg. 49)	not yet assessed	not yet assessed
Jacks Creek	Y	Warmwater Community 1	Low Gradient Valley Stream Community	not yet assessed
Juniata River-Raccoon Creek	Y	River and Impoundment Community	not yet assessed	not yet assessed
Juniata River-Tuscarora Creek	Y	River and Impoundment Community	High Quality Small Stream Community	Yellow Lampmussel Community (pg. 57)
Lost Creek	Y	Warmwater Community 1	not yet assessed	not yet assessed
Mahantango Creek (Snyder County)	N	Warmwater Community 2 (pg. 51)	not yet assessed	not yet assessed
Narrows Branch Tuscarora Creek	Y	Warmwater Community 1	High Quality Small Stream Community	not yet assessed
Susquehanna River-Wiconisco Creek	Y	not yet assessed	not yet assessed	not yet assessed
Tuscarora Creek	Y	Warmwater Community 2	High Quality Small Stream Community	not yet assessed
Tuscarora Creek-Rhines Hollow	Y	Warmwater Community 1	High Quality Mid-Sized Stream Community (pg. 54)	not yet assessed
Tuscarora Run-Warble Run	Y	Warmwater Community 2	High Quality Small Stream Community	not yet assessed
West Branch Mahantango Creek	Y	Warmwater Community 1	not yet assessed	not yet assessed
Willow Run	N	Warmwater Community 1	not yet assessed	not yet assessed

[†]Pennsylvania Watershed Boundary Dataset DRAFT, USDA, Natural Resources Conservation Service: Watershed (10-digit hydrologic unit area) and Subwatershed (12-digit hydrologic unit area) delineation based on *Federal Standard for Delineation of Hydrologic Unit Boundaries*, October 2004 publication. For more information, go to <http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/>

*Surveys by the Pennsylvania Fish and Boat Commission found one or more fish (trout or warm-water game fish) 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.

**A lack of assessment may be caused by either a lack of data or existing data that has not yet been incorporated.

¹ Fish community types were developed for all the Pennsylvania basins flowing to the Atlantic Ocean, including the Susquehanna, Potomac, and Delaware watersheds (Walsh et al., 2007).

² Macroinvertebrate community types were described in the Susquehanna and Potomac basins (Walsh et al., 2007).

AQUATIC COMMUNITY FACT SHEET: FISH

Coldwater Community

typified by: Brook Trout (*Salvelinus fontinalis*), *Brown Trout (*Salmo trutta*), *Rainbow Trout (*Oncorhynchus mykiss*)

* = non-native species

Community Description and Habitat: This headwater stream community occurs in small, swift streams running off ridges. 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.

mean watershed area 17.6 mi²
mean elevation 383 m
mean gradient 2.5%



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 systems often flow from sandstone or shale ridges and have a unique water chemistry signature with few dissolved cations and low buffering capacity. The large amounts of forest cover, little agriculture, and little open water in the upstream watershed, local riparian zone and local upstream watershed were the most important factors in shaping the habitat of the Coldwater Community

The community is known to occur in the headwaters of many streams in Juniata County.

mean alkalinity 27 mg/l
mean conductivity 140 µS/cm
mean pH 6.7

Willow Run and Lost Creek are examples of community habitat; small tributaries to Tuscarora Creek, like Horse Valley Run, and the headwaters of E Licking Creek are also community habitat.

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. Some headwater streams, like Little Valley Creek, are impaired by acid deposition and low pH (DEP 2006).

Conservation Recommendations: 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 these 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: Andrew Strassman (PNHP)

Warmwater Community 1

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

Community Description and Habitat: This community usually occurs in small to medium size streams and small rivers at moderate to high elevation and with low gradient streams.

Streams have moderate alkalinity and conductivity relative to other groups, and nearly neutral pH values. Warm water temperatures are also characteristic of this community group. Thermal tolerances of fish in the community group are higher than fish from other communities. Habitat preferences of indicator taxa suggest this

mean watershed area 128 mi²
mean elevation 255 m
mean gradient <1%

mean alkalinity 50 mg/l
mean conductivity 175 µS/cm
mean pH 7.2



Medium-sized streams without many groundwater inputs, such as Lost Creek, are typical of 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



Northern Hogsucker

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

community occurs in warm-water streams with moderate to high gradients and currents with little silt.

The community occurs in sections of Little Lost Creek, Lost Creek, West Branch Mahantango Creek, Blacklog Creek, and Tuscarora Creek. Waters that flow from small headwaters warm when they reach the valley, supporting a community that is not principally defined by the presence of coldwater species. However, stocked or naturalized brown trout may also occur in some community locations. The community habitat in some sections may be classified as Trout Stocked Fishery or Cold Water Fishery by PA DEP.

Stream Quality Rating: medium

Threats and Disturbances: Water quality and habitat are influenced by non-point source pollution. 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. Some community streams and their tributaries were designated as impaired by PA DEP (2006) (e.g., Little Lost Creek, Lost Creek, and West Branch of Mahantango Creek) because of excess nutrients and silt related to agriculture. Some tributaries to Tuscarora Creek are impaired for the same reasons.

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.

Since warmwater streams mainly occur in valleys dominated by human modified landscapes, they are often subject to pollution from agriculture and urban runoff. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Warmwater Community 2

typified by: Sunfish (*Lepomis spp.*), Rock Bass (*Ambloplites rupestris*), Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), Common Shiner (*Luxilus cornutus*), Satinfish Shiner (*Cyprinella analostana*), Spotfin Shiner (*Cyprinella spiloptera*), Spottail Shiner (*Notropis hudsonius*), Swallowtail Shiner (*Notropis procne*), Shield Darter (*Percina peltata*), Tessellated Darter (*Etheostoma olmstedii*), American Eel (*Anguilla rostrata*), Bluntnose Minnow (*Pimephales notatus*), Common Carp (*Cyprinus carpio*)

Community Description and Habitat: The Atlantic Warmwater Community 2 is found in many larger waterways. The typical 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.

The community fish prefer pools in warm streams.

Some indicator fish are

tolerant of low dissolved oxygen and turbid waters.

Many community fish are habitat generalists including game fish, like Smallmouth Bass and Bluegill, which

mean watershed area 626 mi²
mean elevation 96 m
mean gradient 1.1%

mean alkalinity 47 mg/l
mean conductivity 237 uS/cm



This community occurs in large streams and rivers, such as Tuscarora Creek, with warmwaters, because of variety of habitats supports a diverse fish community.

photo source: Andrew Strassman (PNHP)



Redbreast Sunfish

photo source: <http://www.ohiodnr.com/dnap>

were likely stocked in many locations and have since become naturalized.

In Juniata County, the larger valley creeks flowing to the Juniata River were classified as the Warmwater 2 Community. The lower sections of E Licking Creek and Tuscarora Creek are some examples of community habitat.

Fish communities are influenced by assemblages in the nearby Juniata River and support a variety of warm water fish species. Both streams are 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.

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 E Licking Creek and Tuscarora Creek are designated as impaired by PA DEP (2006) because of excess sediment and nutrients from agricultural sources.

Because developments and roads occur near valley streams, poor urban land management and associated stream discharges are particularly detrimental to this community group. Some larger streams are degraded from residential and municipal discharges. Urban runoff and sewer discharge contain silt, nutrients, and other pollutants that damage stream conditions.

Many fish in the community were not originally present in the Susquehanna River watershed that covers the eastern and central regions of Pennsylvania. For instance, rock bass and smallmouth bass were introduced into the Susquehanna River basin and are widely stocked.

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 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.

River and Impoundment Community

typified by: Walleye (*Sander vitreus*), Yellow Perch (*Perca flavescens*), Black Crappie (*Pomoxis nigromaculatus*), Goldfish (*Carassius auratus*)

Community Description and Habitat: The River and Impoundment Community habitat is 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. Landscape associates of large streams and rivers were

mean watershed area 325 mi²
mean elevation 203 m
mean gradient <0.5%

Some examples of community habitat are the Juniata River and parts of Cocolamus Creek. The presence of game fish in larger streams and rivers, where there is diverse flowing water habitat, is indicative of this community type. 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.

mean water temperature 18.6°C
mean alkalinity 60 mg/l
mean conductivity 256 µS/cm
mean pH 7.4



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 Juniata, 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 the Juniata River and to Cocolamus Creek are impaired for agricultural contributions of sediments and nutrients (PA DEP 2006). Crop and animal 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. A concern for the Juniata River may be runoff from Route 322, where the roadway is near the river.

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



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

Photo source: PNHP

and impoundment community are many, solutions to pollution problems are possible by minimizing point source pollution and managing water quality in the smaller tributaries. Reducing pollution impacts from storm sewers, sewage treatment plants, and any industrial point sources could improve some water quality and in-stream habitat. 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 COMMUNITY FACT SHEET: MACROINVERTEBRATES

High Quality Small Stream Community

typified by: Brushlegged mayfly (Isonychiidae), fingernet caddisfly (Philopotamidae), dobsonfly (Corydalidae), saddlecase maker (Glossosomatidae), watersnipe fly (Athericidae), common burrower (Ephemeraidae), 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. Urban land cover in the watershed is relatively low, but moderate amounts of agricultural land cover may have some adverse influence on water quality.

mean watershed area 67 mi²
mean elevation 251 m
mean gradient 1.4%

The High Quality Small Stream Community is typically found in streams with sandy bottoms mixed with larger cobble and boulders. This community type is indicative of high quality streams. The organisms associated with this community are generally pollution intolerant.

mean alkalinity 53 mg/l
mean conductivity 203 µS/cm
mean pH neutral



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

photo source: Andrew Strassman (PNHP)

Water chemistry values of the streams that support this community type are usually typified by moderate alkalinity, moderate conductivity, and a neutral pH.

In Juniata County, the community was found in high quality sections of Blacklog Creek, E Licking Creek, Markee Creek, the mid-reaches of Tuscarora Creek, and smaller tributaries to Tuscarora Creek and to the Juniata River.



Brushlegged Mayfly

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

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

High quality habitats and water quality are suggested for the streams that this community occupies. Although the community habitat may have fewer impairments than that associated with other assemblages in Juniata 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. Some tributaries to Tuscarora Creek are impaired because of excess sediment and nutrients, contributed from agricultural sources (PA DEP 2006).

Conservation Recommendations: While some non-point source pollution occurs in watersheds supporting this 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 rehabilitating riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. We also recommend practices for soil conservation and low impact crop agriculture to protect County streams.

High Quality Mid-Sized Stream Community

typified by: Green stonefly (Chloroperlidae), giant black stonefly (Pteronarcyidae), spiny crawler (Ephemerellidae), flat-headed mayfly (Heptageniidae), free-living caddisfly (Rhyacophilidae), light brown stonefly (Perlodidae), prong gill mayfly (Leptophlebiidae), common stoneflies (Perlidae), crane fly (Tipulidae), roachlike stoneflies (Peltoperlidae), clubtail dragonfly (Gomphidae), northern case maker (Limnephilidae), Uenoid caddisfly (Uenoidae), Odonocerid caddisflies (Odontoceridae)



Mid-sized, high gradient streams with high quality water and habitats are typical of this community.

Photo source: PNHP

Community Description and Habitat: The High Quality Mid-Sized Stream Community is found in medium-sized streams in relatively high elevations. Streams are generally high gradient systems with good habitat quality.

Streams where this community is found generally have low alkalinity and conductivity. The watersheds are relatively undisturbed by humans. In Juniata County watersheds, the community was found in the streams with much natural land cover in the watershed, like Horse Valley Run, Burns Creek, and the upper section of Tuscarora Creek.

Community taxa are a combination of stoneflies, mayflies, caddisflies, and other organisms that are pollution sensitive.

mean watershed area 94.6 mi²
mean elevation 371 m
mean gradient 2.8%

mean alkalinity 27 mg/l
mean conductivity 178 µS/cm

Stream Quality Rating: high



Giant Black Stonefly

Photo source: www.dec.state.ny.us

Threats and Disturbances: Streams in this community type generally have few direct threats, compared to the habitats of other communities. Since high elevation streams tend to be on steep slopes, not generally conducive to human development, the typical urban and agricultural pollution problems are not as common in this community type as they are in streams indicated by other communities. Because of the large amounts of agricultural lands in Juniata County, excess contributions of nutrients and sediments to community habitats may still be a concern. Some community habitats, like transitions between high gradient headwaters and lower sloped valley streams, may be susceptible to non-point source pollution.

Conservation Recommendations:

Protecting high quality mid-sized streams should be a priority for watershed managers. The long-term health of stream communities is linked to the maintenance of high quality water conditions and habitat. Ensuring that agricultural operations implement measures to protect streams, like stream bank fencing, riparian buffers, rotational grazing, and soil conservation, will maintain this community.



Northern Case Maker case

photo source: http://bio-ditr1.sunsite.ualberta.ca/detail/?P_MNO=3857

Low Gradient Valley Stream Community

typified by: Riffle beetle (Elmidae), waterpenny beetle (Psephenidae) net-spinning caddisfly (Hydropsychidae), Asian Clam (*Corbicula fluminea*), narrow-winged damselfly (Coenagrionidae), rusty dun mayfly (Caenidae), fingernail clam (Sphaeriidae), freshwater limpet (Ancylidae), broad-winged 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.

mean watershed area 75.3 mi²
mean elevation 201 m
mean gradient 1.0%

mean alkalinity 76 mg/l
mean conductivity 318 µS/cm

In Juniata County, valley streams in the Cocolamus Creek watershed and Markee Creek characterized this community's habitat.



Riffle Beetle

photo source: www.epa.gov

Stream Quality Rating: intermediate

Threats and Disturbances: 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 moderately degraded from excess nutrients, habitat modification, and

siltation due to improper agricultural practices.

Community habitat in Markee Creek is impaired because of excess siltation and nutrients from agriculture (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.

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



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

photo source: PNHP

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 up-to-date would also improve stream habitats that support aquatic communities.

AQUATIC COMMUNITY FACT SHEET: 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 (S1 G5), Yellow Lampmussel (S3S4 G3G4), and Eastern Lampmussel (S1 G5).

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 Juniata County, the community was found in the lower reaches of E Licking 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 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.

Conservation Recommendations:

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



Eastern Elliptio (*Elliptio complanata*)

photo source: PNHP

quality will mean that communities will endure and potentially be reintroduced where they have been lost.

Zebra Mussels have been reported in the most of major drainage basins in Pennsylvania: Delaware River, Susquehanna River, Genesee River, and Ohio River and Lake Erie basins. 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 Juniata County. Stream bank fencing, riparian restoration, rotational grazing, and soil conservation are some recommendations for improving streams and maintaining habitat to support mussel communities in agricultural watersheds.



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

photo source: PNHP

Yellow Lampmussel Community

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

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

Community Description and Habitat: This community type occurs in large river systems in the Susquehanna and Potomac drainages at low elevations. Average stream gradient is very low. The community is found in the Juniata River in Juniata County.

Habitat information is currently limited for the Yellow Lampmussel community. Little is known about the

community's water chemistry profile. 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).

As is typical of larger river, watersheds have many roads and point sources. Typical watershed land cover for the community has moderate proportions of forest, and relatively high proportions of urban and agricultural land cover. Sandstone and shale formations usually dominate the watershed bedrock where this community occurs.

Stream Quality Rating: medium

mean watershed area 167 mi²
mean elevation 198 m
mean gradient 0.05%

water chemistry unstudied

mean shale bedrock 52%
mean sandstone bedrock 47%



Yellow Lampmussel (*Lampsilis cariosa*)

photo source: PNHP



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

photo source: Andrew Strassman (PNHP)

Threats and Disturbances: Watershed disturbances including improperly managed agriculture and impervious surface runoff are detrimental to the Yellow Lampmussel community. Non-point source pollution from agriculture impairs some tributaries to the Juniata River (DEP 2006). Habitat alteration from stream bank vegetation removal and sedimentation and any water quality impairments may reduce the range and health of the Yellow Lampmussel community. Poor water quality may occur when runoff from roads and other impervious surfaces reaches the Juniata River. The resulting contaminants and altered flow may degrade the river conditions. Runoff from Route 322 may be a concern for the Juniata River.

Conservation Recommendations: Large river habitat conservation is a daunting task. 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 may allow declining mussel species to rebound. In the Juniata River watershed, addressing agricultural non-point source pollution through stream bank fencing, riparian restoration, rotational grazing, and soil conservation may improve mussel habitats and water quality. Mitigating storm water runoff, especially for future developments and road building, is also encouraged to protect and maintain mussel habitats in county waterways.

Threats and Conservation of Freshwater Mussels

Freshwater mussel populations are rapidly declining in North America. In the past 100 years, more than 10% of our continent's mussels have become *extinct*. Nearly 25% of US mussels have a Federal endangered or threatened status and 75% are listed as endangered, threatened, or species of special concern by individual states (Neddeau 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 size streams. Mussel richness generally increases with increasing watershed size (Strayer and Jirka 1997), so the largest rivers in Pennsylvania (Ohio, Allegheny, Susquehanna, and Delaware Rivers) generally have the richest mussel communities. Large streams and rivers of good quality without major habitat alterations are few and where they occur (such as the Juniata River) warrant special protection.

Water quality threats to mussels include compounds released from industrial and municipal point sources. 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). 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 comparatively undisturbed by agricultural pollution. However, excessive sedimentation and habitat alteration is detrimental to mussel communities. Runoff from urban and suburban developments appears to be more damaging to mussels, most likely due to the combined effects of altered hydrology, excess sediment and nutrients, and thermal pollution (Strayer and Jirka 1997).



Yellow Lampmussel

photo source: PNHP

Hydrologic alteration, disrupted connectivity, habitat alteration, changes in thermal properties, and disconnection from host fishes are ways in which dams negatively influence mussel communities. Host fishes are necessary for the dispersal of the larvae of these otherwise sedentary creatures, though this process is poorly understood. 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*) are likely damaging populations of native molluscs. Zebra Mussels damage native mussels by attaching to individuals in large numbers and eventually killing them (Strayer and Jirka 1997). Non-native mussels may alter food resources and compete for habitat (Hakenkamp et al. 2001) with endemic mussel populations.

Mussel habitat requirements are not well known. Protecting known mussel colonies is a first step to ensuring the long-term survival of mussel resource. Protection from major channel alteration by bridges, dams, and especially dredging is important for maintaining habitat. Preventing unnatural sediment and nutrient inflows, and toxin inputs in streams and rivers will maintain good water quality to support healthy mussel communities. Adopting and enforcing existing zoning, stormwater flow 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.

Many experts believe that effective aquatic conservation will only result from the protection of mussels in ecological and evolutionary contexts, which they equate with biological organization above the level of individual species (Angermeier and Schlosser 1995). Preserving at the biological community level is a proactive approach to biodiversity conservation because it protects whole assemblages of species before any single species declines into imperilment. All species are protected: the common, the rare, and those not yet known (Higgins et al. 1998). Pennsylvania is fortunate to harbor many inland freshwater mussel taxa that are globally rare. Thus, it is important to protect examples of each mussel community and protect watersheds that contain rich mussel populations to effectively protect the biodiversity of the state, and the nation.

METHODS

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

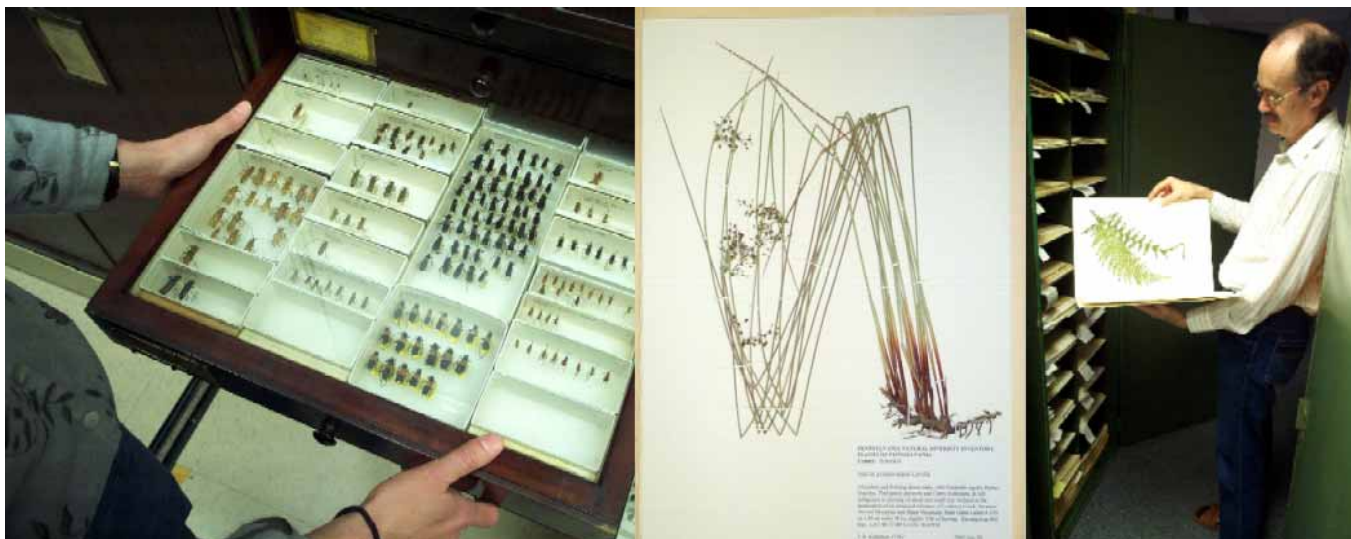
PNHP Data System

The Pennsylvania Natural Heritage Program (PNHP) was established in 1982 as a joint venture between the PA Department of Environmental Resources, 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), and the Pennsylvania Fish and Boat Commission (PFBC). The database maintained by the PNHP has become Pennsylvania's chief storehouse of information on outstanding natural habitat types (natural communities) and sensitive plant and animal species of special concern. Several other noteworthy natural features are also stored in the database, including the Department of Environmental Protection (DEP)-designated Exceptional Value Streams (Shertzer 1992) and outstanding geologic features (based on recommendations from Geyer and Bolles 1979 and 1987).

The database includes known existing and historic 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.

The database has recorded over 17,750 detailed occurrences of species and communities of special concern as of January 2007, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps and geographic information system (GIS) files. Additional data are stored in extensive manual and digital files set up for over 200 natural community types, 1,400 animals, and 3,500 plant species. These files are organized by each of Pennsylvania's 881 7½-minute USGS topographic quadrangle maps using GIS.

In order to conduct an inventory of significant flora, fauna, and natural communities in a county, scientists from the PNHP first consult the database of rare plants, animals and communities. They then used a systematic inventory approach to identify the areas of highest natural integrity in the county. The natural community and sensitive species data are the basis for judging the biological values of sites within the county. Protecting the sites with the best occurrences



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

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 is preserved with the county for the future.

Information Gathering

A list of natural features found in the county was prepared from the database and supplemented with information volunteered by local individuals and organizations familiar with Juniata County. In October of 2004 a public meeting was held and recommended Site Survey Forms (Appendix I, pg. 170) 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 sites were identified by audience members and scheduled for field surveys.

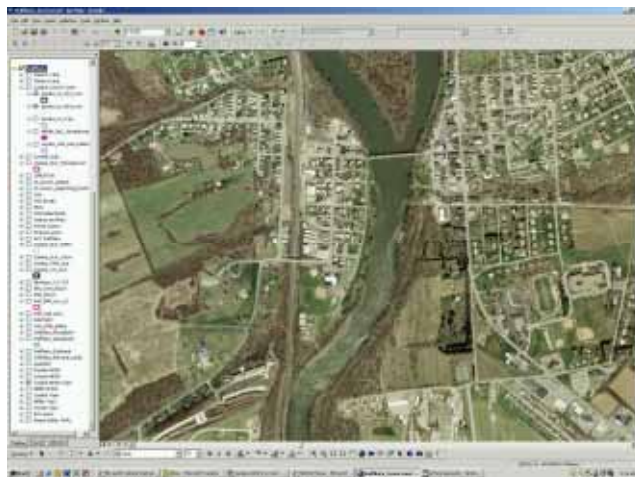
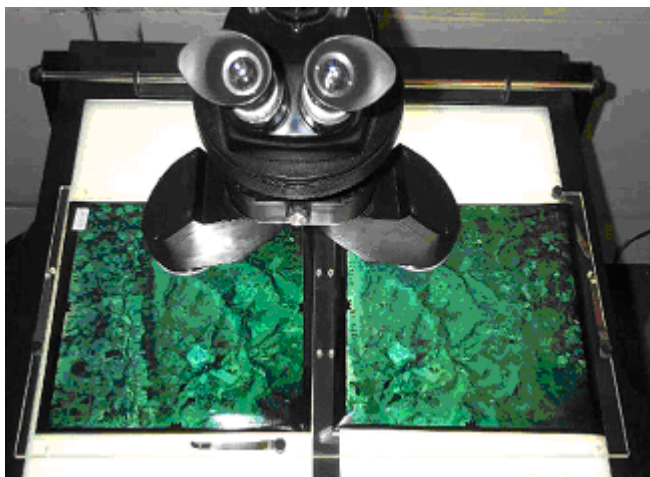
Map and Air Photo Interpretation

PNHP ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented (Appendix II, pg. 171). Additional data from vegetation maps, soil survey maps, field survey records, and other sources were consulted to gain familiarity with Juniata 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 and animal species. Baseline information on sites appearing to have good quality communities or potential for rare species was compiled to help prioritize fieldwork.

After an initial round of photo interpretation, field surveys were conducted to evaluate the potential natural areas. In March of 2005, two low altitude reconnaissance flights were flown over the county to provide a more accurate overview of the current condition and extent of known natural areas and to assess the potential of any additional 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 with poor quality sites led to the elimination of further fieldwork on other sites with similar signatures.



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 step for identifying areas that will be targeted for field surveys.

Field Work

Experienced PNHP biologists and contractors conducted numerous field surveys throughout Juniata County during 2004 and 2006. 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, the quality of each population or community was assessed, and locations were marked on USGS topographic quadrangle maps.

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 III, pg. 174). 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 IV (pg. 177). The element-ranking and element occurrence-ranking systems help PNHP personnel to simultaneously

gauge the singular importance of each occurrence of, for example, an ephemeral/fluctuating pool natural community or yellow-fringed orchid occurrence in Juniata 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 (S3 and C-rank or better), and for all plant and animal species of concern found, were combined with existing data and summarized on 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 GIS layer.

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; for mussels Strayer and Jirka (1997) was the primary source. A list of Plant and Animals of Special Concern currently known in Juniata County is provided in Appendix V (pg. 178).

Landscape Analysis

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 greatly increases the



Small Mammal Surveys



Invertebrate Surveys



Experienced PNHP staff conducts 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.

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 one from 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.

Forest Block Analysis

Forested areas in Juniata County were identified through 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 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 100-foot 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 were identified in Juniata County and grouped into four size classes: 0-250 acres (not shown); 250-1,000 acres (yellow); 1,000-5,000 acres (orange); and greater than 5,000 acres (green) (Fig. 8, pg. 66). The largest blocks were concentrated in the Tuscarora State Forest of along the Blue/Shade Mountain and Tuscarora Mountain. These are among the largest contiguous blocks within the state (Fig. 9, 67). A discussion of the importance of considering these large remaining forested areas in conservation follows.

Riparian Buffer Analysis

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. An undisturbed (no-cut) riparian buffer of 100 meters is recommended adjacent to all streams. The riparian buffers recommended in this report also include wetlands, artificially created farm ponds have been excluded from this riparian buffer.

The individual 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, though they may still occur through smaller disconnected forests.

Species Ranking

Each year biologists representing various taxonomic groups of the Pennsylvania Biological Survey meet to discuss and prioritize the most important species for the protection of biodiversity in Pennsylvania. There are various Biological Technical Committees for each of these groups: Bryophytes and Lichens, Vascular Plants, Fungi, Invertebrates (with subcommittees of aquatic, terrestrial, arachnid, and mollusc), Fishes, Herptiles, Birds, and Mammals. 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 Mapping and Ranking

Boundaries defining core habitat and supporting natural landscape for each site were delineated based upon PNHP conservation planning specifications for the elements of concern. These specifications are based on scientific literature and professional judgment for individual species or animal assemblages and may incorporate physical factors (e.g., slope, aspect, hydrology), ecological factors (e.g., species composition, disturbance regime), and input provided by jurisdictional government agencies. Boundaries tend to vary in size and extent depending on the physical characteristics of a given site and the ecological requirements of its unique natural elements. For instance, two wetlands of exactly the same size occurring in the same region may require very different buffers if one receives mostly ground water and the other mostly surface water, or if one supports migratory waterfowl and the other does not.

Sites were then assigned a significance rank to help prioritize future conservation efforts. The PNHP considers several criteria when ranking NHI 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 III, pg. 174), 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 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 Juniata 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: 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: 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: 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.

RESULTS

Priorities for Protection

Fifty-nine Natural Heritage Sites were identified in the Juniata County Natural Heritage Inventory. Detailed maps and description of each 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 2 (pg. xvi) has a summary of sites by significance category. Definitions of the significance categories are outlined in Methods (pg 64).
- Listed under each site name are any state-significant natural communities and species of special concern that have been documented within the area.
 - See Appendix II (pg. 171) 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 special concern” rather than by their species name, and no ranks are revealed.
 - The PNHP rarity ranks and current legal status are listed for each community and species (explained in Appendix III, pg. 174).
- The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for conservation.

Site Ranking

Table 2 presented in the Executive Summary section prioritizes sites with natural communities and species of concern documented in Juniata County. This table ranks sites from the most important and threatened to the least, with **Exceptional** representing the higher priority sites, **High** representing the medium priority sites, and **Notable** representing the lower priority sites for the conservation of biodiversity in the county. These sites are displayed in UPPER CASE letters throughout the report. Sites of **Local significance** are indicated in proper 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 are considered to be important at the county level. Examples would include relatively intact forested areas, caves, large wetlands, and other areas significant for maintaining local biodiversity.

Table 2 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.

Core and Supporting Habitats

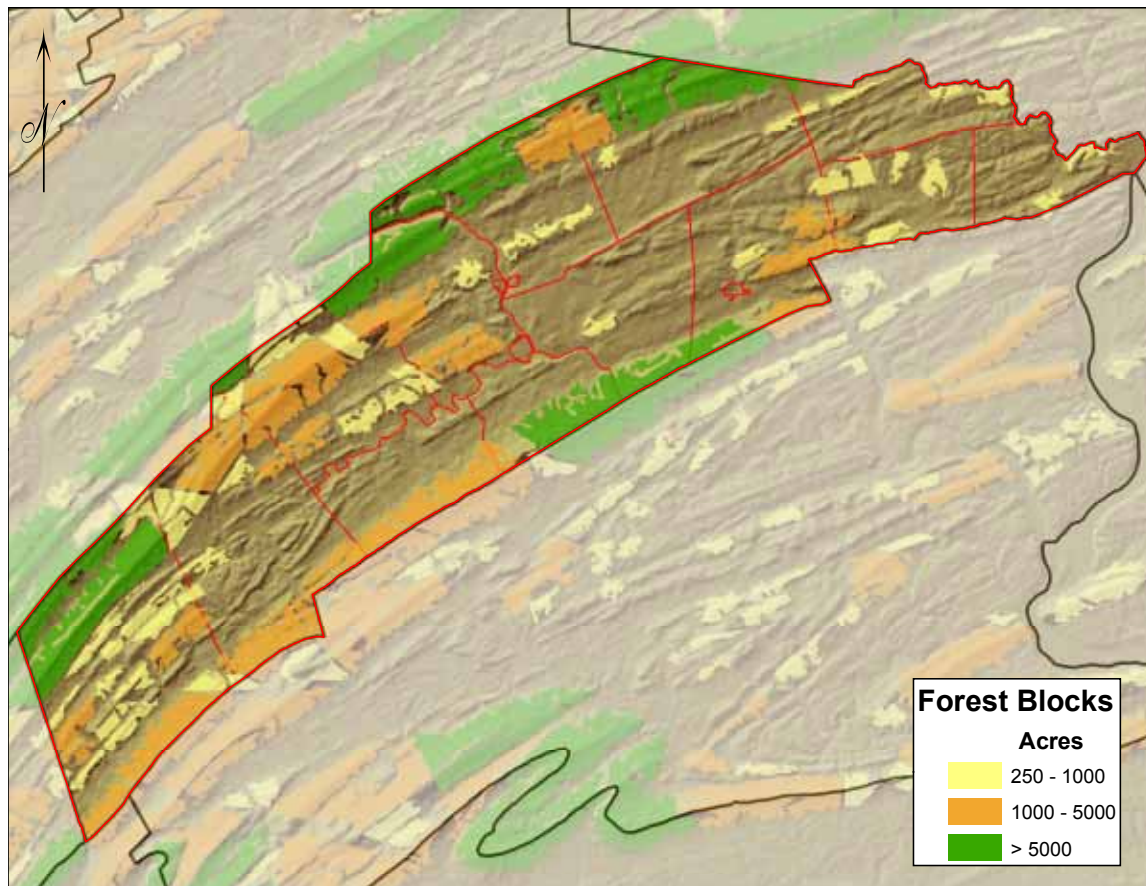
Each of the primary sites identified in this report has associated with it areas mapped as Core Habitat and Supporting Natural Landscape.

- **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.
- **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 species by species basis.

General Forest Block Recommendations

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. Figures 8 and 9 shows forested areas greater than 250 acres that remain after fragmentation by interstate,

Figure 8: Forested blocks greater than 250 acres in Juniata County



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.

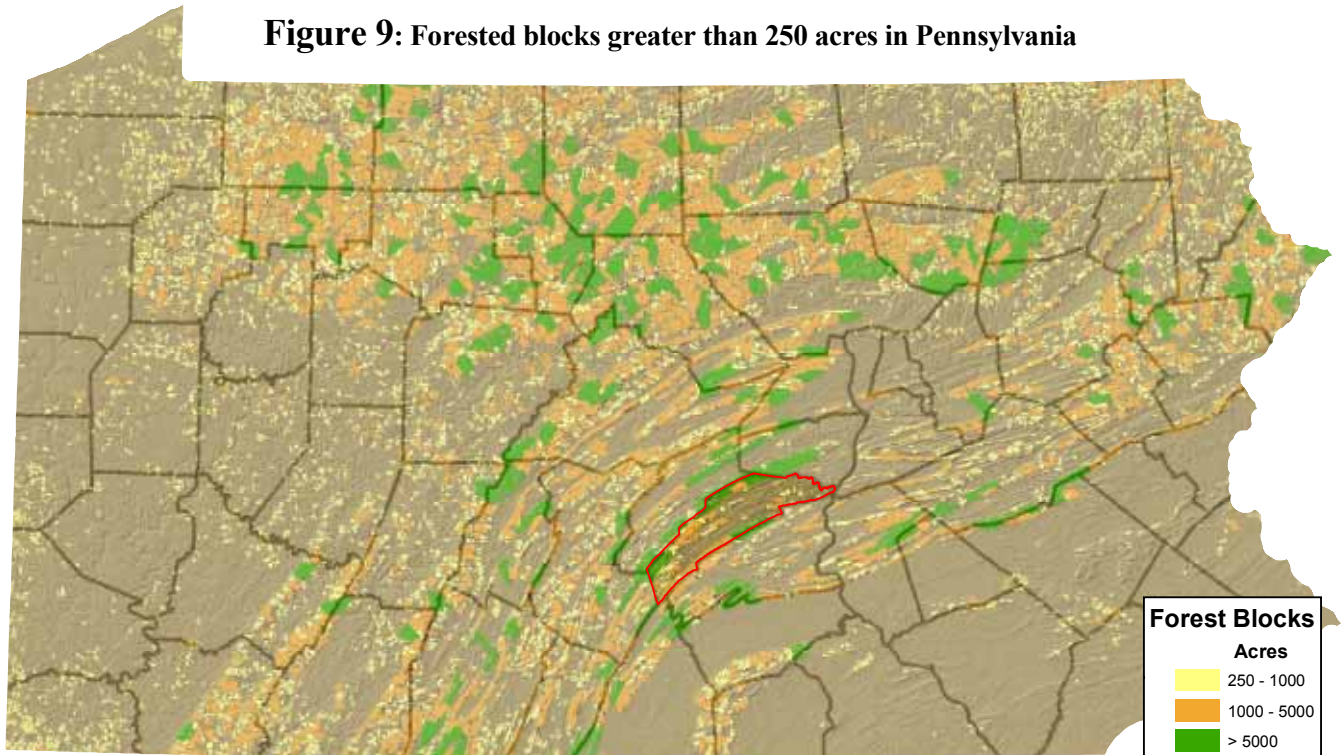
A number of studies have looked at the effects of roads and other linear features on the landscape. Ecological impacts of these fragmenting features include: (1) direct mortality of wildlife from vehicles; (2) disruption of wildlife dispersal; (3) habitat fragmentation and loss; (4) imposition of edge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

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

Figure 9: Forested blocks greater than 250 acres in Pennsylvania



body of fresh water twice as wide (Oxley 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 (*Seiurus 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

forest-interior 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 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



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

Photo source: PNHP

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.

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 significant 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.

A number of resources, listed in Appendix IX (pg. 183), 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 Deer Management Program.

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 (984 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.



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

Riparian buffer through mainly non-forested areas should be considered a priority for restoration (above, Tuscarora Creek floodplain)

General Riparian Buffer Recommendations

The literature varies with regard to buffer distances. From a strictly water quality standpoint, wetland buffers of 10-30 (35-100 feet) are thought to be sufficient for water quality maintenance (Wenger 1999). 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 15-30 meters (49-98 feet) were once thought to be sufficient to protect vernal pool amphibians. A series of papers from Conservation Biology (Semlitsch and Brodie 2003 - Buffer Zones for Wetlands and Riparian Habitats) conclude that buffers of this size are inadequate to protect terrestrial habitats for amphibians and reptiles. As the size of a buffer increases, the functions of that buffer for water

quality, flow, and wildlife habitat expand (Wenger 1999, Palone and Todd 1997). Many species of mammals and birds require much larger forested buffers to persist.

Based on studies of the values of variously-sized riparian buffers, PNHP recommends minimum buffers of 100 meters (328 feet) to maintain the water quality of the wetland as well as to support many of the species of wildlife found in these sites. 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, such as the Fisher and Northern Goshawk. It is our scientific judgment that a minimum buffer of 100 meters should be implemented and maintained around the wetland and riparian areas identified in the report to continue to support the species, both common and rare found at these locations.



TOWNSHIP DESCRIPTIONS

Beale Township

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³	
	Global	State				
NATURAL HERITAGE SITES:						
DOYLE RUN FLOODPLAIN			Exceptional Significance			
silver maple floodplain forest	C	GNR	S3	N	2006	E
yellow water-crowfoot (<i>Ranunculus flabellaris</i>)	P	G5	S2	PT	2006	E
TUSCARORA CREEK ABOVE ACADEMIA			High Significance			
Eastern Lampmussel (<i>Lampsilis radiata</i>)	U	G5	S1	CU	1993	E
WARBLER RUN MEADOWS			Notable Significance			
Species of Special Concern ⁴	-	-	-	-	2006	E
PUBLICLY MANAGED LANDS: Tuscarora State Forest						
OTHER CONSERVATION AREAS: Blacklog Mountain Important Mammal Area						
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: None						
AQUATIC COMMUNITIY CLASSIFICATION PROJECT RESULTS:						
- Fish	Warmwater Community 2		Tuscarora Creek; Tuscarora Run – Warbler Run			
	River and Impoundment Community		East Licking Creek			
- Macroinvertebrate	High Quality Small Stream Community		Tuscarora Creek; Tuscarora Run-Warble Run; East Licking Creek			
- Mussel	Eastern Elliptio Community		East Licking Creek			
	Not Yet Assessed		Tuscarora Creek; Tuscarora Run – Warbler Run			

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

Originally part of two other townships, Beale Township was founded in 1843. Lying between Shade Mountain and Tuscarora Creek, Beale is one of the County's smaller townships. In the northwest corner of the township a small piece of Tuscarora State Forest is present, which coincides with the Blacklog Mountain Important Mammal Area (IMA). This IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*). Tuscarora Creek, running along the south border, is the major water feature and drains the township. Because of the folding of the land in this area, the surface geology is very mixed. Land cover in the township is 32% agriculture and 64% forest. Large forest blocks are found along Shade Mountain and Herringbone Ridge; an effort should be made to preserve these large forest blocks. Major management concerns for the township should be creating a forested buffer along Tuscarora Creek and its



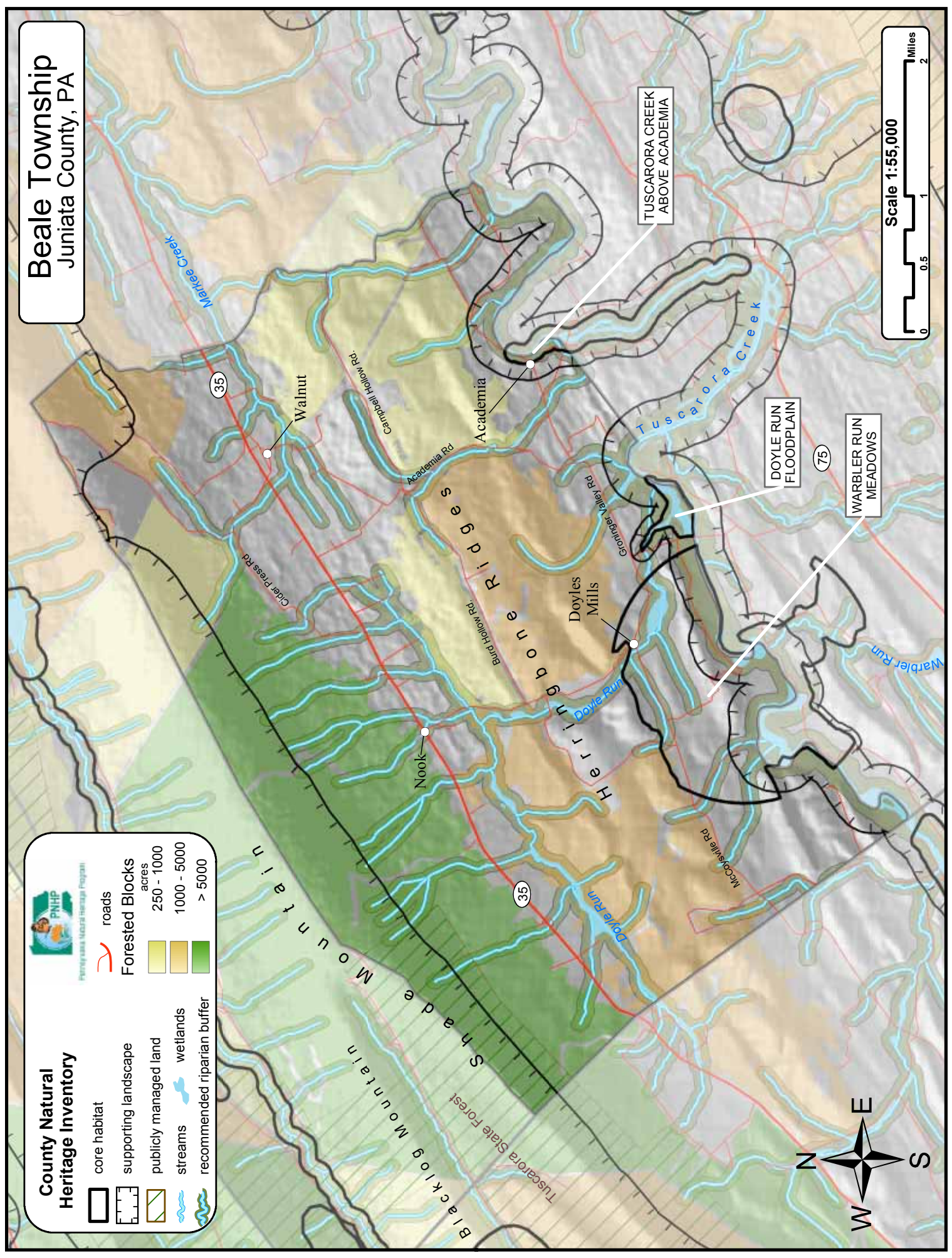
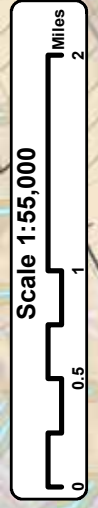
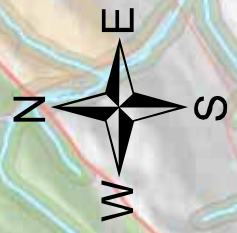
tributaries and maintaining large blocks of interior forest throughout the township. Restoration and conservation efforts should be focused on the Tuscarora Creek and its tributaries. Specifically, an effort should be made to increase forest buffers along Tuscarora Creek, reduce non-point source pollution into the creek (such as agricultural and road runoff), exclude livestock from tributaries, and prevent damming or diversion of the creek.

Beale Township Juniata County, PA



County Natural Heritage Inventory

- core habitat
- supporting landscape
- publicly managed land
- streams
- recommended riparian buffer
- roads
- Forested Blocks
acres
 - 250 - 1000
 - 1000 - 5000
 - > 5000
- wetlands



DOYLE RUN FLOODPLAIN (Beale Township)

At several points along Tuscarora Creek there are wonderful examples of the GNR S3 **silver maple floodplain forest**. One such location is where Doyle Run joins the Tuscarora below Doyles Mills. At this site the floodplain is relatively undisturbed and hosts a number of plant species uncommon at other locations (see plant list). The rarest at this location is the G5 S2 **yellow water-crowfoot** (*Ranunculus flabellaris*), a plant which is only found in calm backwater. Another area at this location contains extensive patches of the G4G5 S4 obovate beak-grass (*Diarrhena obovata*), a former species of concern in Pennsylvania. Additionally, the site contains many indicator species for a rich, calcareous, moist woodland: twinleaf (*Jeffersonia diphylla*), toadshade (*Trillium sessile*), blue cohosh (*Caulophyllum thalictroides*), mayapple (*Podophyllum peltatum*), and ramp (*Allium tricoccum*). Finally, many of these are considered disjunct populations, occurring well outside their expected range making them all the more ecologically important.



Yellow water-crowfoot (*Ranunculus flabellaris*)

photo source: Robert W. Freckmann Herbarium, UWSP
Joanne Kline

Threats and Disturbances:

This floodplain forest community is moderately disturbed by surrounding and upstream agricultural activity and a lack of an adequate forested buffer upstream of the site. Threats to this area include the conversion of forested buffers to agriculture and the conversion of any of the area to housing. Direct disturbances to the creek include several areas with no forested river buffer or very thin buffers. This

increases thermal pollution, agricultural inputs, and generally degrades river quality. Additionally, the bridge over the Tuscarora directly upstream of this location has caused significant changes in the river by constricting and channelizing flow. Threats to the creek include continued degradation of the forested river buffer throughout the river system.

Conservation Recommendations:

This site includes many interesting species well outside their expected range, along with several rare species. Because of its low gradient, even small unforested areas along Tuscarora Creek can greatly increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

TUSCARORA CREEK ABOVE ACADEMIA (Beale and Spruce Hill Townships)

As the Tuscarora Creek flows to the Juniata River, the stream becomes increasingly low gradient interspersed by areas of high gradient where the creek eats through different rock layers. The reach above Academia features one of these high gradient areas surrounded by nearly flat water. This portion/reach of Tuscarora Creek supports a population of the G5 S1 **Eastern Lampmussel** (*Lampsilis radiata*), which prefers the gravelly and sandy bottom. The host fish of this mussel species is still unknown, but suspected to be a member of the shiner or sunfish family.

Threats and Disturbances:

Current disturbances on this reach are created by an inadequate forest buffer and the cumulative effect of upstream thermal and agricultural pollution. Current threats include the continued removal and neglect of the forest buffer, continued agricultural runoff, and the potential release of large amounts of nutrients from local Confined Animal Feeding Operations (CAFOs).

Conservation Recommendations:

Because of the low gradient of the creek on this reach, even small unforested areas can greatly increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the

BEALE TOWNSHIP

entire creek. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Any local CAFOs should also be examined for their potential threat to the creek. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

WARBLER RUN MEADOWS (Beale and Spruce Hill Townships)

This site encompasses an area of pastoral landscape south of Doyles Mills where a **Species of Special Concern** is successfully reproducing. 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 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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. Agriculture preservation zones may be one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly and safely*) is another potential management technique to maintain the open fields.



Tuscarora Creek floodplain at Doyles Mills

photo source: PNHP

Delaware Township & Thompsonstown Borough

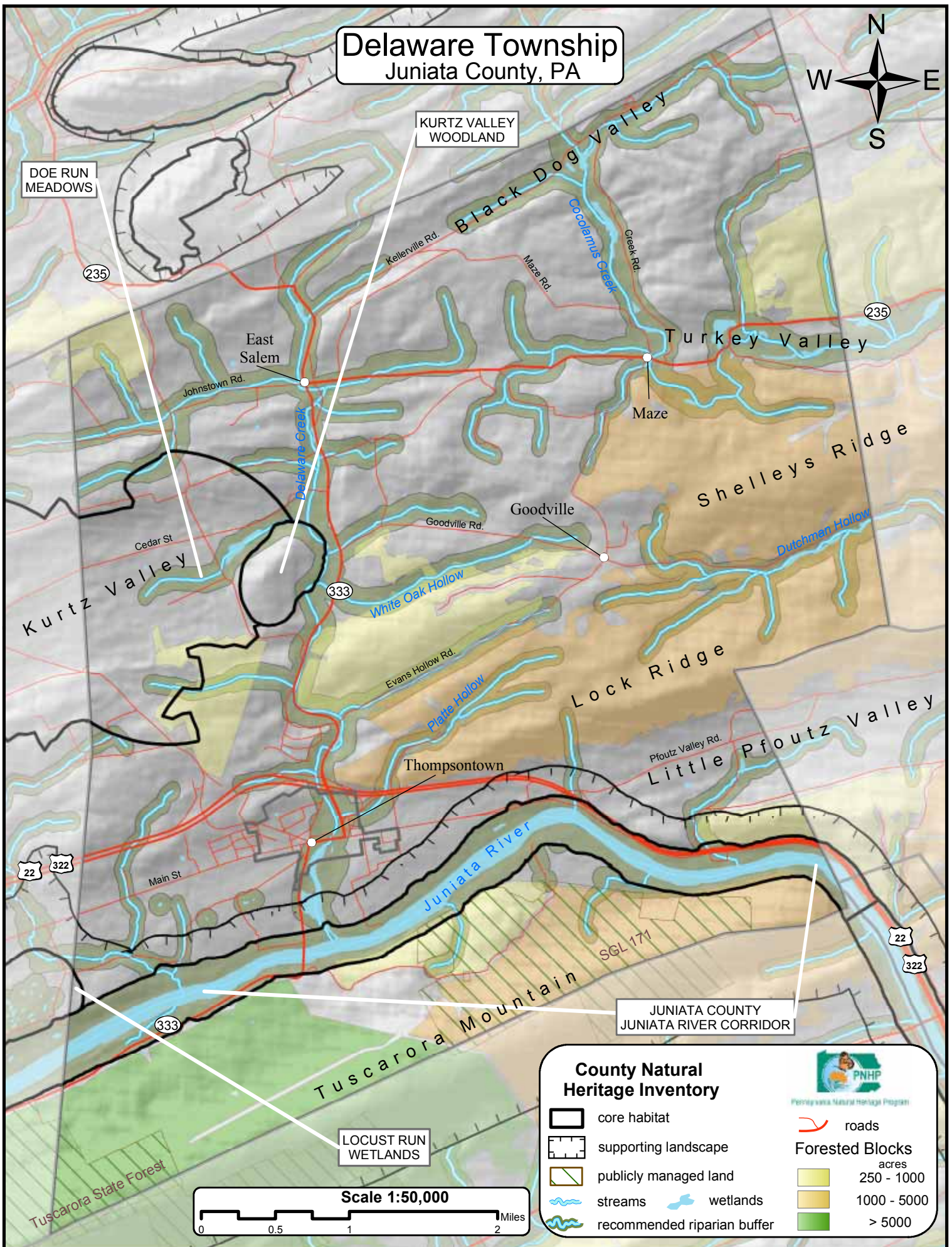
	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³	
		Global	State				
NATURAL HERITAGE SITES:							
KURTZ VALLEY WOODLAND				Exceptional Significance			
	red cedar – redbud shrubland	C	GNR	S2	N	2006	E
	grooved yellow flax (<i>Linum sulcatum</i>)	P	G5	S1	PE	2001	E
	side-oats grama (<i>Bouteloua curtipendula</i>)	P	G5	S2	PT	2006	C
	Henry's Elfin (<i>Callophrys henrici</i>)	L	G5	S1S3	N	1999	B
	Juniper Hairstreak (<i>Callophrys gryneus</i>)	L	G5	S2S4	N	2006	E
	Falcate Orangetip (<i>Anthocharis midea</i>)	L	G4G5	S3	N	1987	E
LOCUST RUN WETLANDS				Exceptional Significance			
	ephemeral/fluctuating natural pools	C	GNR	S3	N	2006	E
JUNIATA COUNTY JUNIATA RIVER CORRIDOR				High Significance			
	Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	N	2006	B
	Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
	Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	2006	E
	Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	E
	Common Sanddragon (<i>Progomphus obscurus</i>)	O	G5	S2	N	1959	H
	white trout-lily (<i>Erythronium albidum</i>)	P	G5	S3	TU	2005	BC
DOE RUN MEADOWS				Notable Significance			
	Species of Special Concern ⁴	-	-	-	-	2005	E
PUBLICLY MANAGED LANDS:		Tuscarora State Forest State Game Lands #171					
OTHER CONSERVATION AREAS:		Tuscarora Ridge (The Pulpit) Important Bird Area Tuscarora / Blue Mountain South Important Mammal Area					
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:		None					
AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:							
-Fish	River and Impoundment Community		Cocolamus Creek-Stoney Run; Juniata River-Raccoon Creek				
	Not Yet Assessed		Cocolamus Creek				
- Macroinvertebrate	Low Gradient Valley Stream Community		Cocolamus Creek-Stoney Run				
	Not Yet Assessed		Cocolamus Creek; Juniata River-Raccoon Creek				
- Mussels	Not Yet Assessed		Cocolamus Creek-Stoney Run; Juniata River-Raccoon Creek; Cocolamus Creek				

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

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DELAWARE TOWNSHIP

Founded in 1836 from Walker and Greenwood Townships, Delaware Township forms a bridge between the forested Tuscarora Mountain and agricultural Kurtz and Turkey Valleys. Running through the southern third of the township are the Juniata River and US 22/322 hemmed in by Tuscarora Mountain along the township's southern edge. The Juniata River and Delaware Creek drain the township. Sitting atop Tuscarora Mountain, SGL 171 is part of a large forest block extending across much of the county. This area corresponds with the Tuscarora / Blue Mountain South Important Mammal Area (IMA) and Tuscarora Ridge (The Pulpit) Important Bird Area (IBA). Blacklog Mountain IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*); while Tuscarora Ridge (The Pulpit) IBA was designated because of its cruciality to migratory birds. The township's underlying bedrock is primarily siltstone and shale with some decent areas of limestone. There is a good split between



agriculture and forestland use in the township; 40% is in agriculture while 53% is in forest. The agricultural land is mainly found in the north of the Township among the many valleys, while most of the forest land is found along Tuscarora Mountain and Shellys and Lock Ridges. Within the township a concerted effort should be made to assure that all the creeks, streams, and river retain or are given a forested riparian buffer. Care should also be taken to assure that the large forest blocks are maintained and protected from development, which is quickly spreading along the US 22/322 corridor.



biennial bee-blossom (*Gaura biennis*) at Kurtz Valley Woodland

photo source: PNHP



nodding ladies' –tresses (*Spiranthes cernua*) at Kurtz Valley Woodland

photo source: PNHP

KURTZ VALLEY WOODLAND (Delaware Township)

Situated atop a hill of 400 million-year old limestone, the thin soils of Kurtz Valley Woodland support a unique community type: GNR S2 **red cedar – redbud shrubland**. The geology and isolation of this site make it an island of specialized habitat in a sea of agriculture. The soils on this site, being too thin and dry to support other tree types or agriculture, promote an area of sparse scrubby trees surrounded by dry-soil tolerant plants and the species that depend on them. Running along the southwest side of the hill is a high-voltage power line that is managed to keep overstory vegetation clear. This provides an area with many flowering plants common to prairie environments. One prairie grass found here is the G5 S2 **side-oats grama** (*Bouteloua curtipendula*) along with many other uncommon grassland constituents. Another plant found in this site's thin, dry soil is the S1 G5 **grooved yellow flax** (*Linum sulcatum*). This makes the site excellently suited to a large butterfly and moth population that reproduces in the shrubland and feeds in the grassland. Specifically, the G5 S2S4 **Juniper Hairstreak** (*Callophrys gryneus*), the G4G5 S3 **Falcate Orangetip** (*Anthocharis midea*), and G5 S1S3 **Henry's Elfin** (*Callophrys henrici*) are butterflies that fly here along with more than 79 other species of moth and butterfly (see spp. list).

Threats and Disturbances:

Currently, the greatest threats to this site are succession and invasive species. Most of the juniper in the shrubland is mature to old and care needs to be taken to ensure that the area continues to recruit new individuals. Additionally, the canopy is beginning to



Juniper Hairstreak (*Callophrys gryneus*)

photo source: Andrew Strassman (PNHP)

Abridged Kurtz Valley Woodland Lepidopteron List

Butterflies (*= Spp. Of Concern)

Cabbage White (Exotic)	<i>Pieris rapae</i>
Dun Skipper	<i>Euphyes vestis</i>
Falcate Orangetip	* <i>Anthocharis midea</i>
Henry's Elfin	* <i>Callophrys henrici</i>
Juniper Hairstreak	* <i>Callophrys gryneus</i>
Juvenal's Duskywing	<i>Erynnis juvenalis</i>
Pearl Crescent	<i>Phyciodes tharos</i>
Spring Azure	<i>Celastrina ladon</i>

Moths

Arched Hooktip	<i>Drepana arcuata</i>
Black-Banded Owlet	<i>Phalaenostola larentioides</i>
Blackberry Looper Moth	<i>Chlorochlamys chloroleucaria</i>
Black-Bordered Lemon Moth	<i>Thioptera nigrofimbria</i>
Broken-Line Hypenodes	<i>Hypenodes fractilinea</i>
Brown-Shaded Gray	<i>Anacamptodes defectaria</i>
Clover Looper Moth	<i>Caenurgina crassiuscula</i>
Common Angle	<i>Macaria aemulataria</i>
Common Gray	<i>Anavitrinella pampinaria</i>
Common Pinkband	<i>Ogdoconta cinereola</i>
Common Tan Wave	<i>Pleuroprucha insularia</i>
Confused Dart	<i>Feltia tricola</i>
Dark-Banded Owlet	<i>Phalaenophana paramusalis</i>
Dark-Spotted Palthis	<i>Palthis angulalis</i>
Flame-Shouldered Dart	<i>Ochropleura implecta</i>
Grape Leafroller Moth	<i>Desmia funeralis</i>
Grateful Midget	<i>Elaphria grata</i>
Green Cloverworm Moth	<i>Hypena scabra</i>
Immaculate Holomelina	<i>Holomelina immaculata</i>
Juniper Geometer	<i>Patalene olyzonaria puber</i>
Large Mossy Lithacodia	<i>Lithacodia muscosula</i>
Little White Lichen Moth	<i>Clemensia albata</i>
Master's Dart	<i>Feltia herilis</i>
Oblique-Banded Leafroller Moth	<i>Choristoneura rosaceana</i>
Obtuse Yellow	<i>Stiriodes obtusa</i>
Oldwife Underwing	<i>Catocala paleogama</i>
Olive-Shaded Bird-Dropping Moth	<i>Tarachidia candefacta</i>
One-Spotted Variant	<i>Hypagyrtis unipunctata</i>
Painted Lichen Moth	<i>Hypoprepia fucosa</i>
Pale Epidelta	<i>Phalaenostola metonalis</i>
Pink-Spotted Dart	<i>Pseudohermonassa bicarnea</i>
Red-Headed Looper Moth	<i>Macaria bisignata</i>
Ruby Tiger Moth	<i>Phragmatobia fuliginosa</i>
Scarlet-Winged Lichen Moth	<i>Hypoprepia miniata</i>
Small Bailey	<i>Baileya australis</i>
Snowy Dart	<i>Euagrotis illapsa</i>
Sparganothis Fruitworm Moth	<i>Sparganothis sulphureana</i>
Spotted Phosphila	<i>Phosphila miselioides</i>
Subgothic Dart	<i>Feltia subgothica</i>
Subterranean Dart	<i>Agrotis subterranea</i>
Three-Lined Leafroller Moth	<i>Pandemis limitata</i>
Unarmed Wainscot	<i>Leucania inermis</i>
Virginian Tiger Moth	<i>Spilosoma virginica</i>
White-Lined Bomolocha	<i>Hypena abalienalis</i>

DELAWARE TOWNSHIP

or has already closed throughout most of the site, shading out the grasses and understory plants and curtailing the recruitment of new trees. Great care also needs to be taken to monitor and manage the invasive species on the site especially mile-a-minute, multiflora rose, and non-native honeysuckles. These plants are a significant danger to the health of the site. A final threat to the site is development. While the site is a poor candidate for buildings, it has an excellent view of the area that may lure developers.

Conservation Recommendations:

Given the rarity, importance, and beauty of this site, serious consideration should be given to its preservation. Because of the close proximity to housing, industry, and woodlands and its current condition, fire is not advisable at this site (dry juniper is explosively flammable!). In the absence of fire, periodic mowing of the site will be necessary to maintain the open environment. This is currently being conducted along the power line right-of-way. Maintenance of this habitat has to be continual rather than sporadic to be successful. Invasive and woody plants need be removed from this site. Ideally, removal should be mechanical (i.e. hand pulled or cut), but *selective* herbiciding may be possible if the correct herbicide is used under ideal conditions. No herbicide treatments should be used near the small population of side-oats grama. The adjacent agricultural field is currently planted in corn. A large portion of this field adjacent to the limestone glade opening should be converted to hay crops to prevent the drifting of herbicides and pesticides into the sensitive areas. Tree removal along the power line right-of-way may also help expand the site. This could be accomplished by the mechanical removal of selected larger woody material from the field edges followed by several successive years of selective cutting, mowing, and active non-native invasive plant management. The seed bank of the site likely contains many grassland seeds that would foster site redevelopment. This could be augmented by collecting seeds from the site for replanting efforts. Following reestablishment of the native grassland habitat, controlled burns or mowing would be necessary every three to five years to suppress woody vegetation and regenerate the soils in the grassy areas. The process would likely be labor intensive and would require support from the local community to implement and maintain.



One of many pools at in the Locust Run Wetlands

photo source: PNHP

LOCUST RUN WETLANDS (Delaware and Walker Townships)

Two large complexes of the GNR S3 **ephemeral/fluctuating natural pools community** are found at this site along with several permanent pools. Additionally, there are many pool remnants found in the surrounding agricultural fields. The pools are likely the result of local subsidence in the layer of permeable limestone below the sites. These sites, having been timbered several times, have a diverse array of tree and plant species with some interesting geographic outliers. Dominant tree species at the site include white, northern red, and pin oaks (*Quercus alba*, *Q. montana*, and *Q. palustris*), eastern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), red and silver maple (*Acer rubrum* and *A. saccharinum*), black birch (*Betula lenta*), and

DELAWARE TOWNSHIP



Juniata River upstream of Bell Island

photo source: PNHP

blackgum (*Nyssa sylvatica*). The site also contains many shrubs common to perennially wet areas including winterberry (*Ilex verticillata*), swamp azalea (*Rhododendron viscosum*), highbush blueberry (*Vaccinium corymbosum*), and buttonbush (*Cephalanthus occidentalis*).

Threats and Disturbances:

The site is owned by several private landowners. The primary land uses are currently agriculture and recreational uses of the forest. Logging within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances. Finally, the area and site have seen substantial recent suburban sprawl that threatens not only the interconnectedness of the site, but the character of the whole landscape.

Conservation Recommendations:

Optimally, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here. Conservation options such

as easements should be discussed with the private landowners in order to best protect the site from future development or forest mismanagement.

JUNIATA COUNTY JUNIATA RIVER

CORRIDOR (Delaware, Fermanagh, Milford, Turbett, and Walker Townships and Mifflin, Mifflintown, and Port Royal Boroughs)

The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery (see Aquatic Community Classification section for details), the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. The many islands provide ample habitat for aquatic birds, mammals, insects, and plants. Additionally, the river acts as a corridor between its headwaters in Somerset County and the Susquehanna River. In Juniata County the river supports populations of freshwater mussels including the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*), the G4 S3S4 **Triangle Floater** (*Alasmodonta undulata*), and the G4 S4 **Elktoe** (*Alasmodonta marginata*). The Eastern Elliptio (*Elliptio complanata*) and the G5 S1 Rainbow Mussel (*Villosa iris*) are also common at this site, though the Rainbow Mussel's state rank only applies to individuals in the Ohio River Basin. The various sandbars, island edges, and river scours provide excellent habitat for the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) whose caterpillar feeds preferentially on wingstem (*Verbesina alternifolia*). The wet, shaded river edges are home to the G5 S3 **white trout-lily** (*Erythronium albidum*). Many dragonflies and damselflies are also found along this stretch including a historic record of the G5 S2 **Common Sanddragon** (*Progomphus obscurus*).



Elktoe (*Alasmodonta marginata*)

photo source: PNHP

DELAWARE TOWNSHIP

Freshwater Mussels – the river's filters

The Juniata 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 Juniata 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.

Threats and Disturbances:

A river is the culmination of all its headwaters and tributaries. Upstream disturbances to the Juniata include substantial amounts of agricultural runoff (nutrients, sediments, and chemicals), thermal pollution, floodplain reduction and modification, and stormwater surges. Direct disturbances at the site include trash in the river, stormwater surges from local roads and municipalities, building on the floodplain, and runoff from agriculture and construction. Threats

to the river include increased building on the floodplain and the resulting increase in stormwater surges along with continued neglect of existing problems.

Conservation Recommendations:

A concerted effort needs to be developed to promote the health of the entire Juniata Basin if the quality of this site is to be maintained or improved. This would include restricting cattle access to tributaries, implementation of runoff barriers at construction sites, and a 100 m (305 ft) forested riparian buffer on *all* tributaries of the Juniata River. Specific site recommendations include removal of trash from this reach, restriction of new buildings within the floodplain, and management of stormwater flows on the road and in the towns adjacent to this reach. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

DOE RUN MEADOWS (Delaware and Walker Townships)

This site encompasses an area of pastoral landscape around the town of Van Wert where a **Species of Special Concern** is successfully reproducing. 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 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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

DELAWARE TOWNSHIP

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. Agriculture preservation zones may be one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and

keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly and safely*) is another potential management technique to maintain the open fields.



Pastoral Landscape in Delaware Township, Juniata County

photo source: Larry Klotz

FAYETTE TOWNSHIP

Fayette Township

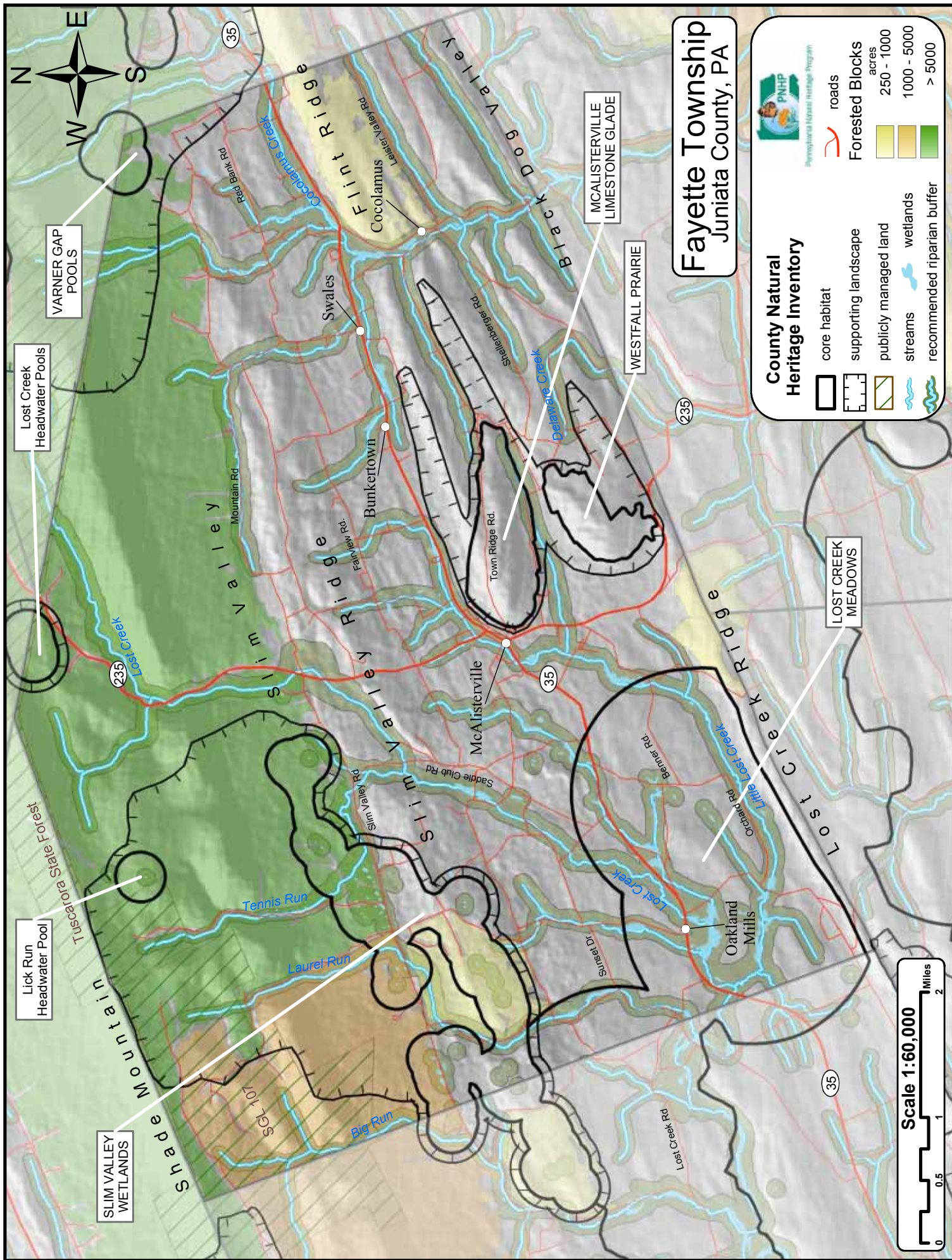
	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
<i>NATURAL HERITAGE SITES:</i>						
MCALISTERVILLE LIMESTONE GLADE				<i>Exceptional Significance</i>		
side-oats grama calcareous grassland	C	GNR	S1	N	2006	B
southern wild senna (<i>Senna marilandica</i>)	P	G5	S1	PE	2005	A
hoary puccoon (<i>Lithospermum canescens</i>)	P	G5	S2	PE	2005	A
side-oats grama (<i>Bouteloua curtipendula</i>)	P	G5	S2	PT	2006	A
Henry’s Elfin (<i>Callophrys henrici</i>)	L	G5	S1S3	N	2006	E
SLIM VALLEY WETLANDS				<i>Exceptional Significance</i>		
twining screw-stem (<i>Bartonia paniculata</i>)	P	G5	S3	TU	2006	BC
spotted pondweed (<i>Potamogeton pulcher</i>)	P	G5	S1	PE	2006	B
ephemeral/fluctuating natural pools	C	GNR	S3	N	2006	E
WESTFALL PRAIRIE				<i>Exceptional Significance</i>		
side-oats grama calcareous grassland	C	GNR	S1	N	1997	B
side-oats grama (<i>Bouteloua curtipendula</i>)	P	G5	S2	PT	2001	B
hoary puccoon (<i>Lithospermum canescens</i>)	P	G5	S2	PE	2005	E
false gromwell (<i>Onosmodium molle</i> var. <i>hispidissimum</i>)	P	G4G5T4	S1	PE	1999	C
Henry’s Elfin (<i>Callophrys henrici</i>)	L	G5	S1S3	N	1995	B
LOST CREEK MEADOWS				<i>Notable Significance</i>		
Species of Special Concern ⁴	-	-	-	-	2005	E
Lick Run Headwater Pool				<i>Locally Significant</i>		
Lost Creek Headwater Pools				<i>Locally Significant</i>		
Varner Gap Pools				<i>Locally Significant</i>		
<i>PUBLICLY MANAGED LANDS:</i>		Tuscarora State Forest State Game Lands #107				
<i>OTHER CONSERVATION AREAS:</i>		Westfall Prairie (The Nature Conservancy) Blacklog Mountain Important Mammal Area				
<i>DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:</i> Lost Creek (above Oakland Mills)						
<i>AQUATIC COMMUNITIY CLASSIFICATION PROJECT RESULTS:</i>						
- Fish	Warmwater Community 1			Lost Creek		
	River and Impoundment Community			Cocolamus Creek-Stoney Run; Juniata River-Raccoon Creek		
- Macroinvertebrate	Low Gradient Valley Stream Community			Cocolamus Creek-Stoney Run		
	Not Yet Assessed			Lost Creek; Juniata River-Raccoon Creek		
- Mussel	Not Yet Assessed			Cocolamus Creek-Stoney Run; Juniata River-Raccoon Creek; Lost Creek		

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection



FAYETTE TOWNSHIP

Originally part of Fermanagh and Greenwood Townships, Fayette Township was founded in 1834. Sloping from the forested Shade Mountain to the north into the agrarian Slim and Black Dog Valleys, the township offers many interesting features. Situated atop the northern ridgeline are Tuscarora State Forest and State Game Lands #107, which comprise a very large, contiguous forest block. This area also corresponds nicely with the Blacklog Mountain Important Mammal Area (IMA). This IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*). Drained by Lost and Cocolamus Creeks and their tributaries, the Township contains two important limestone outcroppings, many interesting perched wetlands, and the headwaters of Lost Creek that are classified as a High Quality Cold Water Fishery by the Department of Environmental Protection (DEP). As expected from the diverse topography, the underlying geology of the Township is very mixed with sandstones, siltstones and shale, and limestone, among others. Land use in the township is generally split with the northern



portion (55% of the township) being forest and the southern portion (40% of the township) being agriculture. Most of the forest along Shade Mountain and its slopes are intact, creating a high proportion of interior forest. Most of the streams in the township are in excellent condition, running through intact forests. However, some in the agricultural areas are in need of riparian buffers to reduce agricultural inputs. Finally, the limestone ridge communities and various wetlands should be protected as unique areas within the township and state.



McAlisterville Limestone Glade

photo source: Larry Klotz

FAYETTE TOWNSHIP

MCALISTERVILLE LIMESTONE GLADE

(Fayette Township)

Unique and important communities are often found in unexpected places. McAlisterville Limestone Glade, a regularly hayed patch of thin, dry, limestone-derived soils, is one of those communities. With the mechanical suppression of woody plants and trees on the slope, many rare grassland and prairie species have flourished within the **side-oats grama calcareous grassland**, a GNR S1 Natural Community. This community, which is typically dominated by side-oats grama grass and scattered wildflowers, is currently only known to occur in 10 locations in Pennsylvania. The prairie-like environment acts as a refuge for uncommon eastern prairie species and has sustained remnant populations of the G5 S2 grass **side-oats grama** (*Bouteloua curtipendula*) and the G5 S1 **southern wild senna** (*Senna marilandica*), and G5 S2 **hoary puccoon** (*Lithospermum canescens*), both grassland plants. Besides these three plant species considered Threatened or Endangered in

Pennsylvania, the site supports a diverse array of native wildflowers, which in turn support a wide variety of native butterflies and other insects.

Historically, patches of grassland may have been more common on the dry, south-facing slopes of the area and could have been sustained by recurrent natural fires, or the activities of herds of large mammals such as elk or bison. The dispersal of seeds of side-oats grama grass may have been accomplished by clinging to the fur of these animals (Laughlin, 2003). The thin, dry soils of this portion of the hillside make this area marginally suitable for cultivation, thus it is currently cut for hay on an infrequent basis. This irregular cutting has proven to be a very effective management method for maintaining this natural grassland opening, in a way mimicking the natural fires or large mammal herds that would likely have kept it open in the past. Other similar grasslands around the state have diminished in size due to conversion to agriculture, quarrying, or other uses, and by succession to shrubs and trees, which eventually shade out the grassland species. Suppression of naturally occurring fires has

Abridged Plant List for McAlisterville Limestone Glade

Common Name	Scientific Name	Common Name	Scientific Name
Trees:		Herbs:	
American basswood	<i>Tilia americana</i>	biennial beeblossom	<i>Gaura biennis</i>
black locust	<i>Robinia pseudoacacia</i>	browneyed Susan	<i>Rudbeckia triloba</i>
black walnut	<i>Juglans nigra</i>	common blue violet	<i>Viola sororia</i>
chestnut oak	<i>Quercus montana</i>	early goldenrod	<i>Solidago juncea</i>
eastern red cedar	<i>Juniperus virginiana</i>	fuzzy wuzzy sedge	<i>Carex hirsutella</i>
flowering dogwood	<i>Cornus florida</i>	garden asparagus	<i>Asparagus officinalis</i>
hawthorn	<i>Crataegus sp.</i>	gray goldenrod	<i>Solidago nemoralis</i>
hophornbeam	<i>Ostrya virginiana</i>	green comet milkweed	<i>Asclepias viridiflora</i>
northern hackberry	<i>Celtis occidentalis</i>	hoary puccoon	<i>Lithospermum canescens</i>
red pine	<i>Pinus resinosa</i>	Indianhemp	<i>Apocynum cannabinum</i>
redbud	<i>Cercis canadensis</i>	southern wild senna	<i>Senna marilandica</i>
slippery elm	<i>Ulmus rubra</i>	nodding onion	<i>Allium cernuum</i>
white ash	<i>Fraxinus americana</i>	orange-fruit horse-gentian	<i>Triosteum aurantiacum</i>
white pine	<i>Pinus strobus</i>	purple-top tridens	<i>Tridens flavus</i>
Chinese elm (<i>exotic</i>)	<i>Ulmus parvifolia</i>	red columbine	<i>Aquilegia canadensis</i>
Scots pine (<i>exotic</i>)	<i>Pinus sylvestris</i>	side-oats grama grass	<i>Bouteloua curtipendula</i>
Shrubs and Vines:		smooth oxeye	<i>Heliopsis helianthoides</i>
blackhaw	<i>Viburnum prunifolium</i>	smooth Solomon's seal	<i>Polygonatum biflorum</i>
gray dogwood	<i>Cornus racemosa</i>	tall thimbleweed	<i>Anemone virginiana</i>
summer grape	<i>Vitis aestivalis</i>	tall thoroughwort	<i>Eupatorium altissimum</i>
autumn olive (<i>exotic</i>)	<i>Elaeagnus umbellata</i>	tick-trefoil	<i>Desmodium sp.</i>
bush honeysuckle (<i>exotic</i>)	<i>Lonicera morrowii</i>	waxy-leaf meadow-rue	<i>Thalictrum revolutum</i>
European privet (<i>exotic</i>)	<i>Ligustrum vulgare</i>	whorled milkweed	<i>Asclepias verticillata</i>
jet-bead (<i>exotic</i>)	<i>Rhodotypos scandens</i>	wild garlic	<i>Allium vineale</i>
Oriental bittersweet (<i>exotic</i>)	<i>Celastrus orbiculatus</i>	field thistle (<i>exotic</i>)	<i>Cirsium discolor</i>
wineberry (<i>exotic</i>)	<i>Rubus phoenicolasius</i>	Queen Anne's lace (<i>exotic</i>)	<i>Daucus carota</i>
		spotted knapweed (<i>exotic</i>)	<i>Centaurea stoebe</i>
		yellow sweetclover (<i>exotic</i>)	<i>Melilotus officinalis</i>



hoary puccoon (*Lithospermum canescens*)

photo source: John Kunsman (PNHP)

likely been instrumental in the reduction of this habitat type in Pennsylvania.

Additionally, a butterfly considered uncommon in the state, the G5 S1S3 **Henry's Elfin** (*Callophrys henrici*), is known from this site. Feeding on redbud (*Circus canadensis*) as a caterpillar, and the many wild flowers as an adult, this little butterfly favors sites like this where food for both the young and adults are in close proximity.

A final important feature of the site is the McAlisterville Cave. This gated site is a limestone solution cave formed by eons of groundwater slowly eroding the limestone bedrock to form a long, deep, wet cavern. Preliminary surveys in the winter of

Threats and Disturbances:

The unrestrained use of herbicides on this site would be catastrophic. The populations of rare plant species could be destroyed by a single broad-scale application. Ironically, succession and invasion by both native and non-native plants are the greatest threats to this site. Invasion of the site by woody species of plants threatens to crowd out and shade the grassland species. Specifically, jetbead (*Rhodotypos scandens*), autumn olive (*Elaeagnus umbellata*), and bush honeysuckle

(*Lonicera morrowii*) are biologically positioned to take over the site. Additional threats to the site include conversion to any other land use (i.e. forest, row-crop, housing, quarry, etc...). Pesticide application or overspray, as well as close mowing that could kill both juveniles and adults of the Henry's Elfin butterfly, are additional threats. Finally, the porous carbonate bedrock typical of limestone topography allows solid and liquid wastes to seep into caves and groundwater without treatment. Housing development on the hilltop could directly affect hydrology and thereby directly affect the cavern. Alteration of the cave entranceway, such as vegetation removal and structural changes, could affect climatic conditions in the cave, including airflow, temperature, and humidity.

Conservation Recommendations:

Given the rarity, importance, and beauty of this site, serious consideration should be given to its preservation. Because of the close proximity to housing and woodlands, fire may not be a practical management option at this site. In the absence of fire, the periodic haying or mowing of the site will be necessary to maintain the open environment. The infrequent mowing that currently occurs at this site is very effective at reducing the amount of woody species present, while still allowing the native plants to set seed and prosper. An early spring mowing is preferable to a late season mowing, as most of the non-native grasses are cool season grasses, which mature and set seed early in the season. The rare grass at this site, side-oats grama grass, is a warm season grass that matures in late summer and early fall. Invasive plants need to be removed from this site. Ideally, removal should be mechanical (i.e. hand pulled), but *selective* herbiciding may be possible if the correct herbicide is used under ideal conditions. Tree removal (excluding redbud) along the field edges may also help expand the site. This is a relatively large patch of native grassland by current Pennsylvania standards, but it could be expanded to improve the overall viability of this natural community. The forest uphill and to either side of the grassland could be thinned or removed to allow an expansion of the grassland community, again being careful to leave ample redbud. The deeper soils on the lower portion of the slope are currently used as a productive hayfield bordered by houses. This area should be retained in its current agricultural use, and not be considered suitable for additional development. The current hay field is also preferable to a cultivated crop such as corn because of the potential for drifting

FAYETTE TOWNSHIP



twinning screw-stem (*Bartonia paniculata*)

photo source: Andrew Strassman (PNHP)

herbicides and pesticides associated with row crops to impact the sensitive natural community. This, and similar native grasslands in the area should be considered of primary importance for the conservation of biodiversity in the county and should be considered an important natural asset of the local community. Other grassy openings and hayfields on hillsides in the area should be the focus of future biological inventories to see if they also support these remnant grassland plants. Suitable nearby areas could be reestablished as native grassland openings with seeds collected from this location. Cave entrances should be buffered from disturbance by at least 160 meters (525 feet). The water quality of the groundwater in this area is critical to human uses and to maintaining any aquatic life in the caves. Access to caves should be limited in winter months in order to avoid disturbance of any hibernating bats.

SLIM VALLEY WETLANDS (Fayette and Fermanagh Townships)

The southern toe-slope of Shade Mountain contains many locations where water naturally pools. This location contains several pools grouped along Slim Valley Road. Clearly seasonal, these pools are an example of the GNR S3 **ephemeral/fluctuating natural pools community**. The isolated pools offer an important breeding location for the surrounding amphibian community. The G5 S1 plant **spotted pondweed** (*Potamogeton pulcher*) occurs in two different pools at the site, in association with buttonbush (*Cephalanthus occidentalis*), winterberry (*Ilex verticillata*), and black willow (*Salix nigra*). Additionally, the G5 S3 plant **twining screw-stem**

(*Bartonia paniculata*) occurs at this site in association with red maple (*Acer rubra*), black gum (*Nyssa sylvatica*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), Virginia marsh St. John's wort (*Triadenum virginicum*), yellow screw-stem (*Bartonia virginica*), and *Sphagnum* moss (*Sphagnum* sp.). The surrounding forest is composed of a red maple – black gum palustrine forest community dominated by red maple and black gum. Young of the year Spotted Salamanders (*Ambystoma maculatum*) were also observed at the site indicating active reproduction.

Threats and Disturbances:

The site is owned and managed by numerous landowners. The primary land use within the site is recreational with extensive logging in the vicinity and agriculture dominating the surrounding landscape. Additionally, past roadwork along Slim Valley Road has adversely affected these pools. Logging or additional roadwork 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 m (1000 ft) 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. 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.



Spotted Salamander (*Ambystoma maculatum*)

photo source: Andrew Strassman

FAYETTE TOWNSHIP

WESTFALL PRAIRIE (Fayette Township)

Westfall Prairie is a small but important site with several rare species. Rather than a landscape-covering expanse of waving grassland, it is an example of the GNR S1 **side-oats grama calcareous grassland community**. This small pocket of native grassland should be considered a disconnected portion of the grassland community that occurs at McAlisterville Limestone Glade. Other pockets of this community type may occur on nearby slopes of similar soil, hydrology, and light conditions. Currently a very small site, the local geology presents the possibility for a substantial increase in coverage of this community. This community type, typified by thin soils over limestone bedrock, is dependent upon regular disturbance to prevent succession. In the past, wildfires and herds of large mammals such as elk or bison may have been responsible for maintaining the open aspect of these communities. Within this site are several plant species of special concern: the G4G5T4 S1 **PA endangered false gromwell** (*Onosmodium molle* var. *hispidissimum*), the G5 S2 **side-oats grama** (*Bouteloua curtipendula*), and the G5 S2 **hoary puccoon** (*Lithospermum canescens*). Of the 10 documented populations of false gromwell known to have occurred in the state, only 3 are considered to still exist. The population of this plant at Westfall Prairie is extremely important to the continued survival of this species in the state. All of the rare plants documented at this location favor the dry, calcareous soil of the site and the open, sunny environment that accompanies it. Additionally, one butterfly species of concern, the G5 S1S3 **Henry's Elfin** (*Callophrys henrici*), was documented at this site. Henry's Elfin feeds on redbud (*Circus canadensis*) as a caterpillar and the nectar of many



false gromwell (*Onosmodium molle* var. *hispidissimum*)

photo source: <http://csdl.tamu.edu/FLORA/imaxxbor.htm>
James Manhart

wildflowers as an adult. This little butterfly favors sites where food for both the young and adults are in close proximity.

Threats and Disturbances:

The unrestrained use of herbicides on this site would be catastrophic. The populations of rare plant species could be destroyed by a single broad-scale application. Succession and invasion by non-native plants are the greatest threats to this site. Specifically, jetbead (*Rhodotypos scandens*), autumn olive (*Elaeagnus umbellata*), and bush honeysuckle (*Lonicera morrowii*) are biologically positioned to take over the site. The adjacent land includes cultivated fields planted in corn, a limestone quarry, and a lumber processing operation. The quarry occupies land that may have at one time consisted of more of this native grassland natural community. Additional threats to the site include conversion of this grassland remnant to any other land use (i.e. forest, row-crop, housing, quarry, etc.). A final threat would be pesticide application or overspray that could kill both juvenile and adult butterflies.

Conservation Recommendations:

Given the rarity, importance, and beauty of this site, serious consideration should be given to its preservation and restoration. Because of the close proximity to housing, industry, and woodlands and its current condition, fire is not advisable at this site. In the absence of fire, the periodic haying or mowing of the site will be necessary to maintain the open environment. A portion of the site has recently been cleared of forest cover and planted with container-grown plugs of side-oats grama grass grown from on-site collected seed in an attempt to expand the grassland habitat. The cleared area has become thick with young redbud saplings, a good thing for the Henry's Elfin, but counterproductive for the expansion of the grassland habitat. Maintenance of this habitat has to be continual rather than sporadic to be successful. Invasive and woody plants need to be removed from this site. Ideally, removal should be mechanical (i.e. hand pulled or cut), but *selective* herbiciding may be possible if the correct herbicide is used under ideal conditions. No herbicide treatments should be used near the small population of false gromwell. The adjacent agricultural field is currently planted in corn. A large portion of this field adjacent to the limestone glade opening should be converted to hay crops to prevent the drifting of herbicides and pesticides into the sensitive areas. Tree removal along

FAYETTE TOWNSHIP



Pastoral landscape of Fayette Township

photo source: PNHP

the field edges may also help expand the site. This could be accomplished by the mechanical removal of selected woody material from the field edges, followed by several successive years of controlled burns, cutting, mowing, and active non-native invasive plant management. The seed bank of the site likely contains many grassland seeds that would foster site redevelopment. This could be augmented by collecting seeds from the site for replanting efforts. Following reestablishment of the native grassland habitat, controlled burns or mowing would be necessary every three to five years to suppress woody vegetation and regenerate the soils. The process would likely be labor intensive and would require support from the local community to implement and maintain.

LOST CREEK MEADOWS (Fayette and Fermanagh Townships)

This site encompasses an area of pastoral landscape around the town of Oakland Mills where a **Species of Special Concern** is successfully reproducing. 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 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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. Agriculture preservation zones may be one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly and safely*) is another potential management technique to maintain the open fields.

Lick Run Headwater Pool (Fayette Township)

This small topographic saddle contains one pool comprising an ephemeral/fluctuating natural pools community. This very large, isolated pool offers an important breeding location for the surrounding amphibian community. The surrounding forest is composed of a blackgum – heath community with blackgum (*Nyssa sylvatica*) 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 single landowner. The primary land use at this site is recreational uses of the forest. Logging within proximity to the pool without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland.

FAYETTE TOWNSHIP

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Lost Creek Headwater Pools (Fayette Township and Snyder County)

This small topographic 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 surrounding forest is composed of a dry oak – heath community with chestnut oak (*Quercus montana*) dominating the overstory and a thick layer of mountain laurel (*Kalmia latifolia*) being the understory. The condition of the pools appears good.

Threats and Disturbances:

The site is owned and managed by a two different 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 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Varner Gap Pools (Fayette and Monroe Townships and Snyder County)

The south toe-slope of Shade Mountain contains many locations where water naturally pools. This location, below Varner Gap, contains several closely grouped small pools comprising an 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.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.



Vernal pool community common to the Ridge and Valley area
photo source: Andrew Strassman (PNHP)

FAYETTE TOWNSHIP



Westfall Prairie Ridge
photo source: T. Smith (PNHP)

Fermanagh Township & Mifflintown Borough

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
SLIM VALLEY WETLANDS		Exceptional Significance				
twining screw-stem (<i>Bartonia paniculata</i>)	P	G5	S3	TU	2006	BC
spotted pondweed (<i>Potamogeton pulcher</i>)	P	G5	S1	PE	2006	B
ephemeral/fluctuating natural pools	C	GNR	S3	N	2006	E
JUNIATA COUNTY JUNIATA RIVER CORRIDOR			High Significance			
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	B
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	2006	E
Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	E
white trout-lily (<i>Erythronium albidum</i>)	P	G5	S3	TU	2005	BC
Common Sanddragon (<i>Progomphus obscurus</i>)	O	G5	S2	N	1959	H
LEWISTOWN NARROWS NORTH		High Significance				
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	2002	B
Northern Myotis (<i>Myotis septentrionalis</i>)	M	G4	S3B/3N	CR	2001	E
southern wild senna (<i>Senna marilandica</i>)	P	G5	S1	PE	2001	H
Virginia mallow (<i>Sida hermaphrodita</i>)	P	G3	S2	PE	1908	H
MACEDONIA GAP		High Significance				
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
SPIGELMYER GAP		High Significance				
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
WAGNER GAP		High Significance				
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1995	E
LOST CREEK MEADOWS		Notable Significance				
Species of Special Concern ⁴	-	-	-	-	2005	E
Arch Rock Anticlines		Locally Significant				
Shape Mountain Pools		Locally Significant				

PUBLICLY MANAGED LANDS: State Game Lands # 107

OTHER CONSERVATION AREAS: Blacklog Mountain Important Mammal Area

DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: Macedonia Run

AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:

- Fish	<i>Warm-water Community 1</i>	Jacks Creek; Lost Creek
	<i>River and Impoundment Community</i>	Juniata River-Raccoon Creek; Juniata River-Tuscarora Creek
- Macroinvertebrate	<i>High Quality Small Stream Community</i>	Juniata River-Tuscarora Creek
	<i>Low Gradient Valley Stream Community</i>	Jacks Creek
	<i>Not Yet Assessed</i>	Juniata River-Raccoon Creek; Lost Creek
- Mussel	<i>Yellow Lampmussel Community</i>	Juniata River-Tuscarora Creek
	<i>Not Yet Assessed</i>	Jacks Creek; Juniata River-Raccoon Creek; Lost Creek

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

Fermanagh Township Juniata County, PA



County Natural Heritage Inventory

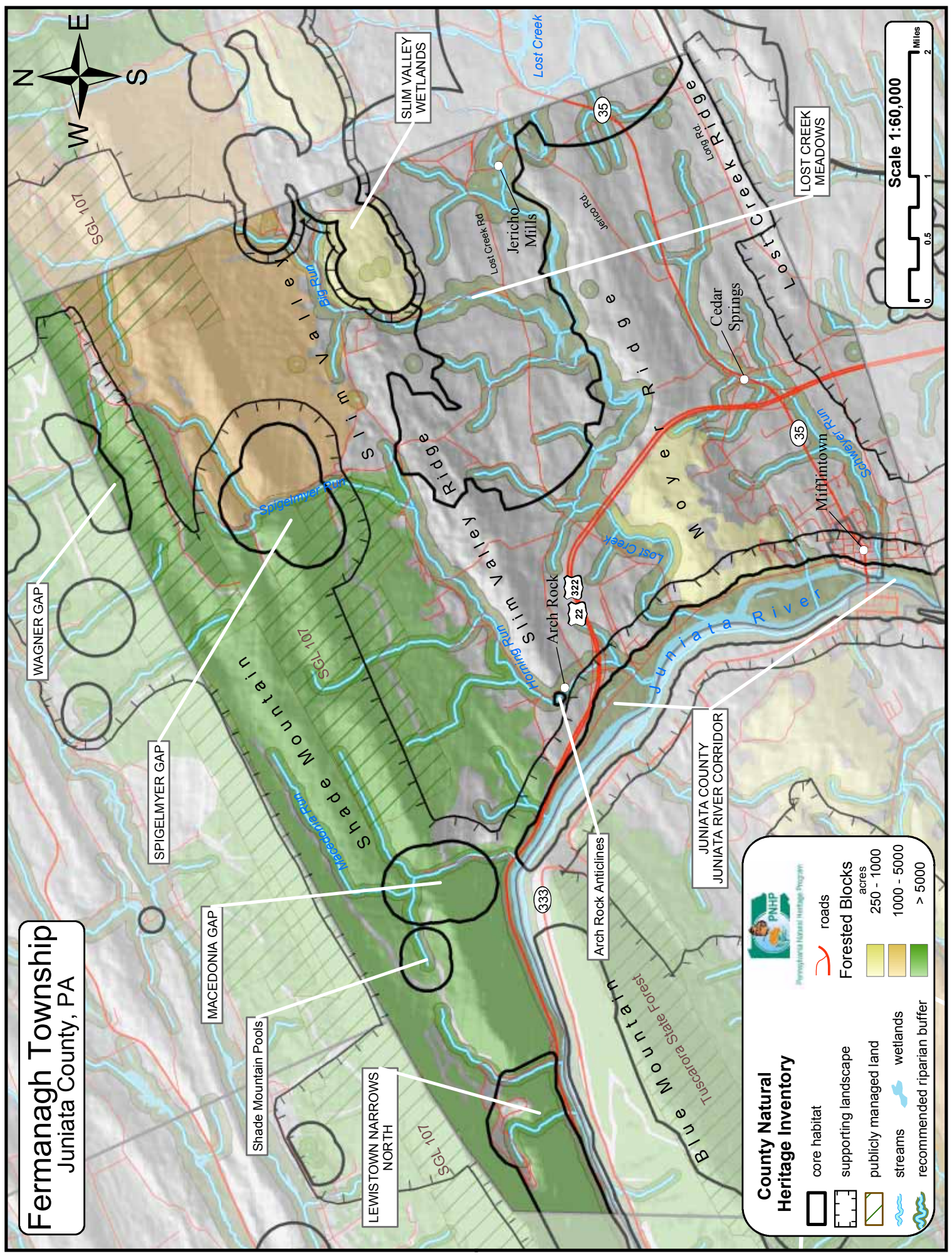
- core habitat
- supporting landscape
- publicly managed land
- streams
- recommended riparian buffer

- roads

Forested Blocks
acres

- 250 - 1000
- 1000 - 5000
- > 5000

- wetlands



FERMANAGH TOWNSHIP

Bordered on the north by Shade Mountain and on the west by the Juniata River, Fermanagh Township slopes gently downward into Slim Valley and its Lost Creek. Founded in 1755, it is also one of the County's original townships. A major feature along its northern edge, State Game Lands 107 covers most of Shade Mountain and corresponds with Blacklog Mountain Important Mammal Area (IMA). This IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*). The waterways of the township are Schweyer Run, Horning Run, and Lost Creek, and all drain into the Juniata River. The Juniata River is home to several important mussel species in this reach and is an excellent warm water fishery. To preserve these species and the scenic and environmental quality of the river, building should not be permitted in the floodplain. Additionally, Macedonia Run is classified as a High Quality Cold Water Fishery by DEP. Surface geology in the township is very mixed due to the folding of the underlying bedrock during the creation of the Ridge and Valley region. Land use in the township is 31% agricultural, primarily in Slim Valley, and 63% forested, mostly north of Horning Run. The township's forest is concentrated in two large blocks north of T527 along



Shade Mountain; both blocks have large tracts of interior forest. These large forest blocks, mainly on public land, should be kept whole to preserve contiguous forest habitat. Major restoration and conservation concerns for the township should focus on creating a continual forest buffer along Lost Creek and its tributaries, buffering around and maintaining the large forest blocks, and reducing non-point source pollution into the waterways (especially Schweyer Run). Further consideration should also be given to storm water management along the Juniata River to prevent nutrient and road salt influxes. Finally, care should be taken to limit development in the Juniata floodplain and around the township's public lands, which will see increased development pressure with the continued improvement of US 22/322.



Lewistown Narrows circa 1897

photo source: J. Murray Jordan *from* <http://www.railsandtrails.com/Pictures/1897PicturesquePRR/default.htm>



spotted pondweed (*Potamogeton pulcher*)

photo source: Andrew Strassman (PNHP)

SLIM VALLEY WETLANDS (Fayette and Fermanagh Townships)

The southern toe-slope of Shade Mountain contains many locations where water naturally pools. This location contains several pools grouped along Slim Valley Road. Clearly seasonal, these pools are an example of the GNR S3 **ephemeral/fluctuating natural pools community**. The isolated pools offer an important breeding location for the surrounding amphibian community. The G5 S1 plant **spotted pondweed** (*Potamogeton pulcher*) occurs in two different pools at the site, in association with buttonbush (*Cephalanthus occidentalis*), winterberry (*Ilex verticillata*), and black willow (*Salix nigra*). Additionally, the G5 S3 plant **twining screw-stem** (*Bartonia paniculata*) occurs at this site in association with red maple (*Acer rubra*), black gum (*Nyssa sylvatica*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), Virginia marsh St. John's wort (*Triadenum virginicum*), yellow screw-stem (*Bartonia virginica*), and *Sphagnum* moss (*Sphagnum* sp.). The surrounding forest is composed of a red maple – black gum palustrine forest community dominated by red maple and black gum. Young of the year Spotted Salamanders (*Ambystoma maculatum*) were also observed at the site indicating active reproduction.

Threats and Disturbances:

The site is owned and managed by numerous landowners. The primary land use within the site is recreational with extensive logging in the vicinity and agriculture dominating the surrounding landscape. Additionally, past roadwork along Slim Valley Road has adversely affected these pools. Logging or

additional roadwork 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 m (1000 ft) 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. 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.

JUNIATA COUNTY JUNIATA RIVER CORRIDOR (Fermanagh, Milford, Turbett, Walker, and Delaware Townships and Mifflin, Mifflintown, and Port Royal Boroughs)

The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery (see Aquatic Community Classification section for details), the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. The many islands provide ample habitat for aquatic birds, mammals, insects, and plants. Additionally, the river acts as a corridor between its headwaters in Somerset County and the Susquehanna River. In Juniata County the river supports populations of freshwater mussels including the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*), the G4 S3S4 **Triangle Floater** (*Alasmidonta undulata*), and the G4 S4 **Elktoe** (*Alasmidonta marginata*). The Eastern Elliptio (*Elliptio complanata*) and the G5 S1 Rainbow Mussel



Mussel survey near Bells Island

photo source: PNHP

FERMANAGH TOWNSHIP

(*Villosa iris*) are also common at this site, though the Rainbow Mussel's state rank only applies to individuals in the Ohio River Basin. The various sandbars, island edges, and river scours provide excellent habitat for the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) whose caterpillar feeds preferentially on wingstem (*Verbesina alternifolia*). The wet, shaded river edges are home to the G5 S3 **white trout-lily** (*Erythronium albidum*). Many dragonflies and damselflies are also found along this stretch including a historic record of the G5 S2 **Common Sanddragon** (*Progomphus obscurus*).

Threats and Disturbances:

A river is the culmination of all its headwaters and tributaries. Upstream disturbances to the Juniata include substantial amounts of agricultural runoff (nutrients, sediments, and chemicals), thermal pollution, floodplain reduction and modification, and stormwater surges. Direct disturbances at the site include trash in the river, stormwater surges from local roads and municipalities, building on the floodplain, and runoff from agriculture and construction. Threats to the river include increased building on the floodplain and the resulting increase in stormwater surges along with continued neglect of existing problems.

Conservation Recommendations:

A concerted effort needs to be developed to promote the health of the entire Juniata Basin if the quality of this site is to be maintained or improved. This would include restricting cattle access to tributaries, implementation of runoff barriers at construction sites, and a 100 m (305 ft) forested riparian buffer on *all* tributaries of the Juniata River. Specific site recommendations include removal of trash from this reach, restriction of new buildings within the floodplain, and management of stormwater flows on the road and in the towns adjacent to this reach. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

LEWISTOWN NARROWS NORTH (Fermanagh Township and Mifflin County)

Long recognized as an exceptionally interesting geological, topographic, and scenic feature of Juniata and Mifflin counties, the Narrows is the Lewistown Narrows is also a core thoroughfare for travel through



southern wild senna (*Senna marilandica*)

photo source: Larry Klotz

the region (historic and current). At its steepest point the Narrows drops over 1600 feet in around one-half mile to the Juniata River. An excellent location to view the Narrows from is the Hawstone Overlook situated just south of PA 333 on Blue Mountain.

Active signs of G3G4, S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located along the talus slopes of the Lewistown Narrows during regular surveys over the past three decades. The sandstone and talus outcrops where the woodrats have been found extend along much of the ridgeline in the Narrows. The surrounding forest is characterized by black birch (*Betula lenta*), basswood (*Tilia americana*), sassafras (*Sassafras albidum*), hickory (*Carya* sp.), white oak (*Quercus alba*), red oak (*Q. rubra*), and chestnut oak (*Q. montana*). The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes (App. XI, pg. 188).

During surveys in 2001, a population of the G4 S3B, S3N **Northern Myotis** (*Myotis septentrionalis*) was found feeding along the Juniata River and open areas at this site. While the relationship of this location to a maternity site or overwintering site is unknown, the multiple individuals captured here show that this population uses this site for foraging. Additionally, the floodplain in the Narrows historically supported populations of the G3 S2 plant **Virginia mallow** (*Sida hermaphrodita*). Finally, there was a population of the

FERMANAGH TOWNSHIP

G5 S1 plant **southern wild senna** (*Senna marilandica*) that was displaced by the US 22/322 widening project. Despite the loss of the known populations, there is still ample habitat along the Narrows where these species may persist.

Threats and Disturbances:

Targeted monitoring stations for these species have been recently established at this site in association with planned and ongoing expansion of US 22/322. While the habitat for the woodrat is generally high on the slope above the road construction, it is unknown what effect nearby disturbance, blasting, and earthmoving will have on the species of concern. The southern wild senna was in the direct path of road construction and was relocated to a similar habitat out of harm's way, though the success of this action has not been evaluated.

MACEDONIA GAP (Fermanagh Township)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rocky habitats in the water gap during surveys in 1992. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.



Allegheny Woodrat (*Neotoma magister*), note furry tail

photo source: Cal Butchkowski



Allegheny Woodrat stick nest

photo source: Andrew Strassman (PNHP)

Threats and Disturbances:

The site is partially within State Game Lands 107 and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

SPIGELMYER GAP (Fermanagh Township)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock outcrops on Shade Mountain during surveys in 1992. This species has been located at several locations along Shade Mountains. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is partially within the State Game Lands #107 and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to

FERMANAGH TOWNSHIP

buffer the woodrat populations from external disturbance and negative environmental influence.

WAGNER GAP (Fermanagh Township and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rocky habitats in the water gap during surveys in 1995. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is primarily on private land and partially within State Game Lands #107 and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

Conservation Recommendations:

Continued monitoring of the populations will be needed to determine the impacts of the highway construction and potential loss of habitat. The chances for success of the plant relocation are low, but additional populations could be found in similar habitats along this stretch of river. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

LOST CREEK MEADOWS (Fermanagh and Fayette Townships)

This site encompasses an area of pastoral landscape around the town of Oakland Mills where a **Species of Special Concern** is successfully reproducing. 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



Juniata County's pastoral landscape

photo source: PNHP

km² (approximately 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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. Agriculture preservation zones may be one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly*

FERMANAGH TOWNSHIP

and safely) is another potential management technique to maintain the open fields.

Arch Rock Anticlines (Fermanagh Township)

This geological feature is unique to the Ridge and Valley region. Formed by the compression of the differing layers of stone over long periods, anticlines appear as an arch in the rock layers. At Arch Rock the anticlines have been exposed by weathering and are easily viewed from the road.

Threats and Disturbances:

The major threats to this site are development, erosion, and excavation. While geologically stable, development on the site may change drainage patterns causing the site to erode. Excavation at the site would destroy it.

Conservation Recommendations:

Development around the site should be done with respect to the uniqueness of the geology. Building directly above the site would not be recommended without a prior study to the effects it could have on the feature.

Shade Mountain Pools (Fermanagh Township)

This small topographic saddle at the headwaters of Macedonia Run harbors a small group of an ephemeral/fluctuating natural pools community. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. The surrounding forest is composed of various hardwood tree species. Though the pools are small and few, their condition appears good despite close proximity to a forest access road.

Threats and Disturbances:

The site is primarily under private. The primary land use at this site is recreational uses of the forest. Logging within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Additionally, the close proximity to the forest access road is facilitating the introduction of invasive plant species that can be found within this site taking advantage of logging trails and other disturbances.



Anticline and syncline in layered Precambrian gneiss along NJ Route 23 near the rest area exit ramp (west of Butler, NJ).

photo source: <http://3dparks.wr.usgs.gov/nyc/common/captions.htm>

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Greenwood Township

Taxa ¹	PNHP Rank ²		State Legal Status ³	Last Seen	Quality ³
	Global	State			
<i>NATURAL HERITAGE SITES:</i>					
None					
<i>PUBLICLY MANAGED LANDS:</i>		None			
<i>OTHER CONSERVATION AREAS:</i>		None			
<i>DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:</i>		None			
<i>AQUATIC COMMUNITIY CLASSIFICATION PROJECT RESULTS:</i>					
- Fish	River and Impoundment Community		Cocolamus Creek-Stoney Run		
	Warm-water Community 1		West Branch Mahantango Creek		
	Not Yet Assessed		Cocolamus Creek		
- Macroinvertebrate	Low Gradient Valley Stream Community		Cocolamus Creek-Stoney Run		
	Not Yet Assessed		Cocolamus Creek; West Branch Mahantango Creek		
- Mussel	Not Yet Assessed		Cocolamus Creek; Cocolamus Creek-Stoney Run; West Branch Mahantango Creek		

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

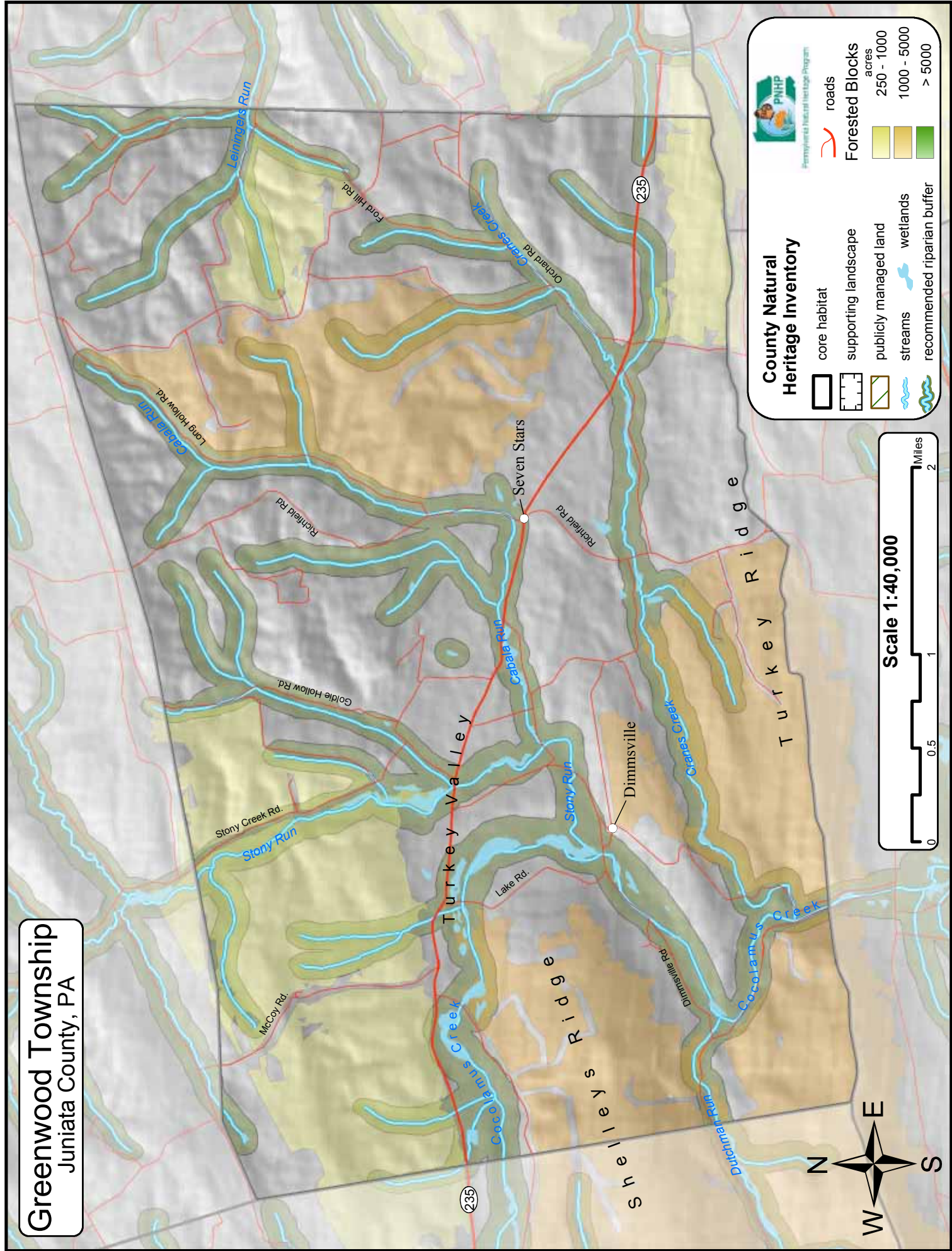
Split from Fermanagh Township in 1767, Greenwood Township is one of the county's smaller townships. Intersected by Turkey Valley, the township's southern border runs along Turkey and Lock Ridges while the northern border runs through a number of broken hills and small ridges. The township is primarily drained by Cocolamus Creek and its tributaries: Cranes, Stony, and Cabala Runs. There are no large blocks of public land. The subsurface geology of the area is composed of siltstone and shale. The primary land cover in the township is forest, which covers 63% of the township. The forest blocks are found along either side of Turkey Valley on top of the hills and ridges with several large, intact blocks. Of the remaining area, most is agricultural; which is concentrated in Turkey Valley and covers 32% of the township. Streams in the township are generally protected by forested riparian buffers. However, several stretches running through Turkey Valley have been adversely impacted by farming. Specifically, reaches



along Cranes and Cabalas Runs that are farmed to the edge of the creeks and are in need of immediate attention. These should have the forested riparian buffer restored to decrease agricultural inputs. These forested stream buffers would also provide connections between the various large forest blocks in the township.

No significant sites were documented within the township during the survey period.

Greenwood Township Juniata County, PA





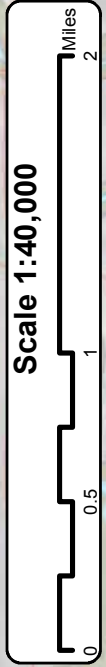
County Natural Heritage Inventory

- core habitat
- supporting landscape
- publicly managed land
- streams
- recommended riparian buffer

- roads

Forested Blocks

acres	Color
250 - 1000	Light Green
1000 - 5000	Medium Green
> 5000	Dark Green



Lack Township

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
TUSCARORA CREEK BELOW BARTON HOLLOW				Exceptional Significance		
Species of Special Concern ⁴	-	-	-	-	2005	B
Carey’s sedge (<i>Carex careyana</i>)	P	G4	S1	PE	2005	B
short-leaf pine (<i>Pinus echinata</i>)	P	G5	S1S2	TU	2006	C
Northern Pearly-eye (<i>Enodia anthedon</i>)	L	G5	S3S4	N	2006	C
Tawny Emperor (<i>Asterocampa clyton</i>)	L	G5	S3S4	N	2006	BC
Blue Corporal (<i>Ladona deplanata</i>)	O	G5	S1	N	2006	E
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
TUSCARORA CREEK BELOW BLAIR HOLLOW				Exceptional Significance		
Short’s sedge (<i>Carex shortiana</i>)	P	G5	S3	PR	2005	B
BLACKLOG MOUNTAIN AT T328				High Significance		
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
CONCORD NARROWS				High Significance		
Virginia mallow (<i>Sida hermaphrodita</i>)	P	G3	S2	PE	2002	B
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1987	C
REED’S GAP RIDGELINE				High Significance		
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	E
WILLOW RUN AT STATE GAME LANDS #215				Notable Significance		
Northern Myotis (<i>Myotis septentrionalis</i>)	M	G4	S3B/3N	CR	2003	E
PUBLICLY MANAGED LANDS:		Tuscarora State Forest State Game Lands # 215				
OTHER CONSERVATION AREAS:		Tuscarora Ridge (The Pulpit) Important Bird Tuscarora / Blue Mountain South Important Mammal Area Blacklog Mountain Important Mammal Area				
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:		Blacklog Creek (above Shade Creek) Horse Valley Run East Licking Creek (above Clearview Reservoir) Willow Run				
AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:						
- Fish	Coldwater Community	Horse Valley Run				
	Warm-water Community 1	Blacklog Creek; Narrows Branch Tuscarora Creek; Tuscarora Creek-Rhines Hollow; Willow Run				
	Warm-water Community 2	Tuscarora Run-Warble Run				
	River and Impoundment Community	East Licking Creek				
- Macroinvertebrate	High Quality Small Stream Community	Blacklog Creek; East Licking Creek; Narrows Branch Tuscarora Creek; Tuscarora Run-Warble Run				
	High Quality Mid-sized Stream Community	Tuscarora Creek-Rhines Hollow				
	Not Yet Assessed	East Licking Creek; Horse Valley Run; Willow Run				
- Mussel	Eastern Elliptio Community	East Licking Creek				
	Not Yet Assessed	Blacklog Creek; Horse Valley Run; Narrows Branch Tuscarora Creek; Tuscarora Creek-Rhines Hollow; Tuscarora Run-Warble Run; Willow Run				

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

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Lack Township Juniata County, PA



BLACKLOG MOUNTAIN AT T328

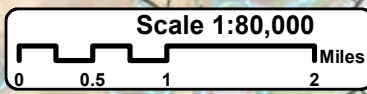
REED'S GAP RIDGELINE

WILLOW RUN AT STATE
GAME LANDS #215

TUSCARORA CREEK
BELOW BARTON HOLLOW

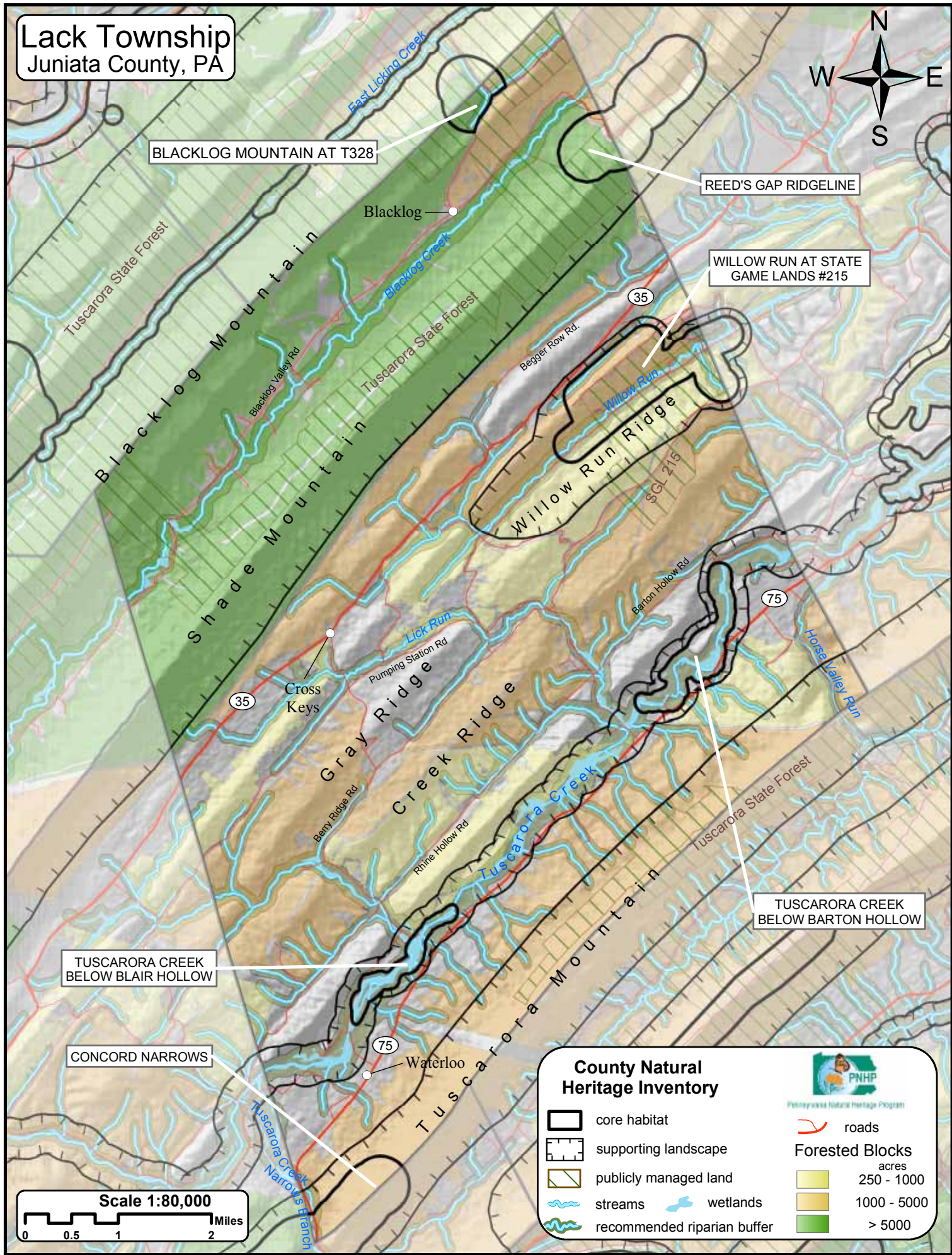
TUSCARORA CREEK
BELOW BLAIR HOLLOW

CONCORD NARROWS



County Natural Heritage Inventory

core habitat	roads
supporting landscape	Forested Blocks
publicly managed land	acres
streams	250 - 1000
recommended riparian buffer	1000 - 5000
wetlands	> 5000



LACK TOWNSHIP

Founded in 1754 and lying in the far west of Juniata County, Lack Township is bounded by Tuscarora Mountain to the south and Blacklog and Shade Mountains to the north. Running through a valley in the south, Tuscarora Creek is the major water feature of the township and an excellent warm water fishery. Several other streams in the township rate as High Quality Cold Water Fisheries including: Blacklog Creek, Willow Run, Horse Valley Run, and all of their tributaries. Public land is a major component of the township with Tuscarora State Forest along the north and south ridge tops and State Game Lands 215 nestled in the eastern-central region. These public lands also host Blacklog Mountain Important Mammal Area (IMA) on the northern ridge and Tuscarora Ridge (The Pulpit) Important Bird Area and Tuscarora / Blue Mountain South IMA on the south ridge. Blacklog Mountain IMA was designated because it represents a stronghold for the Allegheny Woodrat. (*Neotoma magister*), while Tuscarora / Blue Mountain South IMA was designated because of its importance to Allegheny Woodrats and many bat species of special concern. Tuscarora Ridge (The Pulpit) IBA was designated because of its cruciality to migratory birds. Land cover in the township is 19% agriculture, mainly in Shade Valley and along Tuscarora Creek; and 76% forest, mainly everywhere else. Lack Township has the most forest cover of any township in the county. Of that



forestland a great majority is interior forest, which is very important for neo-tropical birds. The large forest blocks, found along Shade and Tuscarora Mountains and Willow Run Ridge should be preserved. Major management concerns for the township should focus on retaining forested buffers along Tuscarora Creek and its tributaries, maintaining or improving forest cover along all High Quality streams, and maintaining large blocks of interior forest throughout the township. Public lands in the township should also be buffered to prevent future development directly adjacent to their edges. Restoration and conservation efforts should be focused on Tuscarora Creek. Specifically, an effort should be made to increase forest buffers along the Tuscarora Creek, reduce non-point source pollution into the creek (such as agricultural and road runoff), and prevent damming or diversion of the creek.



Tuscarora Creek below Blair Hollow

photo source: PNHP

TUSCARORA CREEK BELOW BARTON HOLLOW (Lack Township)

As Tuscarora Creek progresses towards the Juniata River, several hills and ridges rise around it. These hills and ridges support many unique species and communities that differ depending on the surface geology. The geology at Barton Hollow is a mix of limestone, shale, and sandstone that promotes very rich and diverse communities. One of these communities supports a **Species of Special Concern** and the G4G5 S1 plant **Carey's sedge** (*Carex careyana*), along with the G4 S4 American gromwell (*Lithospermum latifolium*), twinleaf (*Jeffersonia diphylla*), and James' sedge (*Carex jamesii*). Additionally, a population of G5 S3S4 butterfly **Tawny Emperor** (*Asterocampa clyton*) is found in this area that has an abundant population of northern hackberry (*Celtis occidentalis*), the butterfly's host plant. Heading down to the floodplain, there is the G5 S1S2 **short-leaf pine** (*Pinus echinata*), a species of the southern US. Finally, the creek supports a population of the G4 S3S4 **Triangle Floater** (*Alasmidonta undulata*) mussel, the G5 S1 **Blue Corporal** (*Ladona deplanata*) dragonfly, Illinois pondweed (*Potamogeton illinoensis*), and has historic records of G5T5 S3 white water-crowfoot (*Ranunculus aquatilis* v. *diffusus*) in this highly braided reach.

Threats and Disturbances:

The hill community at this site is only disturbed by encroaching invasive species. The main threat to this system would be logging on the slopes or other activities that would increase the prevalence of invasive plant species. The floodplain area is moderately disturbed by agricultural activity and the lack of an adequate forested buffer throughout much of the site. Threats to this area include the further conversion of forested buffer to agriculture and the conversion of any of the area to housing. Direct disturbances to the creek include several areas with no forested river buffer, or very thin buffers. This increases thermal pollution, agricultural inputs, and generally degrades river quality.

Conservation Recommendations:

The hill at this site includes many interesting species well outside their expected range along with many rare species. Because of its low gradient, even small unforested areas along Tuscarora Creek can greatly



Tuscarora Creek below Barton Hollow

photo source: PNHP

increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center. Finally, because of the general absence of non-native invasive species along this reach, any species that are encountered within this area they should be targeted for removal to prevent further colonization.

TUSCARORA CREEK BELOW BLAIR HOLLOW (Lack Township)

Running unimpeded for roughly 40 miles through western Juniata County, Tuscarora Creek is a very important feature of the landscape. Nearly flat through

LACK TOWNSHIP



Tuscarora Creek below Blair Hollow

photo source: PNHP

this area, Tuscarora Creek exhibits a broad, shallow, and braided appearance with a very wide floodplain that is relatively free of invasive species. This creates the necessary conditions for the marshy creek edges, oxbows, and back-channels present throughout this reach. These environments support the G5 S3 plant **Short's sedge** (*Carex shortiana*), which grow in the wet limestone-derived soils along and above the creek. The richness of this site is exemplified by the approximately 350 plant and 50 animal species identified over several surveys around the site. Other species of interest found here are the recently delisted G4 S4 American gromwell (*Lithospermum latifolium*), the G5 S4 golden club (*Orontium aquaticum*) the G4G5 S4 obovate beak-grass (*Diarrhena obovata*), and the G5 S3S4B Louisiana Water-thrush (*Seiurus motacilla*), which is showing persistent population decline.

Threats and Disturbances:

There are currently no direct disturbances to the creek on this reach and only some minor problems resulting from removal of the forested buffer. The major threats to the creek are further removal of the existing forested buffer and the resulting increase in agricultural inputs (sediments, nutrients, and chemicals) and thermal pollution. Additionally, unrestricted water withdrawals from the creek could adversely affect the system. A final threat to the area is invasive plant species such as reed canary-grass (*Phalaris arundinacea*), Morrow's honeysuckle (*Lonicera morrowii*), and Japanese knotweed (*Polygonum cuspidatum*) that out compete the native species.

Conservation Recommendations:

Because of its low gradient, even small unforested areas along Tuscarora Creek can greatly increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center. Because of the general absence of non-native invasive species along this reach, any species that are encountered within this area they should be targeted for removal to prevent further colonization.



Short's sedge (*Carex shortiana*)

photo source: Larry Klotz

LACK TOWNSHIP



Virginia Mallow (*Sida hermaphrodita*)

photo source: Richard H. Wiegand
<http://www.dnr.state.md.us/wildlife/rtemonth.asp>

BLACKLOG MOUNTAIN AT T328 (Lack Township and Mifflin County)

Active signs of the G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in a sandstone talus field during surveys in 1992. The surrounding forest included black birch (*Betula lenta*), eastern hemlock (*Tsuga canadensis*), and red oak (*Quercus rubra*), with a shrub layer of witch hazel (*Hamamelis virginiana*). The woodrat has been located at several sites along the Blacklog Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes (App. XI, pg. 188).

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to

buffer the woodrat populations from external disturbance and negative environmental influence.

CONCORD NARROWS (Lack Township and Huntingdon and Franklin Counties)

The Concord Narrows is a cut through the quartzite of Tuscarora Mountain made by eons of erosion from the Narrows Branch Tuscarora Creek. This site contains a good population of **Virginia mallow** (*Sida hermaphrodita*), a G3 S2 plant species of concern.

This species has a very limited range, occurring more abundantly in Ohio, Kentucky, and West Virginia, and is typically found in artificially altered habitats like road cuts and railroad beds. The natural habitat of this species is typically sites that receive natural disturbances such as ice scouring along rivers and creeks. Despite its weedy character, populations are declining over much of its natural range, making the long-term outlook for this species precarious. This population is situated on a roadside at the foot of Tuscarora Mountain. Invasive plant species found here include multiflora rose, tree-of-heaven, and Morrow's honeysuckle. Also included in this site on a talus slope is a fair population of **PA-threatened Allegheny Woodrat** (*Neotoma magister*), a G3G4 S3 animal species of concern.

Threats and Disturbances:

Threats to the roadside population of Virginia mallow include mowing, invasive plant species, and roadside herbicides. For the Allegheny Woodrat site, disturbances include logging on top of ridges and potential development.



Ridgeline habitat along the Juniata-Mifflin County border

photo source: PNHP

LACK TOWNSHIP

Conservation Recommendations:

Since this is a roadside population, any herbicide application to invasive species should be very carefully administered due to the vulnerability of this population. Even though this is a roadside population, the G3 status of this species increases the importance of this population. For the Allegheny Woodrat site, it is recommended that an undisturbed forested buffer be maintained around ridgetop rocky outcrops where the woodrats occur.

REED'S GAP RIDGELINE (Lack and Tuscarora Townships)

Active signs of G3G4 S3 **PA-threatened Allegheny woodrat** (*Neotoma magister*) were located at the crest of this mountain during surveys in 1993. This is one of several locations for this species along the Shade Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed excepting a pipeline right-of-way that crosses the site.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

WILLOW RUN AT STATE GAME LANDS #215 (Lack and Tuscarora Townships)

State Game Lands #215, situated along Willow Run, is a recorded breeding location for the G4 S3B S3N **Northern Myotis** (*Myotis septentrionalis*). This bat species spends the winter hibernating in the many caverns of the area. During the summers it frequents wooded streams and trails where it forages, while spending the day roosting in natural cavities and hollow trees. While the relationship of this location to a maternity site or overwintering site is unknown, the

multiple individuals captured here show that this population uses the site for foraging.

Threats and Disturbances:

The various wildlife openings created around the stream and trails at this site as well as a gas pipeline right-of-way expose the interior forest where the bats feed to the elements and predators that they are otherwise buffered from. Potential threats to the site are logging and expansion of the wildlife plots. This could remove both foraging and denning habitat. Special consideration should be given to the planned expansion of the gas pipeline right-of-way given its potential as a corridor for invasive species and as an impermeable barrier for native species dispersal.

Conservation Recommendations:

A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the creek and trails. This will maintain "interior" forest around the creek and trails even if logging occurs outside this area. Additionally, standing deadwood and hollow trees should be left as ideal denning locations.



Gas pipeline through SGL 215

photo source: PNHP

LACK TOWNSHIP



Blacklog Creek, Lack Township, Juniata County
photo source: Andrew Strassman (PNHP)

Milford Township and Mifflin & Port Royal Boroughs

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
LEWISTOWN NARROWS SOUTH			Exceptional Significance			
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	AB
BLUE MOUNTAIN AT HISSING ROCKS			High Significance			
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
BLUE MOUNTAIN AT SLIP ROCK #2			High Significance			
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
BLUE MOUNTAIN AT VINCENT TRAM ROAD			High Significance			
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	E
BLUE MOUNTAIN AT WHITSEL TRAIL			High Significance			
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	E
EAST LICKING CREEK ABOVE ZOOK’S DAM			High Significance			
Species of Special Concern ⁴	-	-	-	-	2006	F
JUNIATA COUNTY JUNIATA RIVER CORRIDOR			High Significance			
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	B
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	2006	E
Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	E
white trout-lily (<i>Erythronium albidum</i>)	P	G5	S3	TU	2005	BC
Common Sanddragon (<i>Progomphus obscurus</i>)	O	G5	S2	N	1959	H
TUSCARORA CREEK AT PORT ROYAL			High Significance			
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	E
CLEARVIEW RESERVOIR DELTA			Notable Significance			
short hair sedge (<i>Carex crinita brevicrinis</i>)	P	G5	S1	PE	1993	BC
VINCENT TRAM ROAD ROADCUT			Notable Significance			
purple bedstraw (<i>Galium latifolium</i>)	P	G5	S3	TU	2006	BC
East Licking Creek			Locally Significant			
Rainbow Rocks Anticlines			Locally Significant			

PUBLICLY MANAGED LANDS: Tuscarora State Forest

OTHER CONSERVATION AREAS: Central Pennsylvania Conservancy
Blacklog Mountain Important Mammal Area

DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: East Licking Creek (above Clearview Reservoir)

AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:

- Fish	<i>Warm-water Community 2</i>	Tuscarora Creek
	<i>River and Impoundment Community</i>	East Licking Creek; Juniata River-Tuscarora Creek
- Macroinvertebrate	<i>High Quality Small Stream Community</i>	East Licking Creek; Juniata River-Tuscarora Creek; Tuscarora Creek
	<i>Eastern Elliptio Community</i>	East Licking Creek
- Mussel	<i>Yellow Lampmussel Community</i>	Juniata River-Tuscarora Creek
	<i>Not Yet Assessed</i>	Tuscarora Creek

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

Milford Township Juniata County, PA

JUNIATA COUNTY
JUNIATA RIVER CORRIDOR

TUSCARORA CREEK
AT PORT ROYAL

Rainbow Rocks
Anticlines

LEWISTOWN NARROWS
SOUTH

BLUE MOUNTAIN AT
SLIP ROCK #2

BLUE MOUNTAIN AT
HISSING ROCKS

CLEARVIEW
RESERVOIR DELTA

BLUE MOUNTAIN AT
VINCENT TRAM ROAD

VINCENT TRAM ROAD
ROADCUT

EAST LICKING CREEK
ABOVE ZOOK'S DAM

East Licking Creek

BLUE MOUNTAIN AT
WHITSEL TRAIL

Mifflin

Port
Royal

Coaling Valley Rd

Martins
Crossroad

(75)

(35)

(333)

(35)

(333)

(322)

22



County Natural Heritage Inventory

core habitat

supporting landscape

publicly managed land

streams

recommended riparian buffer

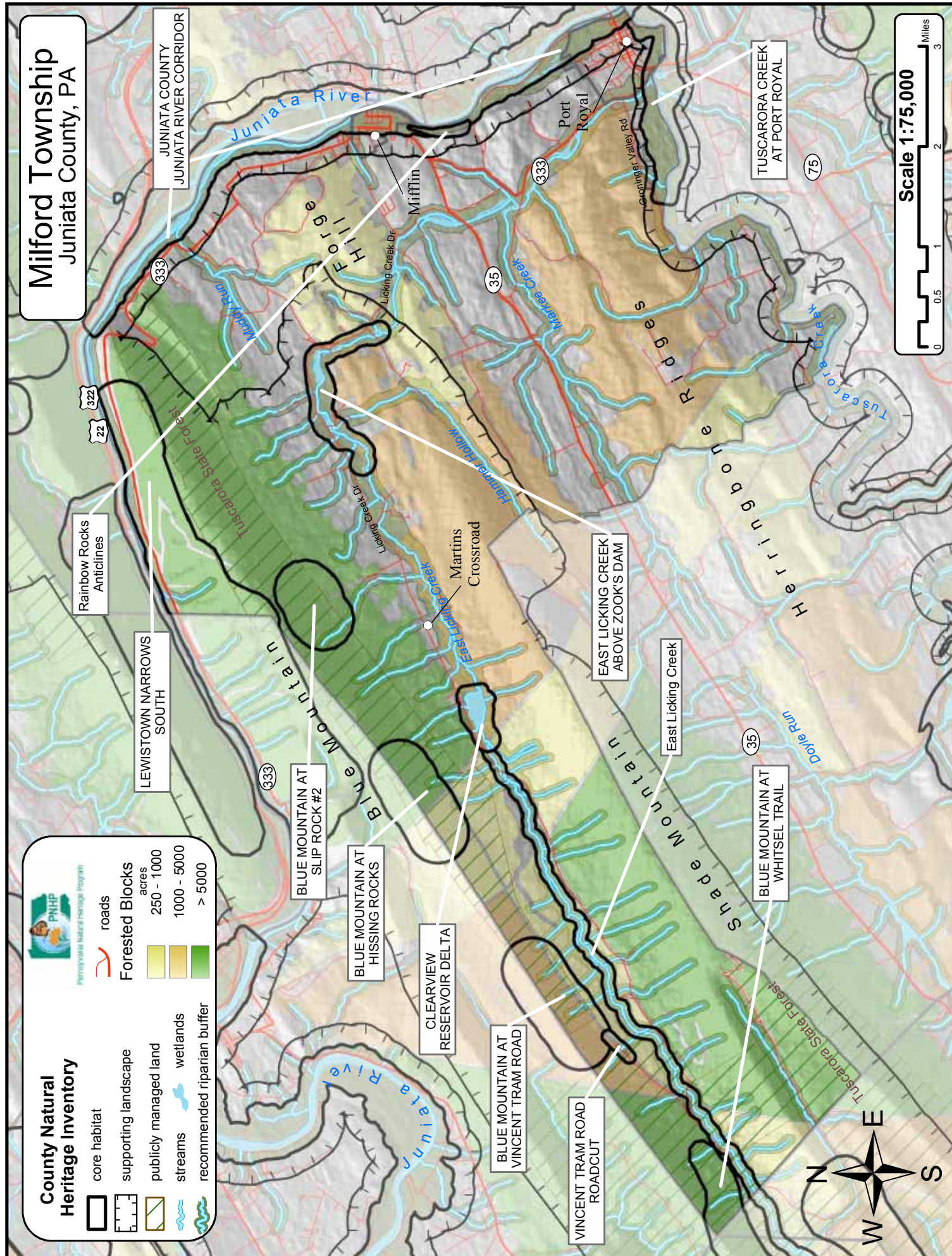
roads

Forest Blocks
acres

250 - 1000

1000 - 5000

> 5000



MILFORD TOWNSHIP

Founded in 1768 from part of Lack Township, Milford Township is bounded by Blue Mountain to the north, the Juniata River to the east, and Tuscarora Creek to the south. Running down the valley between Blue and Shade Mountains, East Licking Creek is a beautiful forested mountain stream with a High Quality Cold Water Fishery designation. The Juniata River is home to several important mussel species in this reach and is an excellent warm water fishery. To preserve these species and the scenic and environmental quality of the river, building should not be permitted in the floodplain. An additional consideration along the Juniata should be storm water management to prevent nutrient and road-salt influxes. Running along Blue Mountain in the north, Tuscarora State Forest is a major component of the landscape and also contains part of Blacklog Mountain Important Mammal Area (IMA). This IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*). Land cover in the township is 24% agriculture and 72% forest; the township's forested acreage is the second highest in the county. Most of that forestland is intact, indicating large amounts of interior forest. An effort should be made to maintain these large



forest blocks found on Blue and Shade Mountains and along Herringbone Ridge. Major restoration and conservation concerns for the township should be focused on creating a forested buffer along Tuscarora Creek and its tributaries, maintaining the forested buffer along East Licking Creek and all its tributaries, and reducing non-point source pollution into all creeks and rivers (especially along Muddy Run and Markee Creek). Finally, care should be taken to limit development in the Juniata River and Tuscarora Creek floodplains and around the township's public lands, which will see increased development pressure with the continued improvement of US 22/322.



Juniata River in Milford Township
photo source: Andrew Strassman (PNHP)

LEWISTOWN NARROWS SOUTH (Milford Township and Mifflin County)

Long recognized as an exceptionally interesting geological, topographic, and scenic feature of Juniata and Mifflin counties, the Lewistown Narrows it is also a core thoroughfare for travel through the region (historic and current). At its steepest point the Narrows drops over 1600 feet in around one-half mile to the Juniata River. An excellent location to view the Narrows from is Hawstone Overlook situated just south of Route 333 on Blue Mountain.

Active signs of G3G4, S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located along the talus slopes of the Lewistown Narrows during regular surveys over the past three decades. The sandstone and talus outcrops where the woodrats have been found extend along much of the ridgeline in the Narrows. The surrounding forest is characterized by black birch (*Betula lenta*), basswood (*Tilia americana*), sassafras (*Sassafras albidum*), hickory (*Carya* sp.), white oak (*Quercus alba*), red oak (*Quercus rubra*), and chestnut oak (*Quercus montana*). The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes (App. XI, pg. 188).

The floodplain in the Narrows offers excellent habitat for the G5 S1 southern wild senna (*Senna marilandica*) and the G3 S2 Virginia mallow (*Sida hermaphrodita*). While none have been found on the south slope, there is ample habitat along the entire Narrows where these species may be and recorded populations from the north slope. This site may additionally provide foraging habitat for bats as seen on the north bank.

Threats and Disturbances:

Targeted monitoring stations for these species have been recently established at this site in association with planned and ongoing expansion of US 22/322. While there is no active construction on the south slope, it is unknown what effect nearby disturbance, blasting, and earthmoving will have on the species of concern.



Virginia mallow (*Sida hermaphrodita*)

photo source: John Kunsman (PNHP)

Conservation Recommendations:

Continued monitoring of the population will be needed to determine the impacts of the highway construction and potential loss of habitat. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

BLUE MOUNTAIN AT HISSING ROCKS (Milford Township and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located at the crest of this mountain during surveys in 1992. This species has been located at several locations along the Blue Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

MILFORD TOWNSHIP



Juvenile Allegheny Woodrat (*Neotoma magister*) captured and released for research (note furry tail)

photo source: Cal Butchkowski

BLUE MOUNTAIN AT SLIP ROCK #2 (Milford Township)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock outcrops on Blue Mountain during surveys in 1987. This species has been located at several locations along Blue Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is on private land and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

BLUE MOUNTAIN AT VINCENT TRAM ROAD (Milford Township and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock

outcrops on Blue Mountain during surveys in 1993. This species has been located at several locations along Blue Mountains. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is partially within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

BLUE MOUNTAIN AT WHITSEL TRAIL (Milford and Tuscarora Townships and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock outcrops on Blue Mountain during surveys in 1992. This species has been located at several locations along the Blue and Blacklog Mountains. The woodrat typically inhabits the deep crevices of rocky outcrops,



Scree slopes are the preferred habitat of the Allegheny Woodrat (*Neotoma magister*)

photo source: PNHP

MILFORD TOWNSHIP

boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

EAST LICKING CREEK ABOVE ZOOK'S DAM (Milford Township)

A **Species of Special Concern** is found at this site. Originally found before the removal of Zook's dam, this species has not been documented from this location since 1994. Given its very cryptic nature, it is likely to persist at this location at a low population density.

Threats and Disturbances:

Within the site there is little or no forested buffer between the creek and active agriculture. Upstream of the site, cattle were documented in the creek channel. This allows for large quantities of agricultural chemicals, nutrients, and sediments to directly enter the creek and greatly increases thermal pollution. This is a major disturbance to the creek and all the waterways downstream. Further threats include continued urban development within the watershed and the continued removal and degradation of the existing forested riparian buffer.

Conservation Recommendations:

Cattle should be excluded from the stream. Their presence is a severe disturbance to this site. A forest buffer should be maintained where it exists, created where it does not, and ideally widened to 100 m (305 ft) along the *entire creek*. These recommendations can be achieved through many existing programs that provide incentives to landowners who exclude cattle from waterways and restore forested stream buffers. Further information on available programs can be

gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

JUNIATA COUNTY JUNIATA RIVER

CORRIDOR (Milford, Fermanagh, Turbett, Walker, and Delaware Townships and Mifflin, Mifflintown, and Port Royal Boroughs)

The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery (see Aquatic Community Classification section for details), the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. The many islands provide ample habitat for aquatic birds, mammals, insects, and plants. Additionally, the river acts as a corridor between its headwaters in Somerset County and the Susquehanna River. In Juniata County the river supports populations of freshwater mussels including the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*), the G4 S3S4 **Triangle Floater** (*Alasmodonta undulata*), and the G4 S4 **Elktoe** (*Alasmodonta marginata*). The Eastern Elliptio (*Elliptio complanata*) and the G5 S1 Rainbow Mussel (*Villosa iris*) are also common at this site, though the Rainbow Mussel's state rank only applies to individuals in the Ohio River Basin. The various sandbars, island edges, and river scours provide excellent habitat for the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) whose caterpillar feeds preferentially on wingstem (*Verbesina alternifolia*). The wet, shaded river edges are home to the G5 S3 **white trout-lily** (*Erythronium albidum*). Many dragonflies and damselflies are also found along this stretch including a historic record of the G5 S2 **Common Sanddragon** (*Progomphus obscurus*).



Silvery Checkerspot (*Chlosyne nycteis*)

photo source: Will Cook, www.carolinanature.com

MILFORD TOWNSHIP

Threats and Disturbances:

A river is the culmination of all its headwaters and tributaries. Upstream disturbances to the Juniata include substantial amounts of agricultural runoff (nutrients, sediments, and chemicals), thermal pollution, floodplain reduction and modification, and stormwater surges. Direct disturbances at the site include trash in the river, stormwater surges from local roads and municipalities, building on the floodplain, and runoff from agriculture and construction. Threats to the river include increased building on the floodplain and the resulting increase in stormwater surges along with continued neglect of existing problems.

Conservation Recommendations:

A concerted effort needs to be developed to promote the health of the entire Juniata Basin if the quality of this site is to be maintained or improved. This would include restricting cattle access to tributaries, implementation of runoff barriers at construction sites, and a 100 m (305 ft) forested riparian buffer on *all* tributaries of the Juniata River. Specific site recommendations include removal of trash from this reach, restriction of new buildings within the floodplain, and management of stormwater flows on the road and in the towns adjacent to this reach. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

TUSCARORA CREEK AT PORT ROYAL (Milford and Turbett Townships)

As Tuscarora Creek approaches the Juniata River it becomes very flat, broad, and slow with a very wide floodplain, which is dominated by agriculture and suburban sprawl. This reach supports a population of the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*) at a site near the mouth of the Tuscarora Creek.

Threats and Disturbances:

Broad, flat, and highly developed in this reach, this portion of the Tuscarora Creek is generally affected by disturbance from combined sewer outflows, accumulated agriculture inputs, and a very thin or missing forested riparian buffer (causing thermal pollution). These are major disturbances to the creek. Further threats include continued urban development within the watershed and the continued removal and



Yellow Lampmussel in its preferred substrate

photo source: PNHP

degradation of the existing upstream forested riparian buffer.

Conservation Recommendations:

A forest buffer should be maintained where it exists, created where it does not, and ideally widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

CLEARVIEW RESERVOIR DELTA (Milford Township)

The manmade delta of the Clearview Reservoir supports great plant diversity including two important plants. The first is the G5 S1 plant **short hair sedge** (*Carex crinita brevicrinis*) that favors the wet forest of the floodplain. The second is the G5 S4 small-floating manna-grass (*Glyceria borealis*), which is only found in very shallow water along the margins of the stream and reservoir, and has recently been delisted. The delta area also provides ample feeding and nesting habitat for various waterfowl and wading birds.

Threats and Disturbances:

The only disturbance noted at this site was a prevalence of non-native invasive species. Potential threats to the site include logging. Removal of the dam would not be expected to adversely affect either plant species.

MILFORD TOWNSHIP

Conservation Recommendations:

Mechanical removal of non-native invasive species would be beneficial to both plant populations.

VINCENT TRAM ROAD ROADCUT (Milford Township)

This population of the G5 S3 plant **purple bedstraw** (*Galium latifolium*) is found situated and expanding along a logging road on Blue Mountain. Normally a resident of open woodlands, this population is flourishing in response to reduced competition.

Threats and Disturbances:

Disturbances to the area include the past logging and non-native invasive species spreading along the road. Threats to the site include logging, the further spread of non-native invasive species, and the introduction of additional invasive species.

Conservation Recommendations:

Care should be given to prevent the introduction and spread of non-native invasive species at this site. Potential sources of additional invasive species are heavy machinery, ATVs, and horses via mud, debris, and other substances carried in with them. Logging, if done with minimal disturbance to the site's soil, should pose little threat to this species.

East Licking Creek (Milford and Tuscarora Townships and Mifflin County)

The upper parts of the East Licking Creek drainage are characterized by several wet meadow openings interspersed throughout the drainage in an otherwise hemlock-dominated floodplain. Dominant plants in the meadows include *Sphagnum* moss, sedges (*Carex* spp.), cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), sensitive fern (*Onoclea sensibilis*), smooth alder (*Alnus serrulata*), rushes (*Juncus* spp.), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and swamp dewberry (*Rubus hispidus*). The seeps and wetlands also provide habitat for several reptile and amphibian species, such as the Long-tailed Salamander (*Eurycea longicauda*) and Red-spotted Newt (*Notophthalmus viridescens*). East Licking Creek is designated as a High Quality stream.

Threats and Disturbances:

The site is within the Tuscarora State Forest and remains relatively undisturbed. Jeep trails and footpaths in the vicinity are providing disturbance pathways for invasive plant species such as Japanese stiltgrass (*Microstegium vimineum*) to establish, but few invasive species were found in the wetlands.

Conservation Recommendations:

The East Licking Creek drainage should be buffered by 100 m (328 feet) from any logging operations in order to maintain the ecological integrity of the wetlands and the water quality of the groundwater seeps and surface water flowing to these wetlands. Populations of invasive plants should be monitored for encroachment into the more sensitive wetland systems.

Rainbow Rocks Anticlines (Milford Township)

This geological feature is unique to the Ridge and Valley region. Formed by the compression of the differing layers of stone over long periods, anticlines appear as an arch in the rock layers. At Rainbow Rocks the anticlines have been exposed by weathering and are easily viewed from the river.

Threats and Disturbances:

The major threats to this site are development, erosion, and excavation. While geologically stable, development on the site may change drainage patterns causing the site to erode. Excavation at the site would destroy it.

Conservation Recommendations:

Development around the site should be done with respect to the uniqueness of the geology. Building directly above the site would not be recommended without a prior study to the effects it could have on the feature.

Monroe Township

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
WEST BRANCH MAHANTANGO CREEK VERNAL POOLS			Exceptional Significance			
ephemeral/fluctuating natural pool	C	GNR	S3	-	2006	E
Species of Special Concern ⁴	-	-	-	-	2006	E
swamp dog-hobble (<i>Leucothoe racemosa</i>)	P	G5	S2S3	TU	2006	E
RICHFIELD MARSH			Notable Significance			
hard-stemmed bulrush (<i>Schoenoplectus acutus</i>)	P	G5	S2	PE	1987	B
Varner Gap Pools		Locally Significant				
PUBLICLY MANAGED LANDS:		None				
OTHER CONSERVATION AREAS:		Central Susquehanna Valley Important Mammal Area				
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:		None				
AQUATIC COMMUNITIY CLASSIFICATION PROJECT RESULTS:						

- Fish	<i>Warm-water Community 1</i>	West Branch Mahantango Creek
	<i>River and Impoundment Community</i>	Cocolamus Creek-Stoney Run
	<i>Not Yet Assessed</i>	Cocolamus Creek
- Macroinvertebrate	<i>Low Gradient Valley Stream Community</i>	Cocolamus Creek-Stoney Run
	<i>Not Yet Assessed</i>	Cocolamus Creek; West Branch Mahantango Creek
- Mussel	<i>Not Yet Assessed</i>	Cocolamus Creek; Cocolamus Creek-Stoney Run; West Branch Mahantango Creek

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

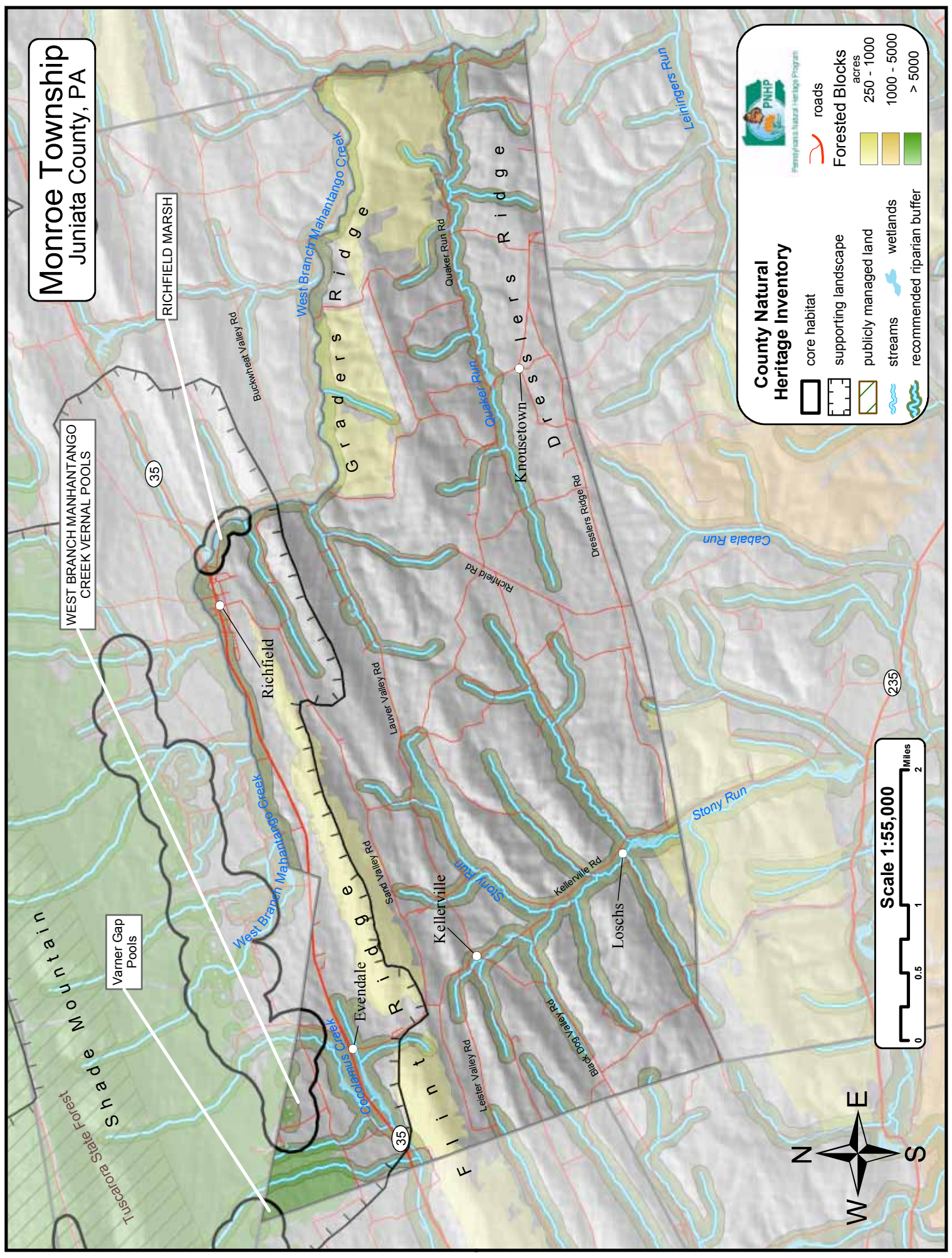
⁴ This species is not named at the request of the agency overseeing its protection

Monroe Township was founded in 1858 when Greenwood Township was split in three. The township is bordered on the north and east by the West Branch Mahantango Creek and on the south and west by Greenwood and Fayette Townships. The landscape is a mix of small forested hills and agricultural plots. The township is drained by the West Branch Mahantango Creek, Stony Run, and Quaker Run and their tributaries. There are no large blocks of public land. Land use in the township is evenly split between agriculture (48%) and forestland (46%) of township. Agricultural areas are concentrated in the township's many valleys (Page, Swartz, Quaker, Black Dog, Leister, and Slim) with the hills and ridges (Dresslers, Graders, and Flint) being primarily forested. The forest blocks within the



Township are highly fragmented and generally isolated and need connecting corridors. Many of the streams in the township lack a riparian buffer, leaving them susceptible to erosion, runoff, and thermal pollution. Restoring these forested buffers should be examined as a means of increasing stream health within the township and connecting isolated forest blocks.

Monroe Township Juniata County, PA





Pennsylvania Natural Heritage Program

County Natural Heritage Inventory

- core habitat
- supporting landscape
- publicly managed land
- streams
- wetlands
- recommended riparian buffer

roads

Forested Blocks

acres

- 250 - 1000
- 1000 - 5000
- > 5000



WEST BRANCH MANHANTANGO
CREEK VERNAL POOLS

Varner Gap
Pools

RICHFIELD MARSH

Richfield

West Branch Manantango Creek

Graders Ridge

Evendale

Kellerville

Knousetown

Loschs

Leiningers Run

Stony Run

Cabala Run

Leister Valley Rd

Black Dog Valley Rd

Kellerville Rd

Richfield Rd

Dresslers Ridge Rd

Lawver Valley Rd

Sand Valley Rd

Quaker Run Rd

Quaker Run

35

235

35

Shade Mountain

Tuscarora State Forest

MONROE TOWNSHIP

WEST BRANCH MAHANTANGO CREEK VERNAL POOLS (Monroe Township and Snyder 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 Mahantango Creek. This site also contains a population of a **Species of Special Concern**. At two of the vernal pools in this community, specimens of the **swamp dog-hobble** (*Leucothoe racemosa*), a G5 S2S3 plant species of concern, were located. This species is typically associated with the coastal plain, though a handful of records exist further inland.

Threats and Disturbances

Many of the ponds have been rather recently logged around the perimeter. During some of these forestry operations, the tops of the trees were thrown into the



West Branch Mahantango Creek Vernal Pools

photo source: Charlie Eichelberger (PNHP)



Swamp dog hobble (*Leucothoe racemosa*)

photo source: Rocky Gleason (PNHP)

pools. Vernal pool communities in Pennsylvania have typically existed in the landscape for tens of thousands of years. These communities are best managed by not cutting the vegetation around the pools.

Conservation Recommendations

A no-cut forested buffer of 305 m (1000 ft) should be established around this community to protect the delicate nature of these communities and the species that rely on them. Though vernal pools are often thought of as isolated wetlands, the species within the pools rely on linkages between the wetlands. The preservation of an intact forest canopy around these ecosystems will help maintain habitat for the species that occur here.

RICHFIELD MARSH (Monroe Township and Snyder County)

This site is a small 1-2 acre wetland along the West Branch Mahantango Creek. This wetland consists 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*). The G5 S2 **state endangered hard-stemmed bulrush** (*Schoenoplectus acutus*) was recorded from this site in 1987. The 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.

MONROE TOWNSHIP

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.

Varner Gap Pools (Monroe and Fayette Townships and Snyder County)

The south toe-slope of Shade Mountain contains many locations where water naturally pools. This location, below Varner Gap, contains several closely grouped small pools comprising an 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.

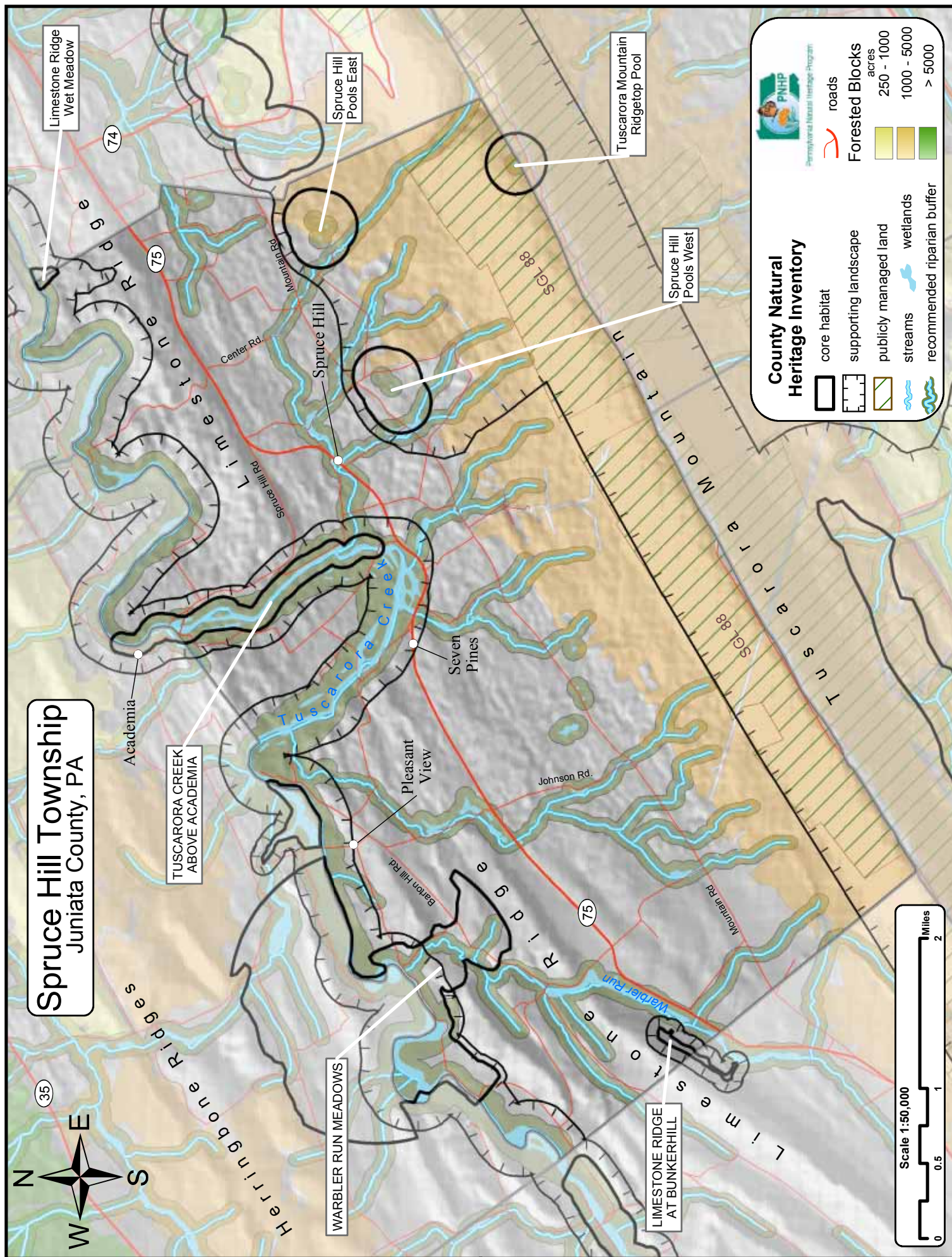
Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.



Hard-stemmed bulrush (*Schoenoplectus acutus*)

photo source: Robert W. Freckmann Herbarium, UWSP
Robert W. Freckmann



TUSCARORA CREEK ABOVE ACADEMIA (Spruce Hill and Beale Townships)

As the Tuscarora Creek flows to the Juniata River, the stream becomes increasingly low gradient interspersed by areas of high gradient where the creek eats through different rock layers. The reach above Academia features one of these high gradient areas surrounded by nearly flat water. This portion/reach of Tuscarora Creek supports a population of the G5 S1 **Eastern Lampmussel** (*Lampsilis radiata*), which prefers the gravelly and sandy bottom. The host fish of this mussel species is still unknown, but suspected to be a member of the shiner or sunfish family.

Threats and Disturbances:

Current disturbances on this reach are created by an inadequate forest buffer and the cumulative effect of upstream thermal and agricultural pollution. Current threats include the continued removal and neglect of the forest buffer, continued agricultural runoff, and the potential release of large amounts of nutrients from local Confined Animal Feeding Operations (CAFOs).

Conservation Recommendations:

Because of the low gradient of the creek on this reach, even small unforested areas can greatly increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Any local CAFOs should also be examined for their potential threat to the creek. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.



Eastern Lampmussel (*Lampsilis radiata*)

photo source: <http://darbycreeks.org/Musselinfo.htm>



Henry's Elfin (*Callophrys henrici*)

photo source: Rocky Gleason (PNHP)

LIMESTONE RIDGE AT BUNKER HILL (Spruce Hill and Tuscarora Townships)

As the layers of Earth's crust were compressed to form the Appalachian Mountains and the Ridge and Valley region, various hidden layers were exposed. One of these is a rich layer of limestone that supports many unique communities throughout the county. At Bunker Hill the limestone supports a large area of redbud (*Cercis canadensis*) and other calcium loving plants. While redbud is very common in the state, the G5 S1S3 **Henry's Elfin** (*Callophrys henrici*) is not. The caterpillar of this small butterfly feeds exclusively on redbud and depends on the close proximity of flowers to feed the adults. Additionally, the small size of this species gives it a very poor ability to colonize new sites, thus making protection of existing populations critical to its persistence.

Threats and Disturbances:

The primary threat at this site is succession to mature woodland or complete removal of the woodland. Either activity would reduce the redbud population, the singular food source for Henry's Elfin caterpillars. An additional threat would be a decrease in nectar plants for the adult, resulting from local land use changes. The only active disturbance to the site is the pasturing of the adjacent field, which limits the available nectar plants.

SPRUCE HILL TOWNSHIP

Conservation Recommendations:

Various ages of forest should be maintained to assure that there is always food available for both the caterpillars and adults. Under no circumstances should this area be clear-cut, but selective cutting may be advisable to maintain younger stands with a high proportion of redbud. Nectar plants should also be promoted to maintain the adult population. This can be achieved by excluding cattle from the edge of the forested area and mowing occasionally as woody plants invade.

WARBLER RUN MEADOWS (Spruce Hill and Beale Townships)

This site encompasses an area of pastoral landscape south of Doyles Mills where a **Species of Special Concern** is successfully reproducing. 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 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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



Limestone Ridge wet meadow

photo source: PNHP

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. Agriculture preservation zones may be one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly and safely*) is another potential management technique to maintain the open fields.

Limestone Ridge Wet Meadow (Spruce Hill and Turbett Townships)

This small wet meadow in the Tuscarora Creek floodplain is an excellent example of a wet meadow community. While no rare plants or animals were found during the survey, the site does support three species of interest: the thicket sedge (*Carex abscondita*), Davis' sedge (*Carex davisii*), and Leavenworth's sedge (*Carex leavenworthii*). The combination of plants present at this site indicates a rich calcareous soil that is perennially wet.



Viewshed, Spruce Hill Township

photo source: Andrew Strassman (PNHP)

SPRUCE HILL TOWNSHIP

Threats and Disturbances:

Disturbances to the area include the past logging and non-native invasive species spreading through logged areas. Threats to the site include logging, the further spread of non-native invasive species, and the introduction of additional invasive species.

Conservation Recommendations:

Care should be given to prevent the introduction and spread of non-native invasive species at this site. Potential sources of additional invasive species are heavy machinery, ATVs, and horses via mud, debris, and other substances carried in with them.

Spruce Hill Pools East (Spruce Hill Township)

The toe-slope of Tuscarora Mountain offers many locations where water can pond. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. It is occupied by a very small complex of an ephemeral/fluctuating natural pools community. The surrounding forest is composed of various hardwood tree species. Though the pools are small and few, their condition appears good.

Threats and Disturbances:

The site is owned by multiple private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational uses of the forest. Logging or development within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Spruce Hill Pools West (Spruce Hill Township)

The toe-slope of Tuscarora Mountain offers many locations where water can pond. This location is drawn from a combination of National Wetland

Abridged Plant List from Limestone Ridge Wet Meadow

Sedges, Grass, and Rushes	
broom sedge	<i>Carex scoparia</i>
Carolina sedge	<i>Carex caroliniana</i>
common rush	<i>Juncus effusus</i>
common woodrush	<i>Luzula multiflora</i>
Davis' sedge	<i>Carex davisii</i>
deertongue grass	<i>Dichanthelium clandestinum</i>
eastern narrowleaf sedge	<i>Carex amphibola</i>
fowl mannagrass	<i>Glyceria striata</i>
fox sedge	<i>Carex vulpinoidea</i>
fringed sedge	<i>Carex crinita</i>
fuzzy wuzzy sedge	<i>Carex hirsutella</i>
Georgia bulrush	<i>Scirpus georgianus</i>
Gray's sedge	<i>Carex grayi</i>
hop sedge	<i>Carex lupulina</i>
inflated narrow-leaf sedge	<i>Carex grisea</i>
Japanese Stiltgrass	<i>Microstegium vimineum</i>
Leavenworth's sedge	<i>Carex leavenworthii</i>
limestone meadow sedge	<i>Carex granularis</i>
nodding fescue	<i>Festuca obtusa</i>
orchard grass	<i>Dactylis glomerata</i>
owlfruit sedge	<i>Carex stipata</i>
poverty oatgrass	<i>Danthonia spicata</i>
rat-tail fescue	<i>Vulpia myuros</i>
reed canarygrass (exotic)	<i>Phalaris arundinacea</i>
rice cutgrass	<i>Leersia oryzoides</i>
rough bluegrass	<i>Poa trivialis</i>
rufous bulrush	<i>Scirpus pendulus</i>
shallow sedge	<i>Carex lurida</i>
slender wedgescale	<i>Sphenopholis intermedia</i>
smoothsheath sedge	<i>Carex laevivaginata</i>
squarrose sedge	<i>Carex squarrosa</i>
starved panicgrass	<i>Dichanthelium depauperatum</i>
sweet vernalgrass	<i>Anthoxanthum odoratum</i>
sweet woodreed	<i>Cinna arundinacea</i>
tapered rosette grass	<i>Dichanthelium acuminatum</i>
thicket sedge	<i>Carex abscondita</i>
twisted sedge	<i>Carex torta</i>
whitegrass	<i>Leersia virginica</i>
woolgrass	<i>Scirpus cyperinus</i>

Inventory maps and aerial photographs. It is occupied by a very small complex of an ephemeral/fluctuating natural pools community. The surrounding forest is composed of various hardwood tree species. Though the pools are small and widely spaced, their condition appears good.

Threats and Disturbances:

The site is owned by multiple private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational uses of the forest. Logging within proximity to the pools without

SPRUCE HILL TOWNSHIP

adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Tuscarora Mountain Ridgetop Pool (Spruce Hill Township and Perry County)

This relatively flat area of the Tuscarora Mountain ridgetop contains one pool comprising an ephemeral/fluctuating natural pools community. This very large, isolated pool offers an important breeding location for the surrounding amphibian

community. The surrounding forest is composed of a dry oak – mixed hardwoods forest with mixed hardwoods and conifers composing 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 within SGL 88. The primary land use at this site is recreational uses of the forest. Logging within proximity to the pool without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) no-cut buffer should be established around this pool complex. Though vernal pools are often thought of as isolated wetlands, the species within the pool rely on the linkages between the wetlands. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.



herbaceous ephemeral/fluctuating natural (vernal) pool community

photo source: Andrew Strassman (PNHP)

Susquehanna Township

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³	
	Global	State				
NATURAL HERITAGE SITES:						
SUSQUEHANNA RIVER AT STATE GAME LANDS #258			High Significance			
Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	1998	E
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	1998	E
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2001	BC
Species of Special Concern ⁴	-	-	-	T	2000	B
Species of Special Concern ⁴	-	-	-	-	1998	C
Mahantango Creek Confluence Pools			Locally Significant			

PUBLICLY MANAGED LANDS: None

OTHER CONSERVATION AREAS: Central Susquehanna Valley Important Mammal Area

DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: None

AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:

- Fish	<i>Warm-water Community 1</i>	West Branch Mahantango Creek
	<i>Warm-water Community 2</i>	Mahantango Creek (Snyder County)
	<i>Not Yet Assessed</i>	Susquehanna River-Wiconisco Creek
- Macroinvertebrate	<i>Not Yet Assessed</i>	Mahantango Creek (Snyder County); Susquehanna River-Wiconisco Creek; West Branch Mahantango Creek
- Mussel	<i>Not Yet Assessed</i>	Mahantango Creek (Snyder County); Susquehanna River-Wiconisco Creek; West Branch Mahantango Creek

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

Susquehanna Township was founded in 1858 when Greenwood Township was split in three. Per its name, the township is the only one in the County to touch the Susquehanna River. The eastern most of the county's townships, Susquehanna Township is bounded on the north by the West Branch Mahantango Creek, the south by Turkey Ridge, and the west by Greenwood Township. The township is drained by the West Branch Mahantango Creek, Leiningers Run, and Dobson Run and their tributaries. There are no large blocks of public land. While there are no major population areas, the township's population is growing at ~2% per year, the fastest in the county. The majority of the land (57%) in the township is forested with this forest concentrated along the hill and ridge tops. While most of the western two-thirds of the township is forest, this forest is fragmented into many small blocks. Agriculture, accounting for 38% of land use in the township, is concentrated primarily along the floodplains of the Susquehanna River, Dobson Creek, and Leiningers Run. Excepting the agricultural valleys, the



township's streams are generally forested and protected by a riparian buffer. In the agricultural valleys, the streams are in much poorer shape, lacking a sufficient or any riparian buffer. Riparian buffers should be created or maintained along all the township's streams to cool and clean the water and act as connecting corridors for the forest blocks.



Susquehanna Township Juniata County, PA



Pennsylvania Natural Heritage Program

County Natural Heritage Inventory

- core habitat
- supporting landscape
- publicly managed land
- streams
- recommended riparian buffer

roads

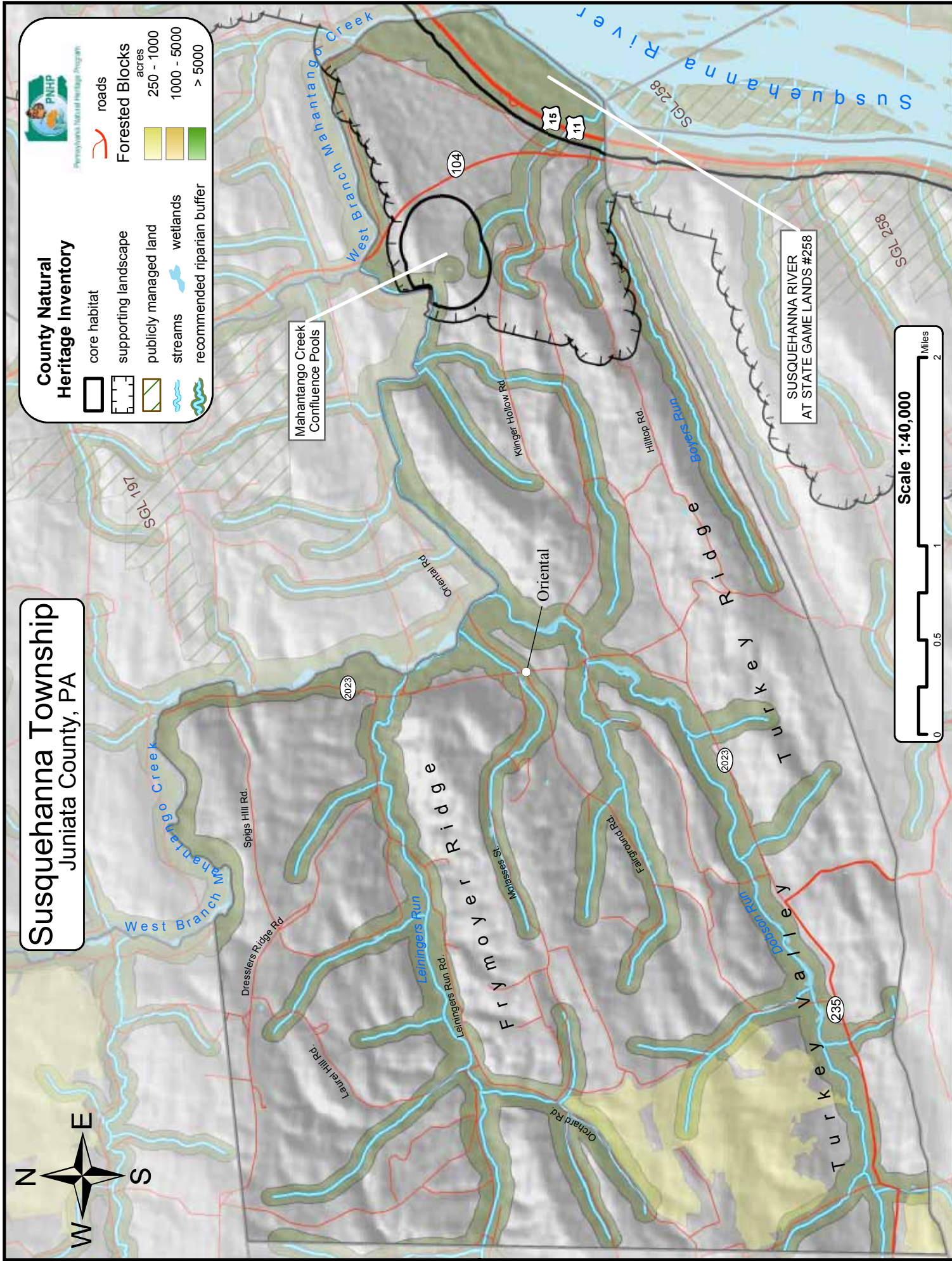
Forested Blocks
acres

- 250 - 1000
- 1000 - 5000
- > 5000

Mahantango Creek
Confluence Pools

Oriental

SUSQUEHANNA RIVER
AT STATE GAME LANDS #258



SUSQUEHANNA RIVER AT STATE GAME LANDS #258 (Susquehanna Township & Dauphin, Northumberland, Snyder, & Perry Counties)

This site consists of an archipelago of islands in the Susquehanna River near the junction of Juniata, Dauphin, Northumberland, Perry, and Snyder Counties. This site contains several clusters of islands including Browns, Crafts, Herrold, Sweigart's and Zeigler Islands. These islands are largely dominated by silver maple (*Acer saccharinum*) and spicebush (*Lindera benzoin*) and support breeding for a **Species of Special Concern**. 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 mussel species of concern, a population of the **Elktoe** (*Alasmidonta marginata*), a G4 S4 mussel species of concern, and a population of a **Pennsylvania threatened Species of Special Concern**. The presence of these mussel populations indicates the importance of the shoals around the islands and the overall water quality of the Susquehanna River at this site.

Deeper waters throughout the river may contain populations of freshwater mussels, but surveying for mussel 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 farther 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 any of these islands would likely have impacts on the freshwater mussel populations at this site. In addition, camping or other recreational visits to this island during the breeding season could disturb the species of concern at this site.

Conservation Recommendations

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



Triangle Floater (*Alasmidonta undulata*)

photo source: PNHP

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.

SUSQUEHANNA TOWNSHIP

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 69.

Mahantango Creek Confluence Pools (Susquehanna Township and Snyder County)

This isolated collection of an ephemeral/fluctuating natural pools community occurs far from any other pool community. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. The surrounding forest is composed of various hardwood tree species. Though the pools are small and widely spaced, their condition appears good and most lie in a relatively undisturbed setting.

Threats and Disturbances:

The site is owned by multiple private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational and timber uses of the forest with several residences built near the site. Logging around the pools has likely already disturbed them. Continued logging or building construction within proximity to the pools without adequate buffers could further disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.



ephemeral/fluctuating natural pools community

photo source: PNHP

TURBETT TOWNSHIP

Turbett Township

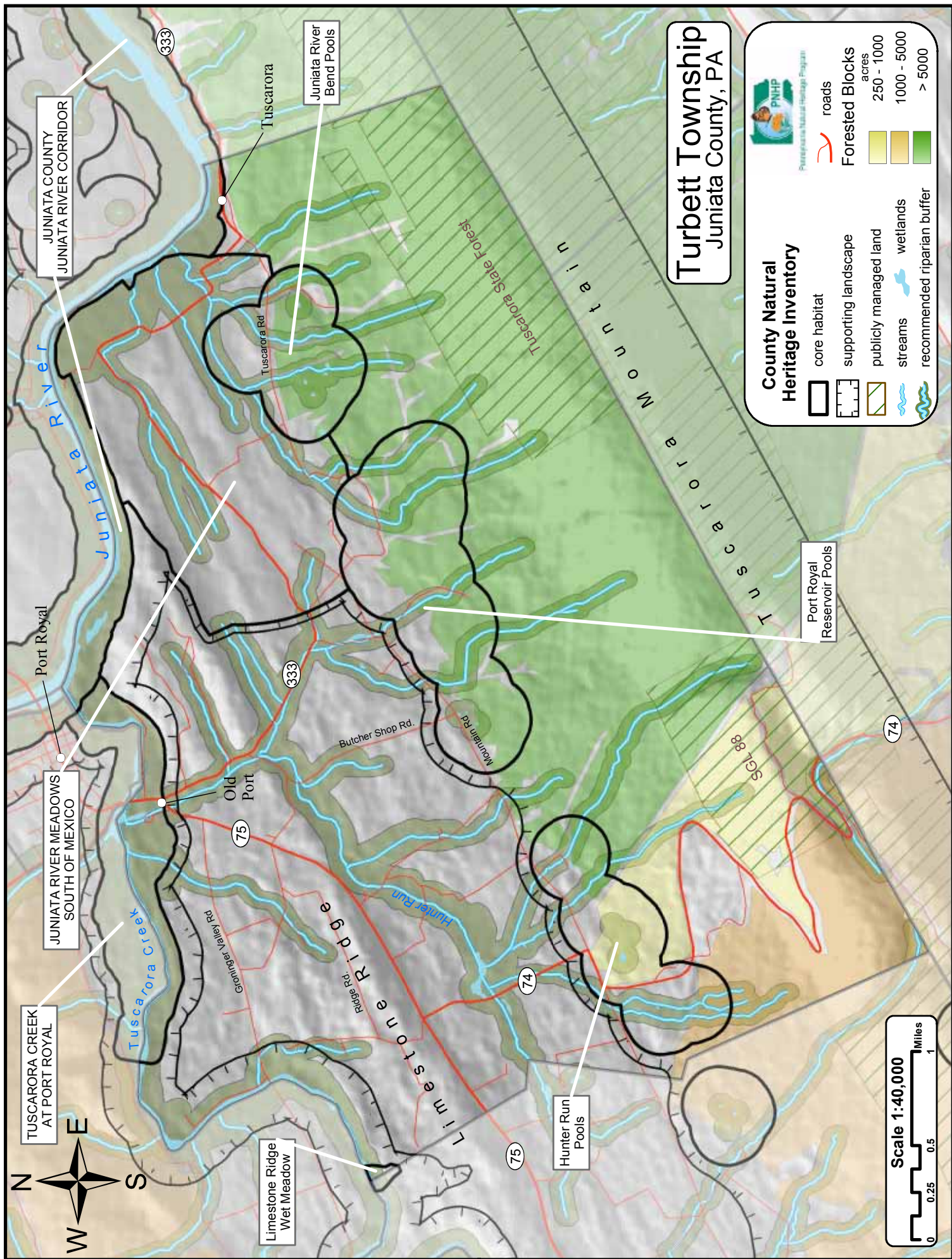
	Taxa ¹	PNHP Rank ²		State Legal Status ⁵	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
JUNIATA COUNTY JUNIATA RIVER CORRIDOR				High Significance		
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	B
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	2006	E
Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	E
white trout-lily (<i>Erythronium albidum</i>)	P	G5	S3	TU	2005	BC
Common Sanddragon (<i>Progomphus obscurus</i>)	O	G5	S2	N	1959	H
TUSCARORA CREEK AT PORT ROYAL				High Significance		
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	E
JUNIATA RIVER MEADOWS SOUTH OF MEXICO				Notable Significance		
Species of Special Concern ⁴	-	G5	S3B/3N	CR	2006	E
Hunter Creek Vernal Pools				Locally Significant		
Juniata River Bend Vernal Pools				Locally Significant		
Limestone Ridge Wet Meadows				Locally Significant		
Port Royal Reservoir Vernal Pools				Locally Significant		
PUBLICLY MANAGED LANDS:		Tuscarora State Forest State Game Lands 88				
OTHER CONSERVATION AREAS:		Tuscarora Ridge (The Pulpit) Important Bird Area Tuscarora / Blue Mountain South Important Mammal Area				
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:		Blacklog Creek (above Shade Creek) Horse Valley Run East Licking Creek (above Clearview Reservoir) Willow Run				
AQUATIC COMMUNITIY CLASSIFICATION PROJECT RESULTS:						
- Fish	Warm-water Community 1		Buffalo Creek			
	Warm-water Community 2		Tuscarora Creek			
	River and Impoundment Community		Juniata River-Raccoon Creek			
- Macroinvertebrate	High Quality Small Stream Community		Buffalo Creek; Tuscarora Creek			
	Not Yet Assessed		Juniata River-Raccoon Creek			
- Mussel	Not Yet Assessed		Buffalo Creek; Juniata River-Raccoon Creek ; Tuscarora Creek			

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection



TURBETT TOWNSHIP

Founded in 1815 from part of Milford Township, Turbett Township is the County's smallest township and is bounded by Tuscarora Creek on the north and by Tuscarora Mountain on the south. The township is drained primarily by Hunters Creek, the Juniata River, and their many tributaries. Sitting atop Tuscarora Mountain, State Game Lands 88 and the adjoining portion of Tuscarora State Forest form a nearly continuous block of forest to the south. This area also corresponds with the Tuscarora / Blue Mountain South Important Mammal Area (IMA) and Tuscarora Ridge (The Pulpit) Important Bird Area (IBA). Blacklog Mountain IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*); Tuscarora Ridge (The Pulpit) IBA was designated because of its cruciality to migratory birds. A very interesting feature of the township is Limestone Ridge, which supports various plants and animals of interest in its calcareous soils. The land use in the township is primarily forest. This covers 56% of the township and is found in one large block along Tuscarora Mountain and several small patches along Firestone Ridge. A relatively high proportion of the township's forest is interior forest because of the large blocks of forestland on Tuscarora Mountain. These forest blocks should be maintained. Of the remaining land, 39% is agriculture concentrated along the valley between Firestone Ridge and Tuscarora Mountain. Major restoration and conservation efforts for the township should be towards creating a continual forest buffer along Hunters Run and its tributaries. This stream is highly degraded by agricultural inputs and siltation caused by the general absence of a forest buffer. Additionally, the large forest block along Tuscarora Mountain should be protected from development and further fragmentation.



Tuscarora Creek in Turbett Township
photo source: Andrew Strassman (PNHP)

JUNIATA COUNTY JUNIATA RIVER

CORRIDOR (Turbett, Milford, Fermanagh, Walker, and Delaware Townships and Mifflin, Mifflintown, and Port Royal Boroughs)

The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery (see Aquatic Community Classification section for details), the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. The many islands provide ample habitat for aquatic birds, mammals, insects, and plants. Additionally, the river acts as a corridor between its headwaters in Somerset County and the Susquehanna River. In Juniata County the river supports populations of freshwater mussels including the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*), the G4 S3S4 **Triangle Floater** (*Alasmodonta undulata*), and the G4 S4 **Elktoe** (*Alasmodonta marginata*). The Eastern Elliptio (*Elliptio complanata*) and the G5 S1 Rainbow Mussel (*Villosa iris*) are also common at this site, though the Rainbow Mussel's state rank only applies to individuals in the Ohio River Basin. The various sandbars, island edges, and river scours provide excellent habitat for the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) whose caterpillar feeds preferentially on wingstem (*Verbesina alternifolia*). The wet, shaded river edges are home to the G5 S3 **white trout-lily** (*Erythronium albidum*). Many dragonflies and damselflies are also found along this stretch including a historic record of the G5 S2 **Common Sanddragon** (*Progomphus obscurus*).

Threats and Disturbances:

A river is the culmination of all its headwaters and tributaries. Upstream disturbances to the Juniata include substantial amounts of agricultural runoff (nutrients, sediments, and chemicals), thermal pollution, floodplain reduction and modification, and stormwater surges. Direct disturbances at the site include trash in the river, stormwater surges from local roads and municipalities, building on the floodplain, and runoff from agriculture and construction. Threats to the river include increased building on the floodplain and the resulting increase in stormwater surges along with continued neglect of existing problems.



white trout-lily (*Erythronium albidum*)

photo source: John Kunsman (PNHP)

Conservation Recommendations:

A concerted effort needs to be developed to promote the health of the entire Juniata Basin if the quality of this site is to be maintained or improved. This would include restricting cattle access to tributaries, implementation of runoff barriers at construction sites, and a 100 m (305 ft) forested riparian buffer on *all* tributaries of the Juniata River. Specific site recommendations include removal of trash from this reach, restriction of new buildings within the floodplain, and management of stormwater flows on the road and in the towns adjacent to this reach. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

TUSCARORA CREEK AT PORT ROYAL

(Turbett and Milford Townships)

As Tuscarora Creek approaches the Juniata River it becomes very flat, broad, and slow with a very wide floodplain, which is dominated by agriculture and suburban sprawl. This reach supports a population of the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*) at a site near the mouth of the Tuscarora Creek.

Threats and Disturbances:

Broad, flat, and highly developed in this reach, this portion of the Tuscarora Creek is generally affected by disturbance from combined sewer outflows, accumulated agriculture inputs, and a very thin or missing forested riparian buffer (causing thermal pollution). These are major disturbances to the creek.

TURBETT TOWNSHIP



Pastoral landscape of central Pennsylvania

photo source: PNHP

Further threats include continued urban development within the watershed and the continued removal and degradation of the existing upstream forested riparian buffer.

Conservation Recommendations:

A forest buffer should be maintained where it exists, created where it does not, and ideally widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

JUNIATA RIVER MEADOWS SOUTH OF MEXICO (Turbett Township)

This site encompasses an area of pastoral landscape south of Mexico between the Juniata River and Tuscarora Mountain. At this location several individuals of a **Species of Special Concern** are successfully reproducing. 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 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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. Agriculture preservation zones may be one method of achieving this. 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.

Hunter Creek Pools (Turbett Township)

The toe-slope of Tuscarora Mountain offers many locations where water can pond. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. It is occupied by an extensive complex of an ephemeral/fluctuating natural pools community. The surrounding forest is composed of various hardwood tree species. Though the pools are widely spaced, their condition appears good and they lie in a relatively undisturbed setting.

Threats and Disturbances:

The site is owned by numerous private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational uses of the forest with several residences built around the roads. Logging and development within close proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within

TURBETT TOWNSHIP

this site taking advantage of logging trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Juniata River Bend Pools (Turbett Township)

The toe-slope of Tuscarora Mountain offers many locations where water can pond. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. It is occupied by an extensive complex of an ephemeral/fluctuating natural pools community. The surrounding forest is composed of various hardwood tree species. Though the pools are small and widely spaced, their condition appears good and they lie in a relatively undisturbed setting.



Vernal pool in Juniata County with wool grass center

photo source: PNHP

Threats and Disturbances:

The site is owned by numerous private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational uses of the forest with several residences built around the roads. Logging and building construction within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Limestone Ridge Wet Meadow (Turbett and Spruce Hill Townships)

This small wet meadow in the Tuscarora Creek floodplain is an excellent example of a wet meadow community (see plant list). While no rare plants or animals were found during the survey, the site does support three species of interest: the thicket sedge (*Carex abscondita*), Davis' sedge (*Carex davisii*), and Leavenworth's sedge (*Carex leavenworthii*). The combination of plants present at this site indicates a rich calcareous soil that is perennially wet.

Threats and Disturbances:

Disturbances to the area include the past logging and non-native invasive species spreading through logged areas. Threats to the site include logging, the further spread of non-native invasive species, and the introduction of additional invasive species.

Conservation Recommendations:

Care should be given to prevent the introduction and spread of non-native invasive species at this site. Potential sources of additional invasive species are heavy machinery, ATVs, and horses via mud, debris, and other substances carried in with them.

TURBETT TOWNSHIP

Port Royal Reservoir Pools (Turbett Township)

The toe-slope of Tuscarora Mountain offers many locations where water can pond. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. It is occupied by an extensive complex of an ephemeral/fluctuating natural pools community. The surrounding forest is composed of various hardwood tree species. Though the pools are small and widely spaced, their condition appears good.

Threats and Disturbances:

The site is owned by numerous private landowners. The primary land use at this site is agriculture in the surrounding fields and recreational uses of the forest with several residences built around the roads. Logging and development within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances.



Limestone Ridge Wet Meadows

photo source: PNHP

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Abridged Plant List from Limestone Ridge Wet Meadow

Sedges, Grass, and Rushes	
broom sedge	<i>Carex scoparia</i>
Carolina sedge	<i>Carex caroliniana</i>
common rush	<i>Juncus effusus</i>
common woodrush	<i>Luzula multiflora</i>
Davis' sedge	<i>Carex davisii</i>
deertongue grass	<i>Dichanthelium clandestinum</i>
eastern narrowleaf sedge	<i>Carex amphibola</i>
fowl mannagrass	<i>Glyceria striata</i>
fox sedge	<i>Carex vulpinoidea</i>
fringed sedge	<i>Carex crinita</i>
fuzzy wuzzy sedge	<i>Carex hirsutella</i>
Georgia bulrush	<i>Scirpus georgianus</i>
Gray's sedge	<i>Carex grayi</i>
hop sedge	<i>Carex lupulina</i>
inflated narrow-leaf sedge	<i>Carex grisea</i>
Japanese Stiltgrass	<i>Microstegium vimineum</i>
Leavenworth's sedge	<i>Carex leavenworthii</i>
limestone meadow sedge	<i>Carex granularis</i>
nodding fescue	<i>Festuca obtusa</i>
orchard grass	<i>Dactylis glomerata</i>
owlfruit sedge	<i>Carex stipata</i>
poverty oatgrass	<i>Danthonia spicata</i>
rat-tail fescue	<i>Vulpia myuros</i>
reed canarygrass (exotic)	<i>Phalaris arundinacea</i>
rice cutgrass	<i>Leersia oryzoides</i>
rough bluegrass	<i>Poa trivialis</i>
rufous bulrush	<i>Scirpus pendulus</i>
shallow sedge	<i>Carex lurida</i>
slender wedgescale	<i>Sphenopholis intermedia</i>
smoothsheath sedge	<i>Carex laevivaginata</i>
squarrose sedge	<i>Carex squarrosa</i>
starved panicgrass	<i>Dichanthelium depauperatum</i>
sweet vernalgrass	<i>Anthoxanthum odoratum</i>
sweet woodreed	<i>Cinna arundinacea</i>
tapered rosette grass	<i>Dichanthelium acuminatum</i>
thicket sedge	<i>Carex abscondita</i>
twisted sedge	<i>Carex torta</i>
whitegrass	<i>Leersia virginica</i>
woolgrass	<i>Scirpus cyperinus</i>



Allegheny Woodrat habitat typical of Juniata County's ridge and valley topography
photo source: PNHP

Tuscarora Township

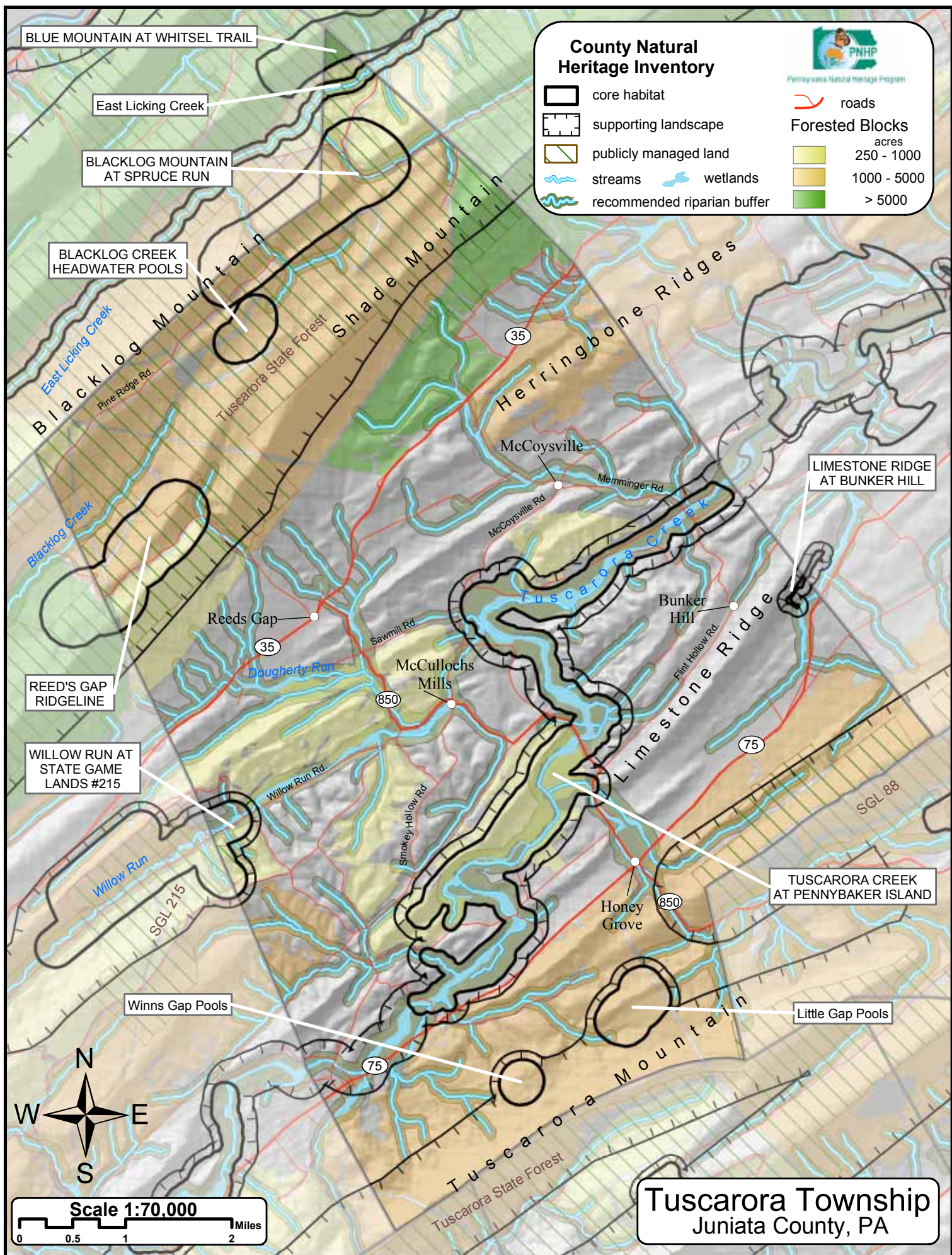
	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES:						
TUSCARORA CREEK AT PENNYBAKER ISLAND				Exceptional Significance		
Species of Special Concern ⁴	-	-	-	-	2005	B
pineland pimpernel (<i>Samolus parviflorus</i>)	P	G5	S2	PE	2006	C
Shumard's oak (<i>Quercus shumardii</i>)	P	G5	S1	PE	2006	C
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	1993	E
BLACKLOG CREEK HEADWATER POOLS				High Significance		
ephemeral/fluctuating natural pool	C	GNR	S3	-	2006	
BLACKLOG MOUNTAIN AT SPRUCE RUN				High Significance		
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1992	E
BLUE MOUNTAIN – WHITSEL TRAIL				High Significance		
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	E
REED'S GAP RIDGELINE				High Significance		
Allegheny Woodrat (<i>Neotoma magister</i>)	M	G3G4	S3	PT	1993	E
LIMESTONE RIDGE AT BUNKER HILL				Notable Significance		
Henry's Elfin (<i>Callophrys henrici</i>)	L	G5	S1S3	N	2006	CD
WILLOW RUN AT STATE GAME LANDS #215				Notable Significance		
Northern Myotis (<i>Myotis septentrionalis</i>)	M	G4	S3B/3N	CR	2003	E
Little Gap Pools				Locally Significant		
Winns Gap Pools				Locally Significant		
East Licking Creek				Locally Significant		
PUBLICLY MANAGED LANDS:		Tuscarora State Forest State Game Lands 88				
OTHER CONSERVATION AREAS:		Tuscarora Ridge (The Pulpit) Important Bird Tuscarora / Blue Mountain South Important Mammal Area Blacklog Mountain Important Mammal Area				
DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS:		None				
AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:						
- Fish	Coldwater Community		Horse Valley Run			
	Warmwater Community 1		Blacklog Creek; Willow Run			
	Warmwater Community 2		Tuscarora Creek; Tuscarora Run-Warble Run			
	River and Impoundment Community		East Licking Creek			
- Macroinvertebrate	High Quality Small Stream Community		Blacklog Creek; East Licking Creek, Tuscarora Creek, Tuscarora Run-Warble Run			
	Not Yet Assessed		Horse Valley Run; Willow Run			
- Mussel	Eastern Elliptio Community		East Licking Creek			
	Not Yet Assessed		Blacklog Creek; Horse Valley Run ; Tuscarora Creek; Tuscarora Run-Warble Run; Willow Run			

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection



TUSCARORA TOWNSHIP

Separated from Lack Township in 1825, Tuscarora Township is sandwiched between Shade Mountain to the north and Tuscarora Mountain to the south. Tuscarora Township is the second most heavily forested township in Juniata County. Winding its way through the southern portion of the township, Tuscarora Creek and its tributaries are the major water features of the area. Tuscarora Creek, with its many back channels and oxbows, abounds with biological diversity and is an excellent warmwater fishery. Several other streams in the township rate as High Quality Cold Water Fisheries including: Blacklog Creek, East Licking Creek, Willow Run, Horse Valley Run, and all of their tributaries. Within the township, especially along Tuscarora Creek, are several shale and limestone bluffs that support many species of particular biological interest. Tuscarora State Forest, in both the north and south of the township, occupies a significant portion of the township. These public lands also host Blacklog Mountain Important Mammal Area (IMA) on the northern ridge and Tuscarora Ridge (The Pulpit) Important Bird Area and Tuscarora / Blue Mountain South IMA on the south ridge. Blacklog Mountain IMA was designated because it represents a stronghold for the Allegheny Woodrat. (*Neotoma magister*), while Tuscarora / Blue Mountain South IMA was designated because of its importance to Allegheny Woodrats and many bat species of special concern. Tuscarora Ridge (The Pulpit) IBA was designated because of its cruciality to migratory birds. Land cover in the township is 27% agriculture and 69% forest. Within the



township, agricultural land is concentrated along Tuscarora Creek and some of its tributaries, while the remainder of the township is forested. A large proportion of that forestland is interior forest, which is very important for neo-tropical birds. Maintaining the large forest blocks found along Shade and Tuscarora Mountains and the Herringbone Ridges should be actively pursued. Major management concerns for the township should be focused on retaining forested buffers along Tuscarora Creek, its tributaries, and the High Quality rivers, and maintaining large blocks of interior forest throughout the township. A buffer should also be established around the various public lands to prevent future development directly adjacent to their edges. Restoration and conservation efforts should be focused on Tuscarora Creek. Specifically, an effort should be made to increase forest buffers along the Tuscarora Creek, reduce non-point source pollution into the creek (especially along Doughty Run), and prevent damming or diversion of the creek.



Tuscarora Creek in Tuscarora Township

photo source: Andrew Strassman (PNHP)

TUSCARORA CREEK AT PENNYBAKER ISLAND (Tuscarora Township)

As Tuscarora Creek flows further downstream the land becomes flatter while the surrounding hills rise higher. The hills in this reach feature much steeper slopes, are much dryer, and are composed primarily of shale. The community on these slopes supports a **Species of Special Concern** along with Burk's smooth rockcress (*Arabis laevigata* v. *burkii*), rock buttercup (*Ranunculus micranthus*), and shale barren bindweed (*Calystegia spithamea* v. *purshiana*). The river valley below supports the G5 S2 plant **pineland pimpernel** (*Samolus parviflorus*) and G5 S1 **Shumard's oak** (*Quercus shumardii*) along with golden club (*Orontium aquaticum*) and Tuckerman's sedge (*Carex tuckermanii*). Finally, the river supports an excellent warmwater fishery, historic records of Illinois pondweed (*Potamogeton illinoensis*), and a population of the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*).

Threats and Disturbances:

The hill community at this site is only disturbed by encroaching exotic species. The main threat to this system would be logging or other activities that increase the prevalence of exotic species. The floodplain area is moderately disturbed by agricultural activity and a lack of an adequate forested buffer along portions of the site. Threats to the bluffs include logging and the conversion of any of the area to housing. Direct disturbances to the creek include several areas with no forested river buffer or very thin buffers. This increases thermal pollution, agricultural inputs, and generally degrades river quality. Threats to the creek include continued degradation of the forested river buffer throughout the river system.

Conservation Recommendations:

The hills at this site include many interesting species well outside their expected range in addition to many rare species. Because of the low gradient of the creek, even small unforested areas can greatly increase thermal pollution. A forest buffer should be maintained where it exists, created where it does not, and ideally widened to 100 m (305 ft) along the *entire creek*. This can be achieved through many existing programs that provide incentives to landowners who restore forested stream buffers. Further information on available programs can be gathered by contacting



pineland pimpernel (*Samolus parviflorus*)

photo source: PNHP

Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

BLACKLOG CREEK HEADWATER POOLS (Tuscarora Township)

This topographic saddle at the headwaters of Blacklog Creek contains over 18 pools spread in a line over 2000 ft. This site is an excellent example of the GNR S3 **ephemeral/fluctuating natural pools community**. These isolated pools offer an important breeding location for the surrounding amphibian community. The immediate forest is a mature gallery composed of a northern red oak – mixed hardwood community dominated by red and white oak (*Quercus rubra* and *Q. alba*) with a layer of shrubby mountain laurel (*Kalmia latifolia*) being the understory. The condition of the pools appears excellent.

Threats and Disturbances:

The site is within Tuscarora State Forest. The primary land use within the site is recreational and preservation with the surrounding matrix being recreational and forestry uses. Logging within proximity to the pool without an adequate buffer could disturb the hydrology, vegetation, and wildlife value of this wetland.

TUSCARORA TOWNSHIP



Blacklog Creek Headwater Pools

photo source: Rocky Gleason (PNHP)

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the rare plant and animals and other species that occur here.

BLACKLOG MOUNTAIN AT SPRUCE RUN (Tuscarora Township and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock outcrops on Blacklog Mountain during surveys in 1992. This species has been located at several locations along the Blacklog Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced

rapid decline in recent decades due to unknown causes (App. XI, pg. 188).

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

BLUE MOUNTAIN AT WHITSEL TRAIL (Tuscarora and Milford Townships and Mifflin County)

Active signs of G3G4 S3 **PA-threatened Allegheny Woodrat** (*Neotoma magister*) were located in rock outcrops on Blue Mountain during surveys in 1992. This species has been located at several locations along the Blue and Blacklog Mountains. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

REED'S GAP RIDGELINE (Tuscarora and Lack Townships)

Active signs of G3G4 S3 **PA-threatened Allegheny woodrat** (*Neotoma magister*) were located at the crest of this mountain during surveys in 1993. This is one of several locations for this species along the Shade

TUSCARORA TOWNSHIP

Mountain. The woodrat typically inhabits the deep crevices of rocky outcrops, boulder-strewn talus slopes, and caves. Populations of this species throughout the state have experienced rapid decline in recent decades due to unknown causes.

Threats and Disturbances:

The site is within the Tuscarora State Forest and appears relatively undisturbed excepting a pipeline right-of-way that crosses the site.

Conservation Recommendations:

Additional surveys for this species along the ridge are recommended to better understand the extent of the population. Avoid further fragmentation of the forested matrix surrounding this site with additional roads and utility right-of-ways. This will help to buffer the woodrat populations from external disturbance and negative environmental influence.

LIMESTONE RIDGE AT BUNKER HILL

(Tuscarora and Spruce Hill Townships)

As the layers of Earth's crust were compressed to form the Appalachian Mountains and the Ridge and Valley region, various hidden layers were exposed. One of these is a rich layer of limestone that supports many unique communities throughout the county. At Bunker Hill the limestone supports a large area of redbud (*Cercis canadensis*) and other calcium loving plants. While redbud is very common in the county,

the G5 S1S3 **Henry's Elfin** (*Callophrys henrici*) is not. The caterpillar of this small butterfly feeds exclusively on redbud and depends on the close proximity of flowers to feed the adults. Additionally, given the small size of this species it a very poor ability to colonize new sites making existing populations all the more important.

Threats and Disturbances:

The primary threat at this site is succession to mature woodland or complete removal of the woodland. Either activity would reduce the redbud population, the singular food source for Henry's Elfin caterpillars. An additional threat would be a decrease in nectar plants for the adult resulting from local land use changes. The only active disturbance to the site is the pasturing of the adjacent field, which limits the available nectar plants.

Conservation Recommendations:

Various ages of forest should be maintained to assure that there is always food available for both the caterpillars and adults. Under no circumstances should this area be clear-cut, but selective cutting may be advisable to maintain younger stands with a high proportion of redbud. Nectar plants should also be promoted to maintain the adult population. This can be achieved by excluding cattle from the edge of the forested area and mowing occasionally as woody plants invade.



Redbud in bloom along Bunker Hill site

photo source: Rocky Gleason (PNHP)

TUSCARORA TOWNSHIP

WILLOW RUN AT STATE GAME LANDS #215 (Tuscarora and Lack Townships)

State Game Lands #215, situated along Willow Run, is a recorded breeding location for the G4 S3B S3N **Northern Myotis** (*Myotis septentrionalis*). The Northern Myotis spends the winter hibernating in the many caverns of the area and during the summers it frequents wooded streams and trails where it forages. Spending the day roosting in natural cavities and hollow trees, the relationship of this location to a maternity site or overwintering site is unknown. The multiple individuals captured here show that this population uses the site for foraging.

Threats and Disturbances:

The various wildlife openings created around the stream and trails at this site as well as a gas pipeline right-of-way expose the interior forest where the bats feed to the elements and predators that they are otherwise buffered from. Potential threats to the site are logging and expansion of the wildlife plots. This could remove both foraging and denning habitat. Special consideration should be given to the planned expansion of the gas pipeline right-of-way given its potential as a corridor for invasive species and as an impermeable barrier for native species dispersal.

Conservation Recommendations:

A forest buffer should be maintained where it exists, created where it does not, and ideally be widened to 100 m (305 ft) along the creek and trails. This will maintain “interior” forest around the creek and trails even if logging occurs outside this area. Additionally,

standing deadwood and hollow trees should be left as ideal denning locations.

East Licking Creek (Tuscarora and Milford Townships and Mifflin County)

The upper parts of the East Licking Creek drainage are characterized by several wet meadow openings interspersed throughout the drainage in an otherwise hemlock-dominated floodplain. Dominant plants in the meadows include *Sphagnum* moss, sedges (*Carex* spp.), cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), sensitive fern (*Onoclea sensibilis*), smooth alder (*Alnus serrulata*), rushes (*Juncus* spp.), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and swamp dewberry (*Rubus hispidus*). The seeps and wetlands also provide habitat for several reptile and amphibian species, such as the Long-tailed Salamander (*Eurycea longicauda*) and Red-spotted Newt (*Notophthalmus viridescens*). East Licking Creek is designated as a High Quality stream.

Threats and Disturbances:

The site is within the Tuscarora State Forest and remains relatively undisturbed. Jeep trails and footpaths in the vicinity are providing disturbance pathways for invasive plant species such as Japanese stiltgrass (*Microstegium vimineum*) to establish, but few invasive species were found in the wetlands.

Conservation Recommendations:

The East Licking Creek drainage should be buffered by 100 m (328 feet) from any logging operations in order to maintain the ecological integrity of the wetlands and the water quality of the groundwater seeps and surface water flowing to these wetlands. Populations of invasive plants should be monitored for encroachment into the more sensitive wetland systems.

Little Gap Pools (Tuscarora Township)

This small topographic saddle on Tuscarora Mountain is occupied by a complex of an ephemeral/fluctuating natural pools community. This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. The surrounding forest is composed of various hardwood tree species. Though the pools are small, their condition appears good and they lie in an undisturbed setting.



Forested stream corridor within SGL #215

photo source: PNHP

TUSCARORA TOWNSHIP

Threats and Disturbances:

The site is owned by multiple private landowners. The primary land use at this site is recreational uses of the forest. Logging within proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Additionally, the close proximity to a large power line cut is facilitating the introduction of invasive plant species that can be found within this site taking advantage of logging trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.

Winns Gap Pools (Tuscarora Township)

This small topographic saddle on Tuscarora Mountain is occupied by a very small group of an ephemeral/fluctuating natural pools community.

This location is drawn from a combination of National Wetland Inventory maps and aerial photographs. The surrounding forest is composed of various hardwood tree species. Though the pools are small and few, their condition appears good and they lie in an undisturbed and remote setting.

Threats and Disturbances:

The site is owned by multiple private landowners. The primary land use at this site is recreational uses of the forest. Logging within close proximity to the pools without adequate buffers could disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances.

Conservation Recommendations:

At the very least, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here.



Amphibian egg masses in a vernal pool

photo source: Charlie Eichelberger (PNHP)

Walker Township

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
CEDAR SPRING RUN WETLAND				Exceptional Significance		
Shumard's oak (<i>Quercus shumardii</i>)	P	G5	S1	PE	2006	E
red maple – black ash palustrine forest	C	GNR	S2S3	N	2006	E
LOCUST RUN WETLANDS				Exceptional Significance		
ephemeral/fluctuating natural pools	C	GNR	S3	N	2006	E
JUNIATA COUNTY JUNIATA RIVER CORRIDOR				High Significance		
Yellow Lampmussel (<i>Lampsilis cariosa</i>)	U	G3G4	S3S4	CU	2006	B
Triangle Floater (<i>Alasmidonta undulata</i>)	U	G4	S3S4	N	2006	D
Elktoe (<i>Alasmidonta marginata</i>)	U	G4	S4	N	2006	E
Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	E
white trout lily (<i>Erythronium albidum</i>)	P	G5	S3	TU	2005	BC
Common Sanddragon (<i>Progomphus obscurus</i>)	O	G5	S2	N	1959	H
TUSCARORA WILD AREA NEAR VANDYKE				High Significance		
Species of Special Concern ⁴	-	-	-	-	2006	E
GREG'S WOODS				Notable Significance		
false hop sedge (<i>Carex lupuliformis</i>)	P	G4	S1	TU	2005	C
Silvery Checkerspot (<i>Chlosyne nycteis</i>)	L	G5	S3S4	N	2006	C
Tawny Emperor (<i>Asterocampa clyton</i>)	L	G5	S3S4	N	2006	BC
DOE RUN MEADOW				Notable Significance		
Species of Special Concern ⁴	-	-	-	-	2005	E
TUSCARORA WILD AREA ABANDONED FACTORY YARD				Notable Significance		
waterpod (<i>Ellisia nyctelea</i>)	P	G5	S2	N	2006	E
PUBLICALLY MANAGED ALNDS: Tuscarora State Forest						
OTHER CONSERVATION AREAS: Central Pennsylvania Conservancy Tuscarora Ridge (The Pulpit) Important Bird Area Tuscarora / Blue Mountain South Important Mammal Area						

PUBLICALLY MANAGED ALNDS: Tuscarora State Forest

OTHER CONSERVATION AREAS: Central Pennsylvania Conservancy
Tuscarora Ridge (The Pulpit) Important Bird Area
Tuscarora / Blue Mountain South Important Mammal Area

DEP EXCEPTIONAL VALUE/HIGH QUALITY WATERSHEDS: None

AQUATIC COMMUNITY CLASSIFICATION PROJECT RESULTS:

- Fish	<i>River and Impoundment Community</i>	Juniata River Raccoon Creek; Juniata River – Tuscarora Creek
	<i>High Quality Small Stream Community</i>	Juniata River – Tuscarora Creek
- Macroinvertebrate	<i>Not Yet Assessed</i>	Juniata River – Raccoon Creek
	<i>Yellow Lampmussel Community</i>	Juniata River – Tuscarora Creek
- Mussel	<i>Not Yet Assessed</i>	Juniata River – Raccoon Creek

¹ B = Bird; C = Community; F = Fish; L = Lepidoptera; O = Odonate; P = Plant; M = Mammal; U = Unionid (Mussel);

² Please refer to Appendix III (pg. 174) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 177) for an explanation of quality ranks

⁴ This species is not named at the request of the agency overseeing its protection

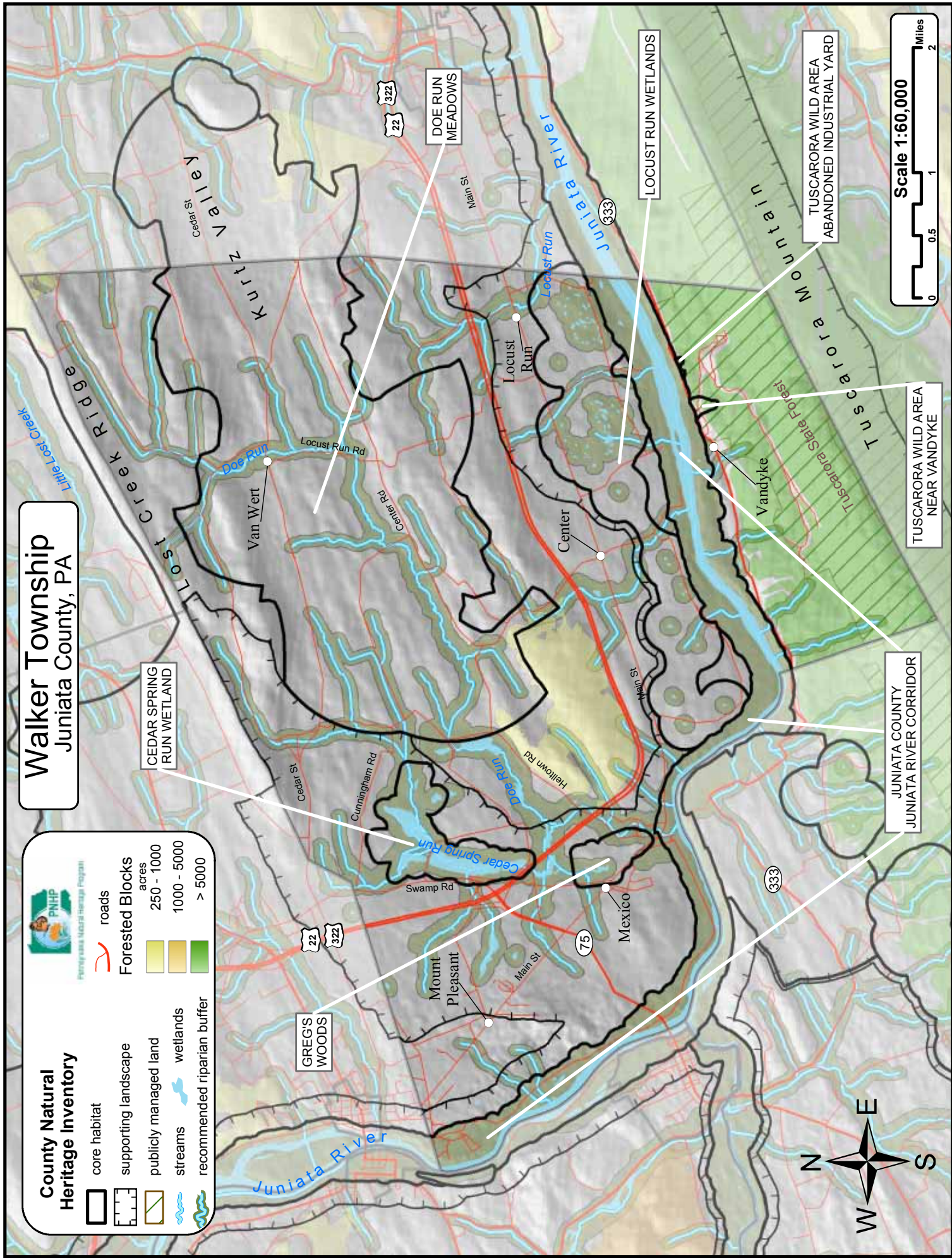
Walker Township Juniata County, PA



County Natural Heritage Inventory
 core habitat
 supporting landscape
 publicly managed land
 streams
 recommended riparian buffer

roads

Forested Blocks
 acres
 250 - 1000
 1000 - 5000
 > 5000



WALKER TOWNSHIP

Founded from Fermanagh Township between 1822 and 1823, Walker Township is crossed by two thoroughfares, the Juniata River and US 22/322. The township line runs along Lost Creek Ridge to the north, Tuscarora Mountain to the south, and the Juniata River to the west. The primary rivers draining the township are the Juniata and its tributaries Doe Run and Cedar Spring Run. The Juniata River is home to several important mussel species in this reach and is an excellent warm water fishery. To preserve these species and the scenic and environmental quality of the river, building should not be permitted in the floodplain. Tuscarora State Forest, running along the top of Tuscarora Mountain in the south, forms a nearly continual forested green block to the south. This area corresponds with the Tuscarora / Blue Mountain South Important Mammal Area (IMA) and Tuscarora Ridge (The Pulpit) Important Bird Area (IBA). Blacklog Mountain IMA was designated because it represents a stronghold for the Allegheny Woodrat (*Neotoma magister*); Tuscarora Ridge (The Pulpit) IBA was designated because of its cruciality to migratory birds. Walker Township is primarily agriculture north of the Juniata and almost entirely forest south of the river. This gives the Township a 57% to 34% ratio of agriculture to forest. Additionally, the township has the most



agricultural cover on both a percentage and acreage basis of any township in the county. Despite this, the township does have a large area of interior forest south of the river and some decent sized forest block along the hills running north of US 22/322. Because of the large amount of agriculture in the northern portion of the township many of the runs and streams have experienced heavy inputs of sediments. Implementation of agricultural best management practices and creation of forested stream buffers can greatly reduce agricultural inputs and quickly increase stream health. Finally, the large forest block along Tuscarora Mountain should be protected from development and further fragmentation.



Juniata River flowing into Walker Township

photo source: Andrew Strassman (PNHP)

CEDAR SPRING RUN WETLAND (Walker Township)

Potentially the largest remaining intact wetland complex in Juniata County, this site supports a diverse range of wetland plants uncommon to the area and state. The rarest of these is the G5 S1 **Shumard's oak** (*Quercus shumardii*). A common species in the southern US, the individuals found in Juniata County are well to the north and east of their principle range. Additional wetland species found at the site include swamp white oak (*Quercus bicolor*), black ash (*Fraxinus nigra*), poison sumac (*Toxicodendron vernix*), wild black currant (*Ribes americanum*), swamp rose (*Rosa palustris*), marsh fern (*Thelypteris palustris*), and many species of sedge. Together, these and other species form a GNR S2S3 **red maple – black ash palustrine forest community** in part of the complex that is influenced by the inflow of calcareous groundwater.

Threats and Disturbances:

Despite its importance, this site is highly disturbed. Attempts have been made to drain the area, leaving many scars across the wetland. The site has also been repeatedly logged. Both these practices have introduced a large number of non-native invasive species to the site. Threats to the site include continued efforts to drain the area, further encroachment by agriculture, and expanding development pressure along the US 22/322 corridor.

Conservation Recommendations:

This site acts as an important physical and genetic refuge for plants uncommon to the area and should be maintained as a potential seed bank. As such, an effort should be made to reduce or remove non-native invasive species from the site. Beyond that, the land should be protected from development with a minimum 100 m (305 ft) buffer around all wetlands including the connecting forest blocks. Finally, there are several old and abandoned trash piles on the site that should be removed.

LOCUST RUN WETLANDS (Walker and Delaware Townships)

Two large complexes of the GNR S3 **ephemeral/fluctuating natural pools community** are found at this site along with several permanent pools. Additionally, there are many pool remnants found in the surrounding agricultural fields. The pools are

likely the result of local subsidence in the layer of permeable limestone below the sites. These sites, having been timbered several times, have a diverse array of tree and plant species with some interesting geographic outliers. Dominant tree species at the site include white, northern red, and pin oaks (*Quercus alba*, *Q. montana*, and *Q. palustris*), eastern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), red and silver maple (*Acer rubrum* and *A. saccharinum*), black birch (*Betula lenta*), and blackgum (*Nyssa sylvatica*). The site also contains many shrubs common to perennially wet areas including winterberry (*Ilex verticillata*), swamp azalea (*Rhododendron viscosum*), highbush blueberry (*Vaccinium corymbosum*), and buttonbush (*Cephalanthus occidentalis*).

Threats and Disturbances:

The site is owned by several private landowners. The primary land uses are currently agriculture and recreational uses of the forest. Logging within proximity to the pools without adequate buffers could



Locust Run wetlands

photo source: Andrew Strassman (PNPHP)

WALKER TOWNSHIP

disturb the hydrology, vegetation, and wildlife value of these wetlands. Invasive plant species can be found within this site taking advantage of logging trails and other disturbances. Finally, the area and site have seen substantial recent suburban sprawl that threatens not only the interconnectedness of the site, but the character of the whole landscape.

Conservation Recommendations:

Optimally, a 305 m (1000 ft) 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. The preservation of an intact forest canopy around this site will help maintain habitat for the species that occur here. Conservation options such as easements should be discussed with the private landowners in order to best protect the site from future development or forest mismanagement.

JUNIATA COUNTY JUNIATA RIVER

CORRIDOR (Walker, Fermanagh, Turbett, Milford, and Delaware Townships and Mifflin, Mifflintown, and Port Royal Boroughs)

The Juniata River corridor is an underappreciated natural resource that runs through the middle of Juniata County. An excellent warm water fishery (see Aquatic Community Classification section for details), the Juniata provides large stretches of easily accessed, picturesque, and ecologically rich river. The many islands provide ample habitat for aquatic birds, mammals, insects, and plants. Additionally, the river



Common Sanddragon (*Progomphus obscurus*)

photo source: http://insects.ummz.lsa.umich.edu/Images/Odonata/Odo_picts.html
Phil Myers

acts as a corridor between its headwaters in Somerset County and the Susquehanna River. In Juniata County the river supports populations of freshwater mussels including the G3G4 S3S4 **Yellow Lampmussel** (*Lampsilis cariosa*), the G4 S3S4 **Triangle Floater** (*Alasmodonta undulata*), and the G4 S4 **Elktoe** (*Alasmodonta marginata*). The Eastern Elliptio (*Elliptio complanata*) and the G5 S1 Rainbow Mussel (*Villosa iris*) are also common at this site, though the Rainbow Mussel's state rank only applies to individuals in the Ohio River Basin. The various sandbars, island edges, and river scours provide excellent habitat for the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) whose caterpillar feeds preferentially on wingstem (*Verbesina alternifolia*). The wet, shaded river edges are home to the G5 S3 **white trout-lily** (*Erythronium albidum*). Many dragonflies and damselflies are also found along this stretch including a historic record of the G5 S2 **Common Sanddragon** (*Progomphus obscurus*).

Threats and Disturbances:

A river is the culmination of all its headwaters and tributaries. Upstream disturbances to the Juniata include substantial amounts of agricultural runoff (nutrients, sediments, and chemicals), thermal pollution, floodplain reduction and modification, and stormwater surges. Direct disturbances at the site include trash in the river, stormwater surges from local roads and municipalities, building on the floodplain, and runoff from agriculture and construction. Threats to the river include increased building on the floodplain and the resulting increase in stormwater surges along with continued neglect of existing problems.

Conservation Recommendations:

A concerted effort needs to be developed to promote the health of the entire Juniata Basin if the quality of this site is to be maintained or improved. This would include restricting cattle access to tributaries, implementation of runoff barriers at construction sites, and a 100 m (305 ft) forested riparian buffer on *all* tributaries of the Juniata River. Specific site recommendations include removal of trash from this reach, restriction of new buildings within the floodplain, and management of stormwater flows on the road and in the towns adjacent to this reach. Further information on available programs can be gathered by contacting Juniata Clean Water Partnership or the Mifflintown NRCS Service Center.

TUSCARORA WILD AREA NEAR VANDYKE (Walker Township)

This secluded draw is home to a **Species of Special Concern**. Associated with a rich, moist forest dominated by tulip tree (*Liriodendron tulipifera*) and spicebush (*Lindera benzoin*) this north-facing wet slope rarely dries out. The area is also rich in spring ephemerals including anise root (*Osmorhiza longistylis*), Canada Mayflower (*Maianthemum canadense*), hairy Solomon's seal (*Polygonatum pubescens*), and Canada waterleaf (*Hydrophyllum canadense*).

Threats and Disturbances:

This site is relatively undisturbed. Excepting a few invasive species and a nearby access road, there is otherwise little human modification to this site in recent history. The major threats to this site are logging and any local road expansion.

Conservation Recommendations:

This site needs to be left alone. Other than controlling the few invasive species on the site, the best management option will be to allow the forest to mature. Logging on the site will greatly disturb the canopy and introduce invasive species. Care should be taken to monitor the nearby road for new, more aggressive non-native invasive species, which should be controlled before they become ubiquitous.

GREG'S WOODS (Walker Township)

The Gregory Alan Grening Nature Preserve is named for and preserved in honor of Gregory Alan Grening (1971-1993). The woods are a mixture of upland and floodplain forest owned and managed by the Central Pennsylvania Conservancy. Open to the public, the tract contains a marked trail to minimize the impact of visitors. Within the preserve, the G4 S1 plant **false hop sedge** (*Carex lupuliformis*) is found in the wetter areas with about 12 other sedges. Also found in the woods are the G5 S3S4 **Silvery Checkerspot** (*Chlosyne nycteis*) and the G5 S3S4 **Tawny Emperor** (*Asterocampa clyton*). The caterpillars of these species feed preferentially on wing-stem (*Verbesina alternifolia*) and hackberry (*Celtis occidentalis*), respectively, both common plants in rich floodplain environments.



false hop sedge (*Carex lupuliformis*)

photo source: John Kunsman (PNHP)

Threats and Disturbances:

Currently, there are few disturbances to the woods other than some invasive species and concentrated areas of old trash. However, great care needs to be taken to monitor and manage the invasive species on the site, especially mile-a-minute, multiflora rose, and non-native honeysuckles. These plants are a significant threat to the health of the site if they become established. Another threat to the site is continued development around the area that may adversely affect the site hydrology, which would endanger the forested wetland.

Conservation Recommendations:

Firstly, invasive species should be regularly monitored. If they are confirmed on the site they should be controlled preferably through mechanical and not chemical means. While this is labor intensive, it reduces the accidental killing of rare species. Secondly, the trash piles on site should be monitored for illegal dumping and removed as time and funds permit. Lastly, given the small size of the preserve (33-acres), establishment of a non-developed buffer around the edge or increasing the preserve size would help increase forest health.

DOE RUN MEADOWS (Walker and Delaware Townships)

This site encompasses an area of pastoral landscape around the town of Van Wert where a **Species of Special Concern** is successfully reproducing. 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

WALKER TOWNSHIP

km² (approximately 7400 acres). The foraging habitat is primarily composed of a matrix of agricultural fields, pastureland, and interspersed woodland edge. The prey of this species includes various small mammals, some of which are considered 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 this site 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. Agriculture preservation zones may be

one method of achieving this. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Prescribed burning (*when done correctly and safely*) is another potential management technique to maintain the open fields.

TUSCARORA WILD AREA ABANDONED FACTORY YARD (Walker Township)

As the name of the site would suggest, the **waterpod** (*Ellisia nyctelea*) a G5 S2 plant, prefers a disturbed landscape. Historically found colonizing moist, disturbed, riverbanks; this species has been relegated to other disturbed areas such as hiking paths, road cuts, and here, an abandoned industrial area.

Threats and Disturbances:

This is a plant that needs disturbance to survive and, as such, this site is heavily disturbed. There are many non-native invasive species found here and, other than the waterpod, it is a very low-quality site. The major threats are succession and exclusion by non-native invasive plants.

Conservation Recommendations:

The best management for this site would be the occasional removal of non-native invasive species by mechanical means. This would create a continual disturbance allowing the species to persist.



Pastoral landscape of central Pennsylvania

photo source: PNHP

GENERAL CONSERVATION RECOMMENDATIONS

The following are general recommendations for protecting the biological diversity of Juniata County. Juniata County has a handful of groups pursuing the protection of natural areas within the county (App. XI). Ideally, conservation efforts should be pursued in coordination with these groups to encourage public support and investment.

Approaches to protecting a natural area are wide-ranging 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. Keep in mind that personnel in our program 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 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 Juniata 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 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 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 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, offer flood protection, 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 (of PA-native 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 right-of-ways), 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 invasive species 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. Below is a list sources for invasive species information:

- The Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) is a non-profit organization (501c3) dedicated to addressing the problem of invasive exotic plants and their threat to the Mid-Atlantic region's economy, environment, and human health. MA-EPPC provides leadership; represents the mid-Atlantic region at national meetings and conferences; monitors and disseminates research on impacts and controls; facilitates information development and exchange; and coordinates on-the-ground removal and training. A membership brochure is available as a PDF file at: <http://www.ma-eppc.org>

- 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. <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.dcr.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/>

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 use 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 landscape of Pennsylvania. Sites identified in the Juniata 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 Salamander - A group of salamanders belonging to the family Ambystomatidae. This group is commonly referred to as the “mole salamanders”, referring to their secretive, subterranean habits. Pennsylvania’s Ambystomatid salamanders are considered vernal pool obligate species, meaning they require the seasonal hydrologic fluctuations of vernal pools to reproduce.

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).

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 – areas 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.

DBH – the diameter of a tree at 4.5 feet above the ground (breast height).

DCNR – Pennsylvania Department of Conservation and Natural Resources.

DEP – Pennsylvania Department of Environmental Protection.

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 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 (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) orders in a given sample.

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.

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.

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.

Igneous - formed by solidification from a molten state. Used of rocks.

Invasive species – 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 invasive species can often cause the breakdown of the natural community.

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.

Lacustrine – any species living in or process involving lakes.

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 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.

Obligate species - able to exist or survive only in a particular environment or by assuming a particular role.

Odonate – dragonflies and damselflies.

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.

POSCIP – Plant of Special Concern in Pennsylvania.

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.

Sedge – grass-like 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 five meters 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.

Stream gradient – the average percent change in elevation of a stream bed over a given reach.

Stream reach – referring to a specific stretch of a stream, creek, or river; i.e. the reach of the Juniata River between Lewistown and Mifflintown.

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).

Swamp - a wooded wetland, intermittently or permanently flooded.

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 – 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 species by species basis.

Talus – slope formed of loose rock and gravel that accumulates at the base of mountains or cliffs.

Taxa richness - the total number of taxa counted within a site, community of system.

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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APPENDICES

APPENDIX I: Site Survey Form

PLANT & ANIMAL SPECIES OF SPECIAL CONCERN REPORT (PLEASE INCLUDE A MAP – SEE MAPPING INSTRUCTIONS)

SPECIES NAME:		SURVEYOR(S): (Please include your address & phone #)	
DATE OF VISIT:		TIME SPENT AT SITE:	
USGS QUADRANGLE:			
SITE NAME AND DIRECTIONS TO SITE:		GPS Coordinates: Latitude: _____ Longitude: _____ DATUM (e.g. NAD27, NAD83) _____	
OWNER INFORMATION: • Public Land: give tract name: _____ • Private Land: Please fill out landowner info below. NOTE: We cannot accept data collected on private land if you didn't have permission!			
Landowner Name:		Address:	
Phone Number:		City / State / Zip code:	
■ Landowner aware of the species of special concern? YES ____ NO ____ ■ Landowner aware that data are submitted to PA Natural Diversity Inventory? YES ____ NO ____ ■ Landowners are welcome to call the PNDI-East office in Middletown at (717) 948-3962 for more information. ■ IF A SPECIMEN WAS COLLECTED: Please ask for the landowner's signature for permission to save the specimen in a museum: Landowner Signature: _____ Date: _____ ■ WHERE IS THE SPECIMEN BEING HELD			
HABITAT DESCRIPTION: Give a general description of the site. You might include other plant/animal species at site, substrate/soils, topography, land use, weather, etc. If revisiting a site, indicate any obvious changes to the habitat.			
DISTURBANCES/THREATS: Include human and/or natural disturbances and threats to the species at this site.			
SPECIES DATA: Fill out as much of the following as you can - include anything else you feel is of importance.			
♣ Give general description of what you saw (i.e.: <i>found scat, heard song, animal crossing road, found plant in bog..</i>)			
♣ Count or estimate the number of plants / animals you observed & estimate the size of the area they occupy.			
♣ Age and condition of individual(s) (i.e.: <i>fresh adult butterfly; healthy mature plants - 50% flowering and with immature fruit...</i>)			
♣ Behavior (animals) (i.e.: <i>nectaring insect, breeding birds, turtle basking...</i>)			
♣ If revisiting this site, compare the health and size of the population to previous visits.			
♣ Confidence level on Identification: ID Positive ID Somewhat Uncertain ID Unknown			
♣ Voucher specimen or photo taken? (Please include if possible)			
♣ Additional information:			

APPENDIX II: Community Classification

CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA

Terrestrial & Palustrine Plant Communities of Pennsylvania (Fike 1999) is the most current community classification system for Pennsylvania's palustrine and terrestrial plant communities. This report was developed by the Pennsylvania Natural Heritage Program to update and refine Smith's 1991 report *Classification of natural communities in Pennsylvania (draft)*, the first effort dedicated specifically to the classification of natural communities in the state. Work is ongoing to improve the current classification system. Future editions may define new community types or alter currently defined types. Aquatic communities (lakes, streams, and rivers), communities where vegetation is absent or not a definitive characteristic (caves, scree slopes), and communities resulting from extensive human disturbance (old agricultural fields, manmade wetlands, etc.), are not addressed in this classification. Until more extensive work can be completed to define these types of communities and incorporate them into a single statewide framework, the County Natural Heritage Inventory reports will provisionally refer to features of ecological interest that fall outside the Fike 1999 system using categories described in Smith 1991.

Community Ranks

As with species that are of concern, ranks have been assigned to rate the rarity of each natural community type identified for Pennsylvania. Appendix III list criteria for global and state ranks. In most cases, the global extent of these communities has yet to be fully evaluated, and no global rarity rank has been assigned. Work is ongoing to refine these ranks and to further develop the ranking system to rate the relative quality of communities within a type.

Community Name (Fike 1999)	State Rank	Community Name (Fike 1999)	State Rank
TERRESTRIAL FORESTS			
CONIFEROUS TERRESTRIAL FORESTS:			
Hemlock (white pine) forest	S4		
CONIFER – BROADLEAF TERRESTRIAL FORESTS			
Serpentine Virginia pine - oak forest	S1	Hemlock (white pine) - red oak - mixed hardwood forest	S4
Serpentine pitch pine - oak forest	S1	Pitch pine - mixed oak forest	S4
Rich hemlock - mesic hardwoods forest	S2S3	Hemlock (white pine) - northern hardwood forest	S5
Dry white pine (hemlock) - oak forest	S4	Virginia pine - mixed hardwood forest	S5
Hemlock - tulip tree - birch forest	S4		
BROADLEAF TERRESTRIAL FORESTS			
Sweet gum - oak coastal plain forest	S1	Black cherry - northern hardwood forest	S4
Mixed mesophytic forest	S1S2	Sugar maple - basswood	S4
Blackgum ridgetop forest	S3	Tuliptree- beech -maple forest	S4
Dry oak-mixed hardwood forest	S3	Dry oak-heath forest	S4S5
Aspen/gray (paper) birch forest	S3*	Red maple (terrestrial) forest	S5
Northern hardwood forest	S4	Red oak - mixed hardwood forest	S5
PALUSTRINE FORESTS			
CONIFEROUS PALUSTRINE FORESTS			
Black spruce - tamarack peatland forest	S3	Hemlock palustrine forest	S3
Red spruce palustrine forest	S3		
CONIFER – BROADLEAF PALUSTRINE FORESTS			
Red spruce - mixed hardwood palustrine forest	S3	Hemlock - mixed hardwood palustrine forest	S3S4
BROADLEAF PALUSTRINE FORESTS			
Great Lakes Region lake plain palustrine forest	S1	Red maple - black ash palustrine forest	S2S3
Red maple - magnolia coastal plain palustrine forest	S1	Sycamore - (river birch) - box-elder floodplain forest	S3
Bottomland oak - hardwood palustrine forest	S2	Silver maple floodplain forest	S3
Red maple - elm - willow floodplain swamp	S2	Red maple - blackgum palustrine forest	S3S4
TERRESTRIAL WOODLANDS			
CONIFEROUS WOODLANDS			
Pitch pine - rhodora - scrub oak woodland	S1	Pitch pine - heath woodland	S2
Red spruce rocky summit	S1	Pitch pine - scrub oak woodland	S2S3
CONIFER – BROADLEAF TERRESTRIAL WOODLANDS			
Red-cedar - mixed hardwood rich shale woodland	S1S2	Pitch pine - mixed hardwood woodland	S2S3
Virginia pine - mixed hardwood shale woodland	S2		
BROADLEAF – TERRESTRIAL WOODLANDS			
Great Lakes Region bayberry - cottonwood community	S1	Yellow oak - redbud woodland	S2
Great Lakes Region scarp woodland	S1S2	Dry oak - heath woodland	S3
Birch (blackgum) rocky slope woodland	S2		

APPENDIX II: (continued)

Community Name (Fike 1999)	State Rank	Community Name (Fike 1999)	State Rank
PALUSTRINE WOODLANDS			
CONIFEROUS PALUSTRINE WOODLANDS			
Pitch pine - leatherleaf palustrine woodland	S1	Red spruce palustrine woodland	S2S3
Black spruce - tamarack palustrine woodland	S2		
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 - pine serpentine shrubland	S1	Red-cedar - prickly pear shale shrubland	S2
CONIFER – BROADLEAF TERRESTRIAL SHRUBLANDS			
Red-cedar - redbud shrubland	S2		
BROADLEAF TERRESTRIAL SHRUBLANDS			
Low heath shrubland	S1	Low heath - mountain ash shrubland	S2
Rhodora - mixed heath - scrub oak shrubland	S1	Scrub oak shrubland	S3
PALUSTRINE SHRUBLANDS			
BROADLEAF PALUSTRINE SHRUBLANDS			
Buckthorn - sedge (<i>Carex interior</i>) - golden ragwort fen	S1	Water-willow (<i>Decodon verticillatus</i>) shrub wetland	S3
Great Lakes Region scarp seep	S1	Alder - <i>Sphagnum</i> wetland	S4
Great Lakes Region bayberry - mixed shrub	S1	Black willow scrub/shrub wetland	S4
Poison sumac - red-cedar - bayberry fen	S1	Buttonbush wetland	S4
Leatherleaf - bog rosemary peatland	S2	River birch - sycamore floodplain scrub	S4
Leatherleaf - cranberry peatland	S2S3	Highbush blueberry - meadow-sweet wetland	S5
Alder - ninebark wetland	S3	Highbush blueberry - <i>Sphagnum</i> wetland	S5
Leatherleaf - sedge wetland	S3		
TERRESTRIAL HERBACEOUS OPENINGS			
Great Lakes Region dry sand plain	S1	Side-oats grama calcareous grassland	S1
Great Lakes Region sparsely vegetated beach	S1	Calcareous opening/cliff	S2
Serpentine grassland	S1	Little bluestem - Pennsylvania sedge opening	S2
Serpentine gravel forb community	S1		
HERBACEOUS WETLANDS			
PERSISTENT EMERGENT WETLANDS			
Great Lakes Region palustrine sand plain	S1	<i>Sphagnum</i> - beaked rush peatland	S3
Open sedge (<i>Carex stricta</i> , <i>C. prairea</i> , and <i>C. lacustris</i>) fen	S1	Tussock sedge marsh	S3
		Golden saxifrage - Pennsylvania bitter-cress spring run	S3S4
Serpentine seepage wetland	S1	Herbaceous vernal pool	S3S4
Prairie sedge - spotted joe-pye-weed marsh	S1S2	Water-willow (<i>Justicia americana</i>)- smartweed riverbed community	S4
Riverside ice scour community	S1S2	Skunk cabbage - golden saxifrage forest seep	S4S5
Golden saxifrage - sedge rich seep	S2	Bluejoint - reed canary grass marsh	S5
Many fruited sedge - bladderwort peatland	S2	Cattail marsh	S5
Big bluestem - Indian grass river grassland	S3	Wet meadow	S5*
Bulrush marsh	S3		
Mixed forb marsh	S3		
NON-PERSISTENT EMERGENT WETLANDS			
Pickereel-weed - arrow-arum - arrowhead wetland	S4	Spatterdock - water lily wetland	S4
COMMUNITY COMPLEXES			
Acidic Glacial Peatland Complex		Ridgetop acidic barrens complex	
Erie lakeshore beach – dune – sand plain complex		River bed – bank– floodplain complex	
Great Lakes Region scarp complex		Serpentine barrens complex	
Mesic till barrens complex			

APPENDIX II: (continued)

Community Name (Smith 1991)	State Rank	Community Name (Smith 1991)	State Rank
SUBTERRANEAN COMMUNITIES			
Talus cave community	S2S4	Solution cave terrestrial community	S3
Solution cave aquatic community	S3	Tectonic cave community	S3S4
DISTURBED COMMUNITIES			
Bare soil	S?	Meadow/pastureland	S?
Conifer plantation	S?	Successional field	S?
Cultivated land	S?	Young miscellaneous forest	S?
ESTUARINE COMMUNITIES:			
Deepwater subtidal community	S1	Freshwater intertidal mudflat	S1
Freshwater intertidal marsh	S1	Shallow-water subtidal community	S1
RIVERINE COMMUNITIES:			
High-gradient brownwater creek	S?	Medium-gradient clearwater creek	S3
High-gradient clearwater river	S?	High-gradient clearwater creek	S3
Medium-gradient clearwater river	S?	Low-gradient clearwater creek	S3S4
Spring community	S1S2	Waterfall and plungepool	S3S4
Spring run community	S1S2	High-gradient ephemeral /intermittent creek	S5
Low-gradient brownwater creek	S2S3	Low-gradient ephemeral/intermittent creek	S5
Low-gradient clearwater river	S2S3	Medium-gradient ephemeral/intermittent creek	S5
Medium-gradient brownwater creek	S3		
LACUSTRINE COMMUNITIES:			
Stable natural pool	S?	Natural pond	S2S3
Ephemeral/fluctuating limestone sinkhole	S1	Artificial lake	---
Ephemeral/fluctuating natural pool	S1	Artificial pond	---
Glacial lake	S1	Artificial pool	---
Nonglacial lake	S2		

* = Communities that are not tracked

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** - Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.
- LT** - Listed Threatened - Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.
- PE** - Proposed Endangered - Taxa proposed to be formally listed as endangered.
- PT** - Proposed Threatened - 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

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** - Tentatively Undetermined - 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** - None - 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 (PaFC) 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 (PaFC) 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.

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.

PNHP GLOBAL ELEMENT RANKS (continued)

- 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).
- GU** = 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.
- GNR** = Global rank has yet to be assessed. A GNR rank indicates neither commonness nor

APPENDIX III (continued)

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.
- DL** = Recently removed from the list of species of concern.

APPENDIX IV: Pennsylvania Element Occurrence Quality Ranks

<u>Quality Rank*</u>	<u>Explanation</u>
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.
F	While know from the site, the last survey failed to find sufficient evidence to verify the element still occurred at the site

* Intermediate ranks may also be assigned.

APPENDIX V: Plants, Animals and Natural Communities of Special Concern in Juniata County

Plants

<i>Scientific Name</i>	<i>Common Name</i>
<i>Bartonia paniculata</i>	screw-stem
<i>Bouteloua curtipendula</i>	tall gramma
<i>Carex careyana</i>	Carey's sedge
<i>Carex crinita</i> var. <i>brevicrinis</i>	short hair sedge
<i>Carex lupuliformis</i>	false hop sedge
<i>Carex shortiana</i>	Short's sedge
<i>Carex typhina</i>	cattail sedge
<i>Ellisia nyctelea</i>	waterpod
<i>Erythronium albidum</i>	white trout-lily
<i>Galium latifolium</i>	purple bedstraw
<i>Leucothoe racemosa</i>	swamp dog-hobble
<i>Linum sulcatum</i>	grooved yellow flax
<i>Lithospermum canescens</i>	hoary puccoon
<i>Onosmodium molle</i> var. <i>hispidissimum</i>	false gromwell
<i>Panicum boreale</i>	panic-grass
<i>Penstemon canescens</i>	beard-tongue
<i>Pinus echinata</i>	short-leaf pine
<i>Potamogeton illinoensis</i>	Illinois pondweed
<i>Potamogeton pulcher</i>	spotted pondweed
<i>Quercus shumardii</i>	Shumard's oak
<i>Ranunculus flabellaris</i>	yellow water-crowfoot
<i>Samolus parviflorus</i>	pineland pimpernel
<i>Schoenoplectus acutus</i>	hard-stemmed bulrush
<i>Senna marilandica</i>	southern wild senna
<i>Sida hermaphrodita</i>	Virginia mallow
<i>Trillium cernuum</i>	nodding trillium

Animals

<i>Scientific Name</i>	<i>Common Name</i>
<i>Anthocharis midea</i>	Falcate Orangetip
<i>Alasmidonta marginata</i>	Elktoe
<i>Alasmidonta undulata</i>	Triangle Floater
<i>Amblyscirtes vialis</i>	Common Roadside-skipper
<i>Asterocampa clyton</i>	Tawny Emperor
<i>Callophrys gryneus</i>	Juniper Hairstreak
<i>Callophrys henrici</i>	Henry's Elfin
<i>Chlosyne nycteis</i>	Silvery Checkerspot
<i>Clemmys guttata</i>	Spotted Turtle
<i>Enodia anthedon</i>	Northern Pearly-eye
<i>Euphydryas phaeton</i>	Baltimore Checkerspot
<i>Haliaeetus leucocephalus</i>	Bald Eagle
<i>Lampsilis cariosa</i>	Yellow Lampmussel
<i>Lampsilis radiata</i>	Eastern Lampmussel
<i>Lasmigona subviridis</i>	Green Floater
<i>Myotis septentrionalis</i>	Northern Myotis
<i>Neotoma magister</i>	Allegheny Woodrat
<i>Progomphus obscurus</i>	Common Sanddragon
<i>Tyto alba</i>	Barn-owl

Natural Communities and Geologic Features

<i>Common Name</i>
anticlines
ephemeral/fluctuating natural pool
red-cedar - redbud shrubland
side-oats grama calcareous grassland community
silver maple floodplain forest

APPENDIX VI: Lepidoptera (Butterflies) collected during field surveys or known from Juniata County

State Scientific Name	State Common Name	Global Rank	State Rank
<i>Anthocharis midea</i>	Falcate Orangetip	G4G5	S3
<i>Asterocampa celtis</i>	Hackberry Emperor	G5	S4
<i>Boloria bellona</i>	Meadow Fritillary	G5	S5
<i>Callophrys gryneus</i>	Juniper Hairstreak	G5	S2S4
<i>Callophrys henrici</i>	Henry's Elfin	G5	S1S3
<i>Callophrys niphon</i>	Eastern Pine Elfin	G5	S3
<i>Cercyonis pegala</i>	Common Wood-nymph	G5	S5
<i>Colias eurytheme</i>	Orange Sulphur	G5	S5B
<i>Colias philodice</i>	Clouded Sulphur	G5	S5
<i>Cupido comyntas</i>	Eastern-tailed Blue	G5	S5
<i>Danaus plexippus</i>	Monarch	G5	S5B
<i>Erynnis baptisiae</i>	Wild Indigo Duskywing	G5	S5
<i>Erynnis juvenalis</i>	Juvenal's Duskywing	G5	S5
<i>Euptoieta claudia</i>	Variegated Fritillary	G5	SNA
<i>Junonia coenia</i>	Common Buckeye	G5	SNA
<i>Limenitis arthemis</i>	White Admiral	G5	S5
<i>Lycaena phlaeas</i>	American Copper	G5	S5
<i>Megisto cymela</i>	Little Wood Satyr	G5	S5
<i>Nymphalis antiopa</i>	Mourning Cloak	G5	S5
<i>Nymphalis vaualbum</i>	Compton Tortoiseshell	G5	S4
<i>Papilio appalachiensis</i>	Appalachian Tiger Swallowtail	G4Q	SNR
<i>Papilio glaucus</i>	Eastern Tiger Swallowtail	G5	S5
<i>Papilio polyxenes</i>	Black Swallowtail	G5	S4
<i>Papilio troilus</i>	Spicebush Swallowtail	G5	S5
<i>Phyciodes tharos</i>	Pearl Crescent	G5	S5
<i>Pieris rapae</i>	Cabbage White	G5	SNA
<i>Poanes hobomok</i>	Hobomok Skipper	G5	S5
<i>Polygonia comma</i>	Eastern Comma	G5	S5
<i>Polygonia interrogationis</i>	Question Mark	G5	S5B
<i>Pyrgus communis</i>	Common Checkered-skipper	G5	SNA
<i>Satyrium calanus</i>	Banded Hairstreak	G5	S5
<i>Satyrium edwardsii</i>	Edwards' Hairstreak	G4	S3S4
<i>Speyeria aphrodite</i>	Aphrodite Fritillary	G5	S3S4
<i>Speyeria cybele</i>	Great Spangled Fritillary	G5	S5
<i>Speyeria idalia</i>	Regal Fritillary (historic)	G3	S1
<i>Strymon melinus</i>	Gray Hairstreak	G5	S5
<i>Thorybes pylades</i>	Northern Cloudywing	G5	S4
<i>Vanessa atalanta</i>	Red Admiral	G5	S5B
<i>Vanessa cardui</i>	Painted Lady	G5	S5B
<i>Vanessa virginiensis</i>	American Lady	G5	S5B

APPENDIX VII: Lepidoptera (Moths) collected during Juniata County field surveys

<i>State Scientific Name</i>	<i>State Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>	<i>State Scientific Name</i>	<i>State Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>
<i>Acrionicta inclara</i>	Unclear Dagger	G5	SNR	<i>Datana angusii</i>	Andus's Datana	G5	SNR
<i>Actias luna</i>	Luna Moth	GNR	SNR	<i>Datana contracta</i>	Contracted Datana	G5	SNR
<i>Agrotis ipsilon</i>	Dark Sword Grass Moth	G5	SNR	<i>Datana drexellii</i>	Drexel's Caterpillar Moth	GNR	SNR
<i>Agrotis subterranea</i>	Subterranean Dart	G5	SNR	<i>Datana integerrima</i>	Walnut Caterpillar Moth	G5	SNR
<i>Alypia octomaculata</i>	Eight Spotted Forrester	G5	SNR	<i>Datana ministra</i>	Yellow-necked Caterpillar Moth	G5	SNR
<i>Amphipoea velata</i>	Veiled Ear Moth	G5	SNR	<i>Desmia funeralis</i>	Grape Leafroller	G5	SNR
<i>Anacamptodes defectaria</i>	Brown-shaded Gray	G5	SNR	<i>Digrammia ocellinata</i>	Faint-spotted Angle	G5	SNR
<i>Anavitrinella pampinaria</i>	Common Gray	GNR	SNR	<i>Drepana arcuata</i>	Arched Hooktip	G5	SNR
<i>Anisota senatoria</i>	Orange-striped Oakworm	G5	SNR	<i>Dryocampa rubicunda</i>	Rosey Maple Moth	G5	SNR
<i>Antheraea polyphemus</i>	Polyphemus Moth	G5	SNR	<i>Eacles imperialis</i>	Imperial Moth	G5	SNR
<i>Apatelodes torrefacta</i>	Spotted Apatelodes	G5	SNR	<i>Elaphria grata</i>	Grateful Midget	G5	SNR
<i>Automeris io</i>	Io Moth	G5	SNR	<i>Ellida caniplaga</i>	Linden Prominent	G5	SNR
<i>Baileya australis</i>	Small Bailey	G5	SNR	<i>Epimecis hortaria</i>	Tuliptree Beauty	G5	SNR
<i>Caenurgina crassiuscula</i>	Clover Looper	G5	SNR	<i>Erynnis baptisiae</i>	Wild Indigo Duskywing	G5	S5
<i>Callopietria mollissima</i>	Pink-shaded Fen Moth	GNR	SNR	<i>Erynnis brizo</i>	Sleepy Duskywing	G5	S4
<i>Catocala andromeda</i>	Gloomy Underwing	GNR	SNR	<i>Erynnis juvenalis</i>	Juvenal's Duskywing	G5	S5
<i>Catocala coccinata</i>	Scarlet Underwing	G5	SNR	<i>Euagrotis illapsa</i>	Snowy Dart	G5	SNR
<i>Catocala grynea</i>	Woody Underwing	G5	SNR	<i>Euchaetes egle</i>	Milkweed Tussock Moth	G5	SNR
<i>Catocala ilia</i>	Ilia Underwing	G5	SNR	<i>Eugonobapta nivosaria</i>	Snowy Geometer	G5	SNR
<i>Catocala micronympha</i>	Little Nymph Underwing	G5	SNR	<i>Eulithis gracilineata</i>	Greater Grapevine Looper	G5	SNR
<i>Catocala paleogama</i>	Oldwife Underwing	GNR	SNR	<i>Euphyes vestris</i>	Dun Skipper	G5	S5
<i>Catocala ultronia</i>	Ultronia Underwing	G5	SNR	<i>Feltia herilis</i>	Master's Dart	G5	SNR
<i>Cerma cerintha</i>	Tufted Bird-dropping Moth	G5	SNR	<i>Feltia subgothica</i>	Subgothic Dart	G5	SNR
<i>Chlorochlamys chloroleucaria</i>	Blackberry Looper	GNR	SNR	<i>Feltia tricola</i>	Confused Dart	G5	SNR
<i>Choristoneura rosaceana</i>	Oblique-Banded Leafroller	G5	SNR	<i>Halysidota tessellaris</i>	Banded Tussock Moth	G5	SNR
<i>Chytonix palliatricula</i>	Cloaked Marvel Moth	G5	SNR	<i>Haploa reversa</i>	Reversed Haploa	G5	SNR
<i>Clemensia albata</i>	Little White Lichen Moth	G5	SNR	<i>Herpetogramma thestealis</i>	A Snout Moth	GNR	SNR
<i>Colocasia propinquilinea</i>	Closebanded Yellowhorn	G5	SNR	<i>Holomelina immaculata</i>	Immaculate Holomelina	GNR	SNR
<i>Cosmia calami</i>	American Dun-bar	G5	SNR	<i>Holomelina opella</i>	Tawny Holomelina	G5	SNR
<i>Crambus youngellus</i>	Grass-veneer Moth	GNR	SNR	<i>Hypagyrtis unipunctata</i>	One-Spotted Variant	G5	SNR
<i>Dasychira vagans</i>	Variable Tussock Moth	GNR	SNR	<i>Hypena abalienalis</i>	White-lined Bomolocha	G5	SNR
<i>Hypena madefactalis</i>	Grey-eyed Bomolocha	G5	SNR	<i>Paonias myops</i>	Small-eyed Sphinx	G5	SNR
<i>Hypena manalis</i>	Flowing-line Bomolocha	G5	SNR	<i>Parasa chloris</i>	Smaller Parasa	G5	SNR
<i>Hypena scabra</i>	Green Cloverworm	GNR	SNR	<i>Patalene olyzonaria puber</i>	Juniper Geometer	G5	SNR

APPENDIX VII: (continued)

<i>State Scientific Name</i>	<i>State Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>	<i>State Scientific Name</i>	<i>State Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>
<i>Hypenodes fractilinea</i>	Broken-Line Hypenodes	G4	SNR	<i>Peridea basitriens</i>	Oval-based Prominent	G5	SNR
<i>Hypercompe scribonia</i>	Giant Leopard Moth	G5	SNR	<i>Pero hubneraria</i>	Hebner's Pero Moth	G5	SNR
<i>Hypoprepia fucosa</i>	Painted Lichen Moth	G5	SNR	<i>Phalaenophana paramusalis</i>	Dark-Banded Owlet	GNR	SNR
<i>Hypoprepia miniata</i>	Scarlet-Winged Lichen Moth	G5	SNR	<i>Phalaenostola hanhami</i>	Hanham's Snout Moth	G4	SNR
<i>Idia aemula</i>	Common Idia	G5	SNR	<i>Phalaenostola larentioides</i>	Black-Banded Owlet	G5	SNR
<i>Idia americalis</i>	American Idia	G5	SNR	<i>Phalaenostola metonalis</i>	Pale Epidelta	G5	SNR
<i>Leucania inermis</i>	Unarmed Wainscot	G4	SNR	<i>Phosphila miselioides</i>	Spotted Phosphila	GNR	SNR
<i>Lithacodia muscosula</i>	Large Mossy Lithacodia	G5	SNR	<i>Phragmatobia fuliginosa</i>	Ruby Tiger Moth	G5	SNR
<i>Lymantria dispar</i>	Gypsy Moth	G5	Exotic	<i>Phyllodesma americana</i>	Lappet Moth	G5	SNR
<i>Lytrosis unitaria</i>	Common Lytrosis	G5	SNR	<i>Plagodis fervidaria</i>	Curved-line Looper	G5	SNR
<i>Macaria aemulataria</i>	Common Angle	G5	SNR	<i>Pleuroprucha insulsaria</i>	Common Tan Wave	G5	SNR
<i>Macaria bisignata</i>	Red-Headed Looper	G5	SNR	<i>Polygrammate hebraicum</i>	The Hebrew	G5	SNR
<i>Macrurocampa marthesia</i>	Mottled Prominent	G5	SNR	<i>Prochoerodes transversata</i>	Large Maple Spanworm Moth	G5	SNR
<i>Malacosoma disstria</i>	Forest Tent Caterpillar Moth	G5	SNR	<i>Pseudohermonassa bicarnea</i>	Pink-Spotted Dart	G5	SNR
<i>Melanolophia canadaria</i>	Canadian Melanolophia	G5	SNR	<i>Renia salusalis</i>	A Moth	G5	SNR
<i>Nadata gibbosa</i>	White-spotted Prominent	G5	SNR	<i>Scopula limboundata</i>	Large Lace-border Moth	G5	SNR
<i>Nemoria bistriaria</i>	Red-fringed Emerald	G5	SNR	<i>Selenia kentaria</i>	Kent's Geometer	GNR	SNR
<i>Noctua pronuba</i>	Large Yellow Underwing	GNR	Exotic	<i>Sparganothis sulphureana</i>	Sparganothis Fruitworm	GNR	SNR
<i>Ochropleura implecta</i>	Flame-Shouldered Dart	GNR	SNR	<i>Spilosoma virginica</i>	Virginian Tiger Moth	G5	SNR
<i>Ogdoconta cinereola</i>	Common Pinkband	G5	SNR	<i>Stiriodes obtusa</i>	Obtuse Yellow	G4G5	SNR
<i>Olceclostera angelica</i>	The Angle	G5	SNR	<i>Symmerista albifrons</i>	White-headed Prominent	G5	SNR
<i>Orgyia definita</i>	Definite Tussock Moth	G5	SNR	<i>Symmerista canicosta</i>	Redhumped Oakworm	G4	SNR
<i>Orgyia leucostigma</i>	White-marked Tussock Moth	G5	SNR	<i>Tarachidia candefacta</i>	Olive-Shaded Bird-Dropping Moth	G5	SNR
<i>Orthodes cynica</i>	Cynical Quaker Moth	G5	SNR	<i>Thioptera nigrofimbria</i>	Black-Bordered Lemon Moth	G5	SNR
<i>Palthis angulalis</i>	Dark-Spotted Palthis	G5	SNR	<i>Zanclognatha laevigata</i>	Variable Zanclognatha Moth	G5	SNR
<i>Pandemis limitata</i>	Three-lined Leafroller	GNR	SNR	<i>Zanclognatha ochreipennis</i>	Wavy-lined Zanclognatha Moth	G5	SNR
<i>Pantographa limata</i>	Basswood Leafroller	GNR	SNR				

APPENDIX IIX: Odonates collected during Juniata County field surveys

<i>Scientific Name</i>	Common Name	Global rank	State rank
<i>Aeshna canadensis</i>	Canada Darner	G5	S4S5
<i>Anax junius</i>	Common Green Darner	G5	S5
<i>Archilestes grandis</i>	Great Spreadwing	G5	S4
<i>Argia apicalis</i>	Blue-fronted Dancer	G5	S4
<i>Argia fumipennis violacea</i>	Variable Dancer	G5T5	S5
<i>Argia moesta</i>	Powdered Dancer	G5	S5
<i>Basiaeschna janata</i>	Springtime Darner	G5	S5
<i>Calopteryx maculata</i>	Ebony Jewelwing	G5	S5
<i>Didymops transversa</i>	Stream Cruiser	G5	S5
<i>Dromogomphus spinosus</i>	Black-shouldered Spinyleg	G5	S5
<i>Enallagma civile</i>	Familiar Bluet	G5	S5
<i>Enallagma exsulans</i>	Stream Bluet	G5	S5
<i>Enallagma geminatum</i>	Skimming Bluet	G5	S5
<i>Epithea canis</i>	Beaverpond Baskettail	G5	S4S5
<i>Epithea cynosura</i>	Common Baskettail	G5	S5
<i>Epithea princeps</i>	Prince Baskettail	G5	S5
<i>Erythemis simplicicollis</i>	Eastern Pondhawk	G5	S5
<i>Gomphus exilis</i>	Lancet Clubtail	G5	S5
<i>Gomphus lividus</i>	Ashy Clubtail	G5	S5
<i>Gomphus vastus</i>	Cobra Clubtail	G5	S3S4
<i>Hagenius brevistylus</i>	Dragonhunter	G5	S5
<i>Hetaerina americana</i>	American Rubyspot	G5	S5
<i>Ischnura posita</i>	Fragile Forktail	G5	S5
<i>Ischnura verticalis</i>	Eastern Forktail	G5	S5
<i>Ladona deplanata</i>	Blue Corporal	G5	S1
<i>Lestes disjunctus australis</i>	Southern Spreadwing	G5	S4S5
<i>Lestes inaequalis</i>	Elegant Spreadwing	G5	S4
<i>Lestes rectangularis</i>	Slender Spreadwing	G5	S5
<i>Leucorrhinia intacta</i>	Dot-tailed Whiteface	G5	S5
<i>Libellula cyanea</i>	Spangled Skimmer	G5	S4S5
<i>Libellula luctuosa</i>	Widow Skimmer	G5	S5
<i>Libellula pulchella</i>	Twelve-spotted Skimmer	G5	S5
<i>Libellula semifasciata</i>	Painted Skimmer	G5	S4S5
<i>Macromia illinoiensis</i>	Illinois River Cruiser	G5	S5
<i>Pachydiplax longipennis</i>	Blue Dasher	G5	S5
<i>Perithemis tenera</i>	Eastern Amberwing	G5	S5
<i>Progomphus obscurus</i>	Common Sanddragon	G5	S2
<i>Sympetrum janeae</i>	Jane's Meadowhawk	G5	S5
<i>Sympetrum rubicundulum</i>	Ruby Meadowhawk	G5	S5
<i>Sympetrum vicinum</i>	Autumn Meadowhawk	G5	S5

APPENDIX IX: 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 cost-share 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.sfi of pa.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>

APPENDIX X: Juniata County Conservation Resources

Land Trusts:

The Central Pennsylvania Conservancy

114 Walnut Street
P.O. Box 587
Harrisburg, PA 17108-0587
Phone: (717) 233-0221
Email: info@centralpaconservancy.org
Web: <http://www.centralpaconservancy.org>

Watershed Organizations:

Juniata Clean Water Partnership

416 Penn Street
Huntingdon, PA 16652
Phone: (814) 506-1190
Email: jcwp@jcwp.org
Web: <http://www.jcwp.org>

Western Pennsylvania Conservancy

Nick Pinizzotto
Senior Director, Freshwater Conservation
246 South Walnut Street
Blairsville, PA 15717
Phone: 724.459.0953
Email: NPinizzotto@paconserve.org

PA CleanWays

105 West Fourth Street
Greensburg, PA 15601-2981
Phone: (877) 772-3673
Email: info@pacleanways.org
Web: <http://www.pacleanways.org>

Other Resources:

Chesapeake Bay Foundation

Pennsylvania Office
The Old Water Works Building
614 North Front Street, Suite G
Harrisburg, PA 17101
Phone: (717) 234-5550
Web: www.cbf.org

Juniata County Conservation District

RR 5 Box 35
Stoney Creek Drive
Mifflintown, PA 17059
Phone: (717) 436-8953 (ext #5)
Email: juniataccd@juniataccd.org
Web: <http://juniataccd.org/>

NRCS Mifflintown Service Center

35 Arch Rock Rd.
Mifflintown, PA 17059
Phone: (717) 436-8953 (ext #4)
Web: <http://www.nrcs.usda.gov/>

Pennsylvania Land Trust Association

105 Locust Street, Suite 300
Harrisburg, PA 17101
Phone: (717) 230-8560
Email: info@conserveland.org
Web: <http://conserveland.org/>

Pennsylvania Organization for Watersheds and Rivers, Inc.

610 North Third St.
Harrisburg, PA 17101
Phone: (717) 234-7910
Email: info@pawatersheds.org
Web: <http://www.pawatersheds.org/index.asp>

Susquehanna River Basin Commission

1721 N. Front Street
Harrisburg, PA 17112
Phone: (717) 238-0423
Web: <http://www.srbcb.net>

**APPENDIX XI: Selected Facts Sheets for Species and Communities of Special Concern in
Juniata County**

Ephemeral/Fluctuating Natural Pools

Pennsylvania Natural Community Type

State Rank: S3 (vulnerable), **Global Rank: GNR** (not yet assessed)

General Description

Ephemeral/fluctuating natural pools, more commonly referred 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 solely 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 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 several meters 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 is raining, during the breeding season!



a spring season view of a vernal pool

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.



a gray treefrog calling at a vernal pool

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 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 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 hognosed 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.



vernal pool salamander egg masses and tadpoles

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.

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 do not 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 poisons and the application of chemicals can destroy the intricate food webs in vernal pool communities.



a marbled salamander migrating to a vernal pool

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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Shaffer, L.L., 1991. *Pennsylvania Amphibians & Reptiles*. Pennsylvania Fish Commission, Harrisburg, PA. 161pp.



Allegheny Woodrat (*Neotoma magister*)

Pennsylvania Threatened Mammal Species

State Rank: S3 (vulnerable), Global Rank: G3G4 (vulnerable/apparently secure)

Identification

The Allegheny Woodrat (*Neotoma magister*) is a relatively large member of this group, ranging from 14-17 inches in total length (including tail). The fur is brownish-gray with slightly darker coloration in the middle of the back. The belly and paws are white and the sides are buff. The Allegheny Woodrat has large ears and a furry, bicolored tail. The introduced exotic Norway rat (*Rattus norvegicus*) has a naked tail and overall brown coloration, which distinguishes it from the woodrat in Pennsylvania.

Habitat

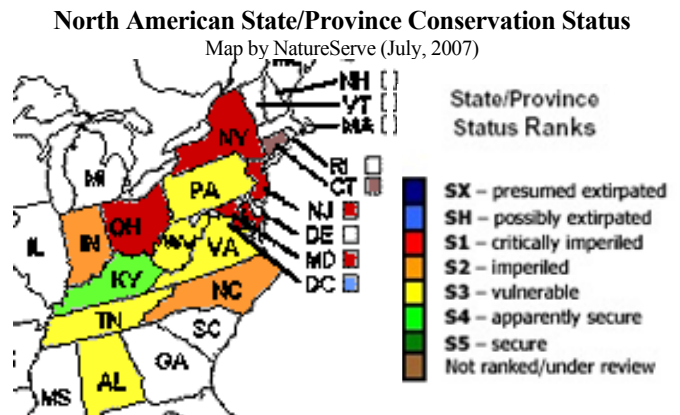
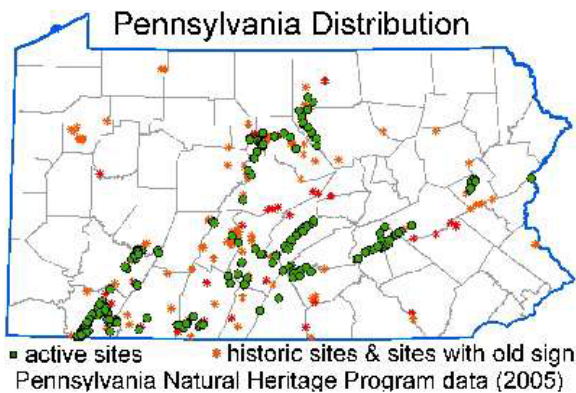
Another name for this species is cave rat because it sometimes inhabits limestone caves. It is also found along cliff faces, in boulder piles and talus slopes. Nests composed of shredded plant fibers are found in dry cave entrances, along narrow ledges and in rock crevices. This species feeds on nuts, seeds, bark, grasses, fruits, and berries. They are nocturnal and a relatively shy species that is often found by locating food caches and latrines.

Status

Distribution of the Allegheny woodrat is primarily along the Appalachian Mountains from New York to Georgia and west to Indiana. Populations in Pennsylvania appeared healthy during the 1940's and early 1950's. However, during bat surveys in 1978 and 1979, John S. Hall from Albright College noted an absence of woodrat sign in caves. Very few locations were occupied in the former range, and woodrats were only found in a few counties during that time. This led to its current status of Threatened in Pennsylvania. It is not clear why this species declined so suddenly in Pennsylvania but it is likely due to a variety of factors.



photo source: Cal Butchkowski



Conservation Status

Increased habitat fragmentation, especially in the eastern portion of its range may be a major factor in the decline. Fragmentation from roads and development causes loss of habitat, isolation, and increased exposure to parasites. The once relatively isolated ridgetops where the woodrat thrived are not bisected by roads, allowing easy access for humans. These corridors also provide easy access for parasite hosts such as raccoons increasing the frequency of parasite infection among woodrats. Raccoon roundworm (*Baylisascaris*) is a dangerous and quickly spreading parasite that may be devastating to woodrat populations in the east. Intact forest ridges that provide habitat for this species must be protected from further fragmentation and development.

References

- Genoway, H.H. and F.J. Brenner. 1985. Species of Special Concern in Pennsylvania. Carnegie Museum of Natural History. Pittsburgh, PA. 430pp.
- Great Smoky Mountains National Park. All Taxa Biodiversity Inventory. Allegheny Woodrat Species Acct. Website: www.smokiesatbi.or/atbi/species/animals/Mammals/Neotoma_magister.html.
- Pennsylvania Game Commission. Endangered and Threatened Species. Eastern Woodrat Species Profile. Website: <http://www.pgc.state.pa.us/pgc/cwp/view.asp?a=486&q=152547>



Bald Eagle (*Haliaeetus leucocephalus*)

Pennsylvania Threatened Bird Species

State Rank: S2B (impaired, breeding) **Global Rank: G4** (apparently secure)

Identification

Bald Eagles are large raptors with a body length up to 32 inches and a wingspan up to 80 inches. Male and female Bald Eagles are similar in plumage. The most notable features are a white head and upper neck, whiter tail, dark brown body, and a heavy yellow bill. Juveniles are dark brown overall, and gradually acquire adult plumage over a period of four years. Juveniles have a dark bill and cere, dark brown body plumage, including head and tail, variable amounts of white on the undertail coverts, belly, and back.

Range

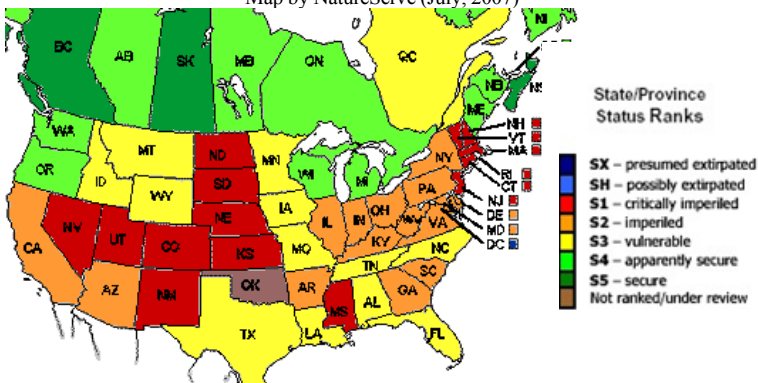
Bald Eagles have extensive breeding populations in Alaska, with major populations in the coastal regions. This species breeds throughout most of Canada, especially along coastal areas. In the continental United States, Bald Eagles breed extensively along the Atlantic Coast from Florida to the Maritime Provinces of Canada. Also, this species breeds in the Great Lake States in Minnesota, Michigan, and Wisconsin, and in the Pacific Northwest (California, Oregon, and Washington). Breeding populations occur along the Gulf Coast in Louisiana and Texas. In Pennsylvania, Bald Eagle populations have been increasing, and can now be found throughout Pennsylvania, with most sightings concentrated in the northwestern and southeastern corners of the state.



photo source: Ron Austing

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

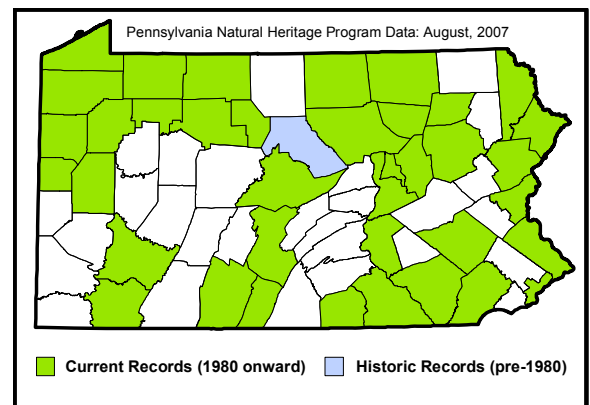


Habitat

This species is typically associated with forested areas adjacent to large bodies of water. Bald Eagles nest in trees, rarely on cliff faces, and ground nest in treeless areas. The majority of Bald Eagle nesting areas are found in mature and old-growth forests with some habitat edge, usually within 2 kilometer to water with suitable foraging opportunities. The quality of foraging areas are defined by diversity, abundance, and vulnerability of the prey base, structure of aquatic habitats, such as the presence of shallow water, and the absence of human development and disturbance. In Pennsylvania, this species nests on islands in major rivers and in forested areas and erected platforms along major rivers, reservoirs, large wetlands, lakes, ponds, and streams.

Conservation Status

This species is currently listed as a Threatened species at the state and federal level. Bald Eagles breeding in Pennsylvania have made a major contribution to the downgrading of this species from Endangered. In the 1970's, Bald Eagle nesting pairs were at an all time low of two due to the effect of the insecticide DDT and pollution of major waterways. Since then, this species has made a comeback, and recently, over 100 nests have been recorded across the state. Continued success of the breeding areas will depend on protection from human persecution and environmental contaminants. Other threats include water quality degradation, disturbance of nesting areas, and disease. If ecological conditions in Pennsylvania continue to improve, there is no reason why this species will not increase nesting populations to increase assurance that Bald Eagles will be around for generations to come.



References

- Buehler, David A. 2000. The Birds of North America, No. 506: Life Histories for the 21st Century Bald Eagle (*Haliaeetus leucocephalus*).
- Brauning, D.W. (ed). 1992. Atlas of Breeding Birds in Pennsylvania Univ. of Pittsburg Press, Pittsburgh, PA. 484 pp.
- Gough, G.A., Sauer, J.R., Iliff, M. Patuxent Bird Identification Infocenter. 1998. Version 97.1 Patuxent Wildlife Research Center, Laurel, MD. <http://www.mbr-pwrc.usgs.gov/Infocenter/infocenter.html>



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 Short-eared 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.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

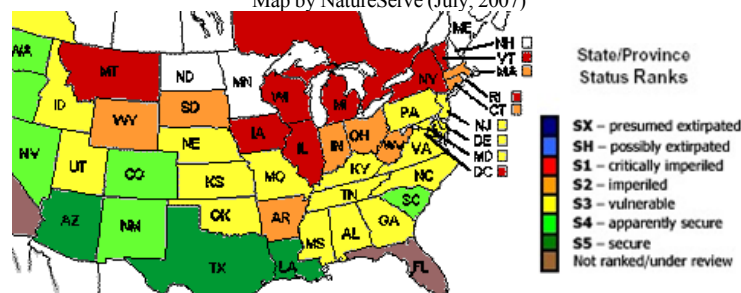


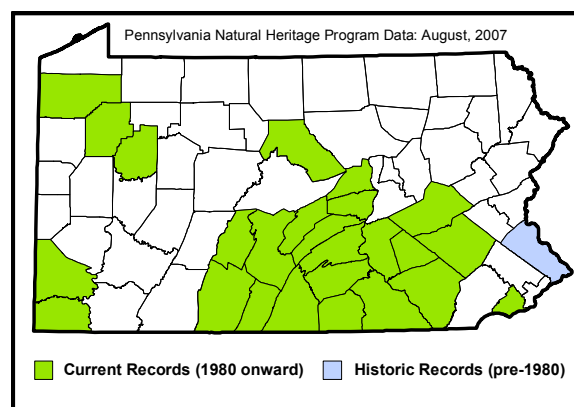
photo source: Jim Malone

Habitat

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.



References

- Austing, Ron. Wildlife Photography, Barn Owl. <http://www.ronausting.com/barnowl.htm>
- Brauning, D.W. (ed.). 1992. Atlas of Breeding Birds in Pennsylvania Univ. of Pittsburgh Press, Pittsburgh, PA. 484 pp.
- Gough, G.A., Sauer, J.R., Iliff, M. Patuxent Bird Identification Infocenter. 1998. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD. <http://www.mbr-pwrc.usgs.gov/Infocenter/infocenter.html>



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 Long-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.

Habitat/Behavior

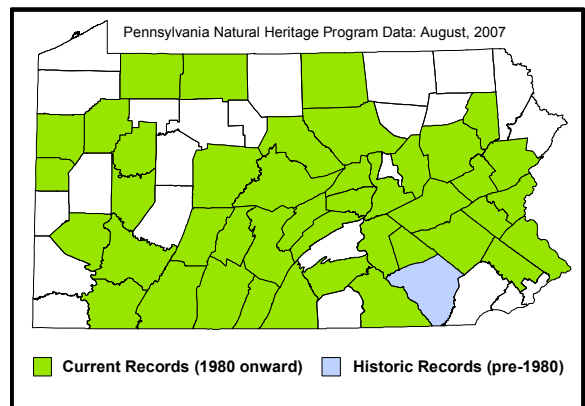
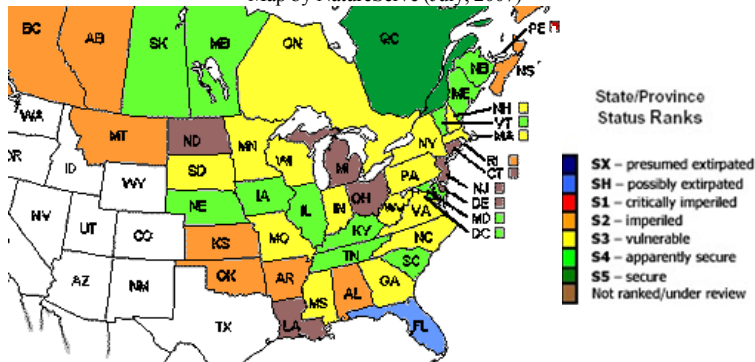
In the more northern parts of their range the northern long-eared bat is associated with boreal forests. In Pennsylvania, this bat is found in forests around the state. Northern Myotis hunt at night over small ponds, in forest clearings, at tree top level and along forest edges. They eat a variety of 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.



photo source: Aura Stauffer

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



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

- Bat Conservation International, Inc. 2002. "Bat Species: U.S. Bats: *Myotis septentrionalis*" Website: www.batcon.org/discover/species/mystep.html.
- 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.



Timber Rattlesnake (*Crotalus horridus*)

Reptile Species of Concern

State Rank: S3S4 (vulnerable/apparently secure), Global Rank: G4 (apparently secure)

Identification

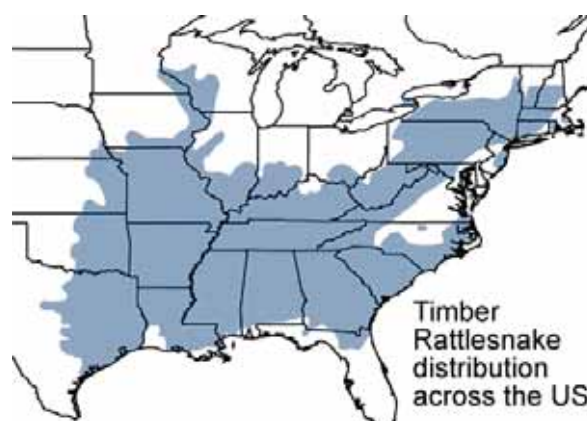
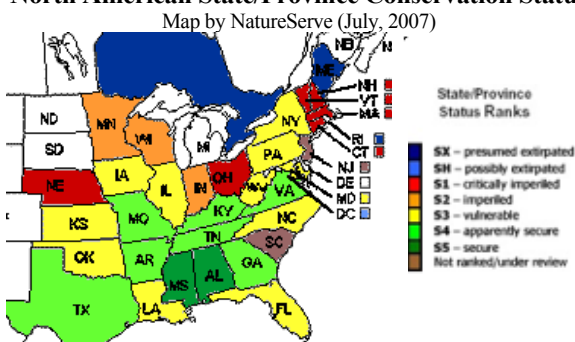
Timber rattlesnakes (*Crotalus horridus*) are easily distinguished from other snakes in Pennsylvania. Timber rattlesnakes are stout-bodied, large snakes reaching lengths of up to 5 feet. Color is extremely variable but usually consists of brown or black bands on bright yellow to black coloration. The 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.

North American State/Province Conservation Status



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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- Hulse, A.C., C.J. McCoy, and E.J. Censky. 2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, New York. 419pp.
- The Center for Reptile and Amphibian Conservation and Management. Species Accounts: Timber Rattlesnake. Website: http://herpcenter.ipfw.edu/outreach/accounts/reptiles/snakes/Timber_Rattlesnake/



Eastern Lampmussel (*Lampsilis radiata*)

Freshwater Mussel Species of Concern

State Rank: S2 (imperiled), Global Rank: G5 (secure)

Identification

The eastern lampmussel (*Lampsilis radiata*) is a medium-sized to large mussel, usually up to 100 mm in length. The shell is usually subovate to subelliptical in shape, and the valves are moderately inflated in cross section. The posterior ventral margin of the shell is usually more rounded in mature females (Connecticut DEP 2003, Nedeau 2000, Strayer and Jirka 1997, Cordeiro). The posterior ridge is not well-defined and the posterior slope is arched (Bogan 2002). The periostracum (outer covering) ranges from yellowish-green (juveniles) to greenish-brown (adults) with dark green rays covering the entire surface of the shell. The nacre (iridescent inner shell) is usually white, bluish-white, pink or salmon. Hinge teeth are well developed – the left valve has two pseudocardinal teeth and two lateral teeth, the right valve has two pseudocardinal teeth and one lateral tooth (Bogan 2002, Connecticut DEP 2003, Nedeau 2000, Strayer and Jirka 1997).



photo source: <http://research.amnh.org/biodiversity/mussel/lampsilistgenustext.html>

Habitat

The eastern lampmussel inhabits a wide variety of habitats including small streams, large rivers, ponds, and lakes. It seems to prefer sand or gravel substrates but can be found on many different types of substrate (Connecticut DEP 2003, Nedeau 2000, Strayer and Jirka 1997).

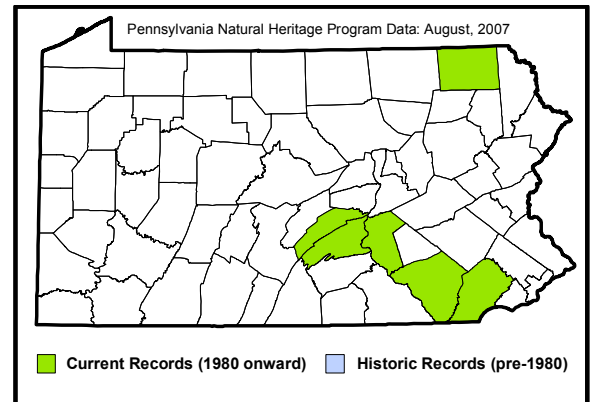
Host Fish

The eastern lampmussel is thought to use a variety of fish hosts for reproduction, including rockbass, pumpkinseed, bluegill, smallmouth bass, longear sunfish, largemouth bass, white perch, sand shiner, yellow perch, bluntnose minnow, and black crappie (Cordeiro; Nedeau 2000).

Status

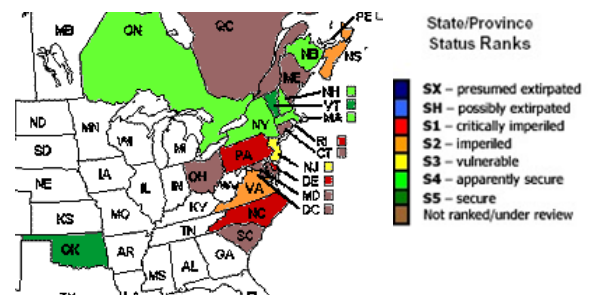
Ranging widely, the eastern lampmussel occurs along the Atlantic coastline from Nova Scotia, Canada to South Carolina, as well as throughout the Great Lakes region from Lake Ontario to Lake Superior (NatureServe 2005, Nedeau 2000, Strayer and Jirka 1997). This species is usually one of the more common ones found during mussel surveys. 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 eastern lampmussel was listed as currently stable. The state status of the eastern lampmussel is imperiled (S2) (PNHP) due to infrequent occurrences of this species within suitable habitat. More surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

The eastern lampmussel is a very stable species throughout its range. This could be due to its ability to survive in many types of habitats and/or wide variety of fish hosts used as prey for larval development. This mussel species will likely continue to play a key ecological role in aquatic ecosystems (Connecticut DEP 2003, Nedeau 2000).



North American State/Province Conservation Status

Map by NatureServe (July, 2007)



References

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Elktoe (*Alasmodonta marginata*)

Freshwater Mussel Species of Concern

State Rank: S4 (apparently secure), Global Rank: G4 (apparently secure)

Identification

The Elktoe (*Alasmodonta marginata*) is a moderately sized mussel, commonly reaching 75 mm in length. The shell is trapezoidal or rhomboid shaped, inflated, and thin (Parmalee 1998, Strayer and Jirka 1997). The anterior margin is rounded, with a somewhat straight ventral margin. The ventral and posterior margins meet in a blunt, squared point (Parmalee 1998). The posterior ridge is the focal point of the shell and is sharply angled. The posterior slope is flattened with fine, well-developed ridges crossing the growth lines. The beaks are high, inflated, and are comprised of three to four heavy double-looped ridges. The periostracum (outer covering) is usually yellowish or greenish, with green rays and darker spots that may appear connected to the rays (rays may appear interrupted). Lateral teeth are vestigial and appear as nothing more than indistinct bumps along the hinge line. The nacre (inner iridescent coloring) is usually bluish-white (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997).



Photo:

http://www.lwatrous.com/missouri_mollusks/mussels/images/a_marginata.jpg

Habitat

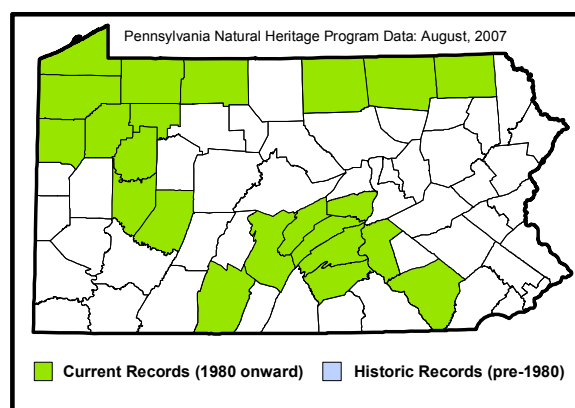
The Elktoe can be found in medium to large size streams, but is most common in smaller streams. This species is present in greatest abundance in small shallow rivers with a moderately fast current and riffles. The preferred substrate is fine gravel mixed with sand (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997; NatureServe 2005).

Host Fish

Hosts for Elktoe glochidia include the white sucker, northern hogsucker, shorthead redhorse, rockbass, and warmouth (Parmalee 1998; Strayer and Jirka 1997).

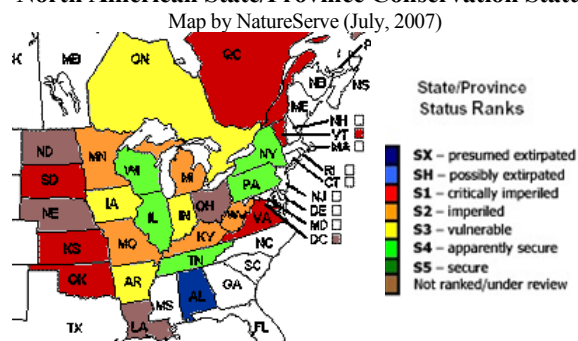
Status

Populations of *Alasmodonta marginata* can be found from Ontario, Canada to Alabama. Its eastern boundary ranges along the east coast from New York to Virginia and the western boundary ranges from North Dakota to Oklahoma. Most populations are located in Ohio, Indiana, and Illinois. This mussel is thought to have been extirpated from Alabama since it has not been reported during surveys for several decades (NatureServe 2005; Parmalee 1998; Strayer and Jirka 1997). This species is not common in Pennsylvania but has been found in the Susquehanna River and Ohio drainages. The proposed state status of the Elktoe is not ranked (N), meaning there is insufficient data



available to provide an adequate basis for assignment to specific categories concerning the security of known populations (PNHP). The state rank of this species suggests it is secure at some sites within Pennsylvania state boundaries. However, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

North American State/Province Conservation Status



Alasmodonta marginata is typically thought of as an interior basin species. It is not well understood how *Alasmodonta marginata* reached the Susquehanna River basin from its native range. Some researchers believe it may have drifted from the Allegheny River basin to Susquehanna via postglacial influences. An alternative theory states this species was introduced to the Susquehanna River basin via human activity (Strayer and Jirka 1997).

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- Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx
- Sietman, B.E. 2003. Field Guide to the Freshwater Mussels of Minnesota. Minnesota Department of Natural Resources, St. Paul, MN 140 pp.
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Green Floater (*Lasmigona subviridis*)

Freshwater Mussel Species of Concern

State Rank: S2 (imperiled), Global Rank: G3 (vulnerable)

Identification

The green floater (*Lasmigona subviridis*) is a small mussel, usually less than 55 mm in length. The shell is thin and the mussel has a subovate or trapezoidal shape. The color varies from a dull yellow to green with many dark green rays visible, especially in young individuals. This species may be confused with the creek heelsplitter (*Lasmigona compressa*) (NatureServe 2005; Strayer and Jirka 1997). The creek heelsplitter is larger, thicker shelled, and less ovate. Also, the creek heelsplitter has only been found in the Ohio River Drainage in Pennsylvania while the green floater is also present in the Susquehanna and Delaware River Drainages.



photo source: PNHP

Habitat

The green floater is often found in small creeks and large rivers and sometimes canals. This species is intolerant of strong currents and occurs in pools and other calm water areas (NatureServe 2005, North Carolina Mussel Atlas, Strayer and Jirka 1997). Preferred substrate is gravel and sand in water depths of one to four feet. This species is more likely to be found in hydrologically stable streams, not those prone to flooding and drying. Good water quality is also important for this mussel species (North Carolina Mussel Atlas).

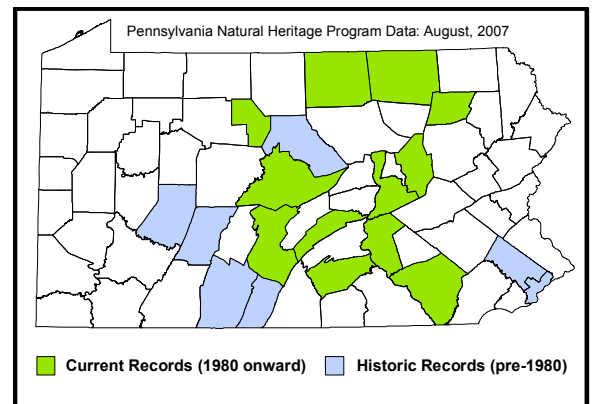
Host Fish

Glochidial (larval) hosts for the green floater are not known (NatureServe 2005, Strayer and Jirka 1997).

Status

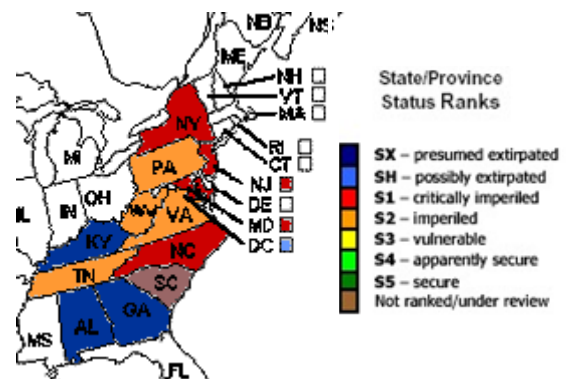
From New York south to Georgia and west to Tennessee the green floater is found. This species is not very common in Pennsylvania, but has been found in the Susquehanna, Delaware, and Ohio River Drainages (NatureServe 2005). The state status of the green floater is imperiled (S2), as it is not frequently encountered within its expected range (www.naturalheritage.state.pa.us/invertebrates.aspx). The small size of this species may make it difficult to locate live animals during surveys. Shells of dead green floaters tend to get buried in the surrounding habitat. More extensive surveys are necessary to determine the current status of this species in Pennsylvania and the United States.

The green floater was listed as threatened 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 green floater has been historically widespread in the Susquehanna River drainage in New York; however, populations have declined since the early 1990s, probably due to pollution (Strayer and Jirka 1997). Decline in the abundance of this species in other places could be due to stream transport of their preferred habitat, as well as increases in pollutants. The introductions of zebra mussels and Asian clams have also negatively impacted abundance of this species in surveys. However, since this mussel species is hermaphroditic, small populations might survive slightly better than other mussel species in less than ideal conditions (NatureServe 2005).



North American State/Province Conservation Status

Map by NatureServe (July, 2007)



References

NatureServe Explorer: An online encyclopedia of life [web application]. 2005. Version 4.5. Arlington, VA. Website:

www.natureserve.org/explorer.

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Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, NY 113pp and plates.

Williams, J.D., M.L. Warren, K.S. Cummins, J.L. Harris, and R.J. Neves. 1993. Conservation Status of Freshwater Mussels. Fisheries 18(9): 6-22.



Triangle Floater (*Alasmidonta undulata*)

Freshwater Mussel Species of Concern

State Rank: S3S4 (vulnerable/apparently secure), **Global Rank: G4** (apparently secure)

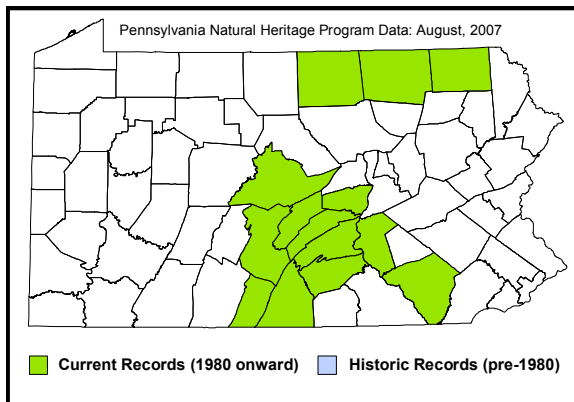
Identification

The triangle floater (*Alasmidonta undulata*) is a small mussel, usually less than 60 mm in length, with a somewhat triangular appearance. The shell is subtriangular to subovate and inflated, giving the mussel a swollen appearance. The anterior end is thicker and rounded, with a rounded ventral margin. The beaks are prominent and rise above the hinge line (Bogan 2002; Connecticut DEP 2003; Nedeau 2000; Strayer and Jirka 1997). The posterior ridge is poorly defined and rounded with a compressed posterior slope. The periostracum (outer covering) is smooth and coloration can vary from yellowish-green (juveniles) to nearly black (adults). Rays are typically dark green and radiate from the beaks but can be obscured in older, darker adult shells. Lateral teeth are vestigial, appearing only as indistinct bumps parallel to the hinge line (Bogan 2002; Nedeau 2000; Strayer and Jirka 1997; NatureServe 2005).



Photo:

http://www.eman-rese.ca/eman/reports/newsletters/monitor/vol_3_num_1/page2.html



Habitat

The triangle floater is frequently found in streams and rivers in sand and gravel substrates. It is the only *Alasmidonta* species that can tolerate standing water typical of ponds, lakes, and canals (Bogan 2002; Connecticut DEP 2003; Nedeau 2000).

Host Fish

Confirmed host fishes for the triangle floater include the blacknose dace, common shiner, fallfish, largemouth bass, longnose dace, pumpkinseed, slimy sculpin, white sucker, central stoneroller, fantail darter, northern hogsucker, and rosyface shiner (Corderio, Bogan 2002; Nedeau 2000; Strayer and Jirka 1997).

Status

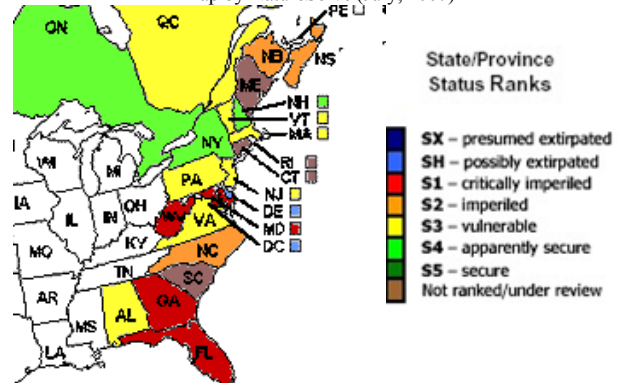
Alasmidonta undulata is found from Nova Scotia west to the St. Lawrence River drainage, and south to Florida. It has a more widespread distribution than other *Alasmidonta* species (Bogan 2002). The triangle floater is found in the Susquehanna drainage in Pennsylvania. The state status of the triangle floater is vulnerable/secure (S3S4) (PNHP), indicating that the species is secure at some sites within Pennsylvania boundaries. However, more surveys are required to determine the status of this species in order to assign it to a single category.

Alasmidonta undulata may be experiencing population declines throughout the southern portion of its range, where states are reviewing protection measures. More populations exist in New England than anywhere else throughout its known range along the Atlantic coast.

The triangle floater seems to be affected less by habitat degradation than some other mussel species, and it is thought to use a greater diversity of fish hosts than most other mussels found in similar ecosystems (Connecticut DEP 2003; Nedeau 2000).

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



References

- Bogan, A.E. 2002. Workbook and Key to the Freshwater Bivalves of North Carolina. North Carolina Freshwater Mussel Conservation Partnership, Raleigh, NC. 101 pp and plates.
- Connecticut DEP. 2003. A Field Guide to the Freshwater Mussels of Connecticut. Hartford, CT Nedeau, E.J., M.A. McCollough, and B.I. Swartz. 2000. The Freshwater Mussels of Maine. Maine Dept. of Inland Fisheries and Wildlife, Augusta, ME.
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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

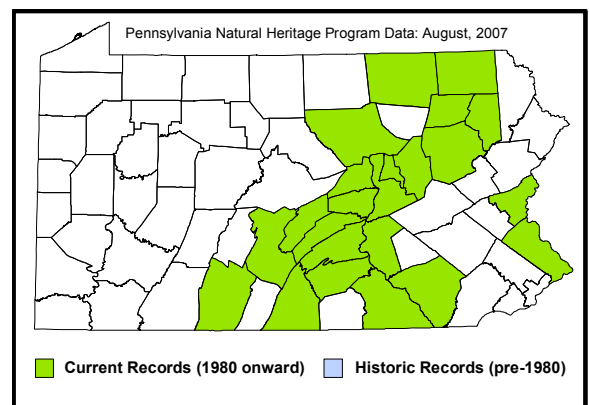
The yellow lampmussel inhabits medium to large rivers throughout most of its range, but is known from lakes and ponds in the north. In Pennsylvania, the yellow lampmussel is found within the Susquehanna and Delaware River drainages. This species occurs in a variety of substrate types including sand, silt, cobble, and gravel (Parmalee 1998; Strayer and Jirka 1997; NatureServe 2005).

Host Fish

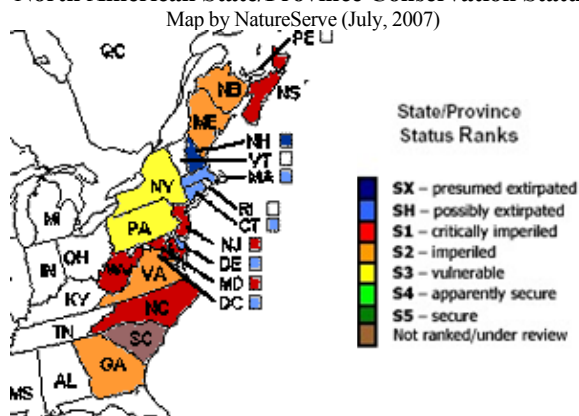
The only known larval hosts are the white perch and yellow perch (Wick and Huryn 2002).

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.



North American State/Province Conservation Status



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).

References

- Connecticut DEP. 2003. A Field Guide to the Freshwater Mussels of Connecticut. Hartford, CT 31 pp.
- NatureServe Explorer. An online encyclopedia of life [web application]. 2005. Version 4.5. Arlington, VA. Website: www.natureserve.org/explorer.
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Juniper Hairstreak (*Callophrys gryneus*)

Butterfly Species of Concern

State Rank: S2S4 (impaired/apparently secure), **Global Rank: G5** (secure)

Identification

The Juniper Hairstreak is a tiny bright-green butterfly with rusty-brown stripes edged in white. These colors help the butterfly blend in with the eastern red-cedars (*Juniperus virginiana*) with which it is closely associated. This species is found throughout central and south-central Pennsylvania, and they do especially well in southeastern Pennsylvania in the Susquehanna Valley.

Habitat

Juniper Hairstreaks prefer hilly, open, old field habitats with small to mid-sized red-cedars. Old fields that are not too overgrown typically support a variety of nectar sources that the adults need such as milkweed, clover, and wild carrot. Juniper Hairstreaks spend much of their time around red cedars (also known as junipers). Males perch among the red-cedars waiting for females. The females lay eggs on the tips of red-cedar needles, upon which the larvae feed.

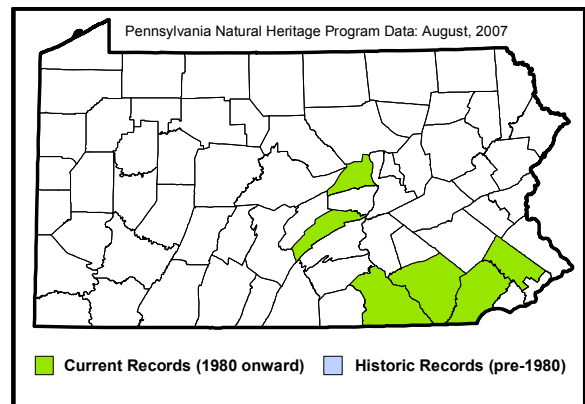
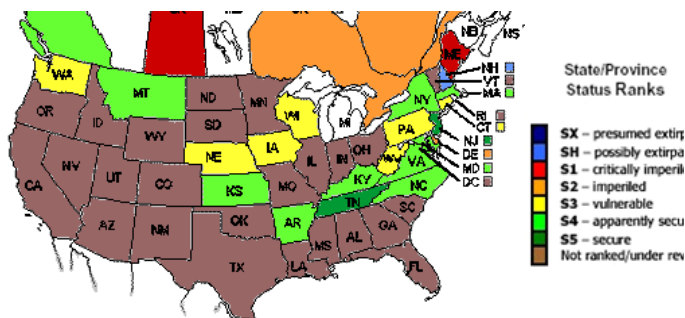


photo source: Sally Ray

The larvae are camouflaged with bumpy green skin and horizontal whitish 'broken-dash' stripes that run the length of their body. This pattern mimics the way light reflects off the scales of the cedar leaves. Two broods (generations) are completed each year. The first brood of adults fly April-May, and the second brood fly July-August. By September-October, the mature larvae move into soil and debris and overwinter as pupae.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

In Pennsylvania, the species is considered to be an S2S4, which means the status of the species is in question. There is evidence that the species is in decline, though it is still doing well in some areas of the state. This species is also rather cryptic and even when in appropriate habitat, it may be necessary to 'beat the bushes' to get these tiny gems to fly. Additional survey work is needed to determine the status of this species.

Conservation

Loss of habitat to succession is a threat to this species. Increasingly, agricultural practices do not allow old fields to develop. At the same time, lands that are not farmed or developed are succeeding into forest. As this happens, the habitat becomes unsuitable for this species. Active management for open old field habitat in areas where the Juniper Hairstreak is known to occur would be beneficial for the species.

References

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Appalachian Beard-tongue (*Penstemon canescens*)

Plant Species of Concern

State Rank: S3 (vulnerable), Global Rank: G4 (apparently secure)

Identification

The Appalachian beard-tongue is a perennial, hairy-stemmed herb from 1 to 2 feet (40-80 cm) in height. The leaves are oppositely arranged, hairy, toothed on the margin, and at least the upper pairs of leaves lack distinct leaf stalks. The flowers are pale purplish and appear in late May and early June. The flowers have a two-lipped appearance, and an open throat that allows the entrance of pollinating insects. The name “beardtongue” refers to a sterile stamen that is covered with hairs. The fruit is a many-seeded capsule.

Habitat

As the common name implies, this species has its main distribution in the Appalachian Mountains. In Pennsylvania, most of the known occurrences are located in the south-central counties. The species grows in open woods, woodland borders, banks, cliffs, and rocky slopes, particularly on shale substrate.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

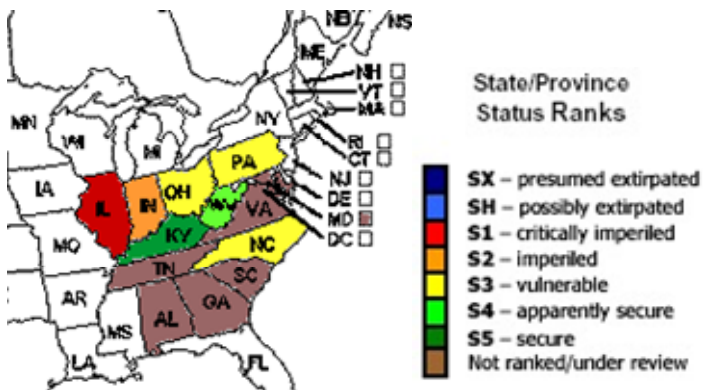
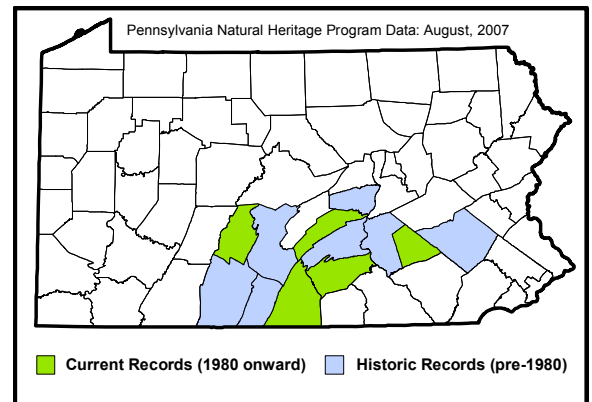


photo source: John Kunsman (PNHP)



Status

The PA Biological Survey considers Appalachian beardtongue to be a species of special concern, based on the relatively few occurrences that have been confirmed and the limited range in the state. It has been assigned a rarity status of Undetermined, meaning that more information is needed before a more definitive rarity status can be designated.

Conservation

More field surveys are needed to determine the range, abundance, and ecological requirements of the Appalachian beardtongue before a more definitive conservation status, if needed, can be assigned.

References

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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Carey's Sedge (*Carex careyana*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G4G5 (apparently secure/secure)

Identification

Carey's sedge is a grass-like plant that reaches 1 to 2 feet (3-6 dm) in height. It grows in dense tufts and has a distinctive purplish color at the base of each leafy stem. The leaves are linear, elongate, and are relatively wide, up to $\frac{3}{4}$ inch (18 mm). The individual flowers are tiny and are grouped in all male or all female clusters along the stem. The female spikes contain 4 to 9 sac-like structures (perigynia) that are strongly triangular in cross-section and relatively large (5 to 7 mm long) when compared to related species.

Habitat

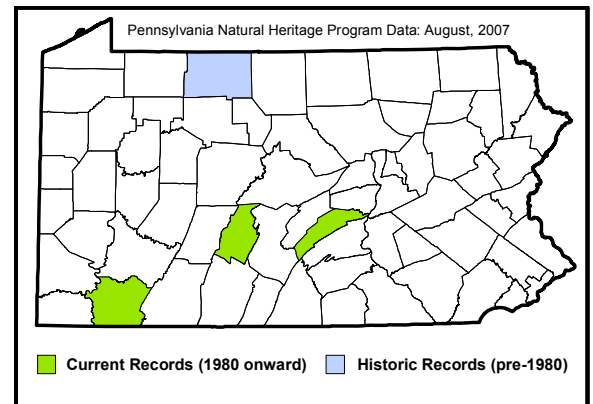
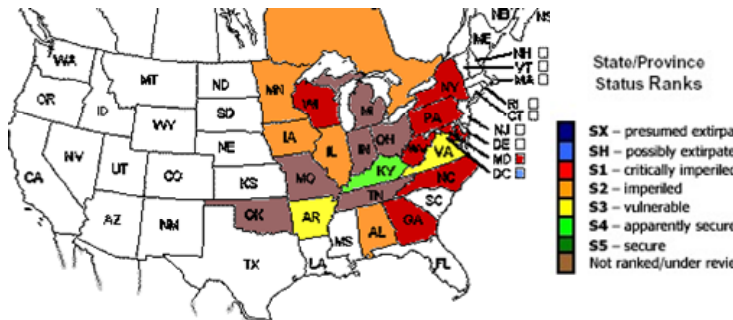
Carey's sedge has a distribution from Minnesota east into New York, and south into Georgia and Oklahoma. In Pennsylvania, the few known occurrences are located in the western half of the state. The species grows in woodlands with a limestone or calcareous substrate.



photo source: Larry Klotz

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers Carey's sedge 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.

Conservation

Carey's sedge is a plant of calcareous woodlands, and has threats from quarrying, invasive species, and logging. Creating buffers around fragmented habitat and controlling of invasive species would be beneficial in protecting occurrences.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>
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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Cattail sedge (*Carex typhina*)

Freshwater Mussel 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 aphylllopody. 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

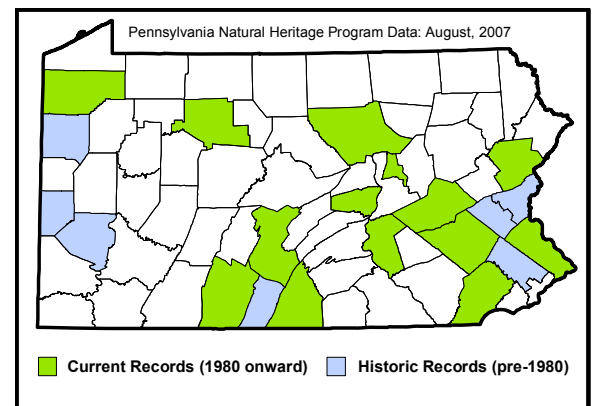
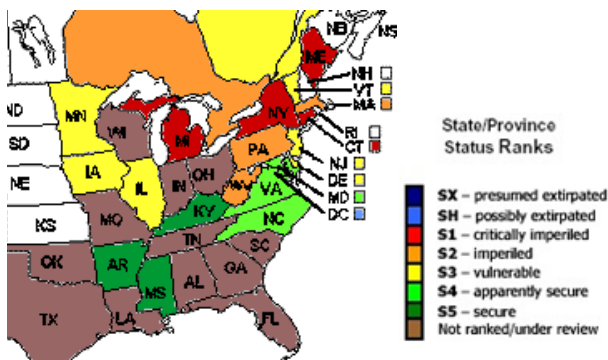
Cattail sedge tolerates shade and acidic soil, but requires very moist conditions. It grows in wet woods, along occasionally flooding streams, and in marshes from Québec south to Florida and Texas.



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)

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



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.

References

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- United States Department of Agriculture-Natural Resources Conservation Service. 2005. The PLANTS Database [web application]. National Plant Data Center, Baton Rouge, Louisiana. Available at <http://plants.usda.gov>. Accessed 24 February 2005.



Ellisia; Waterpod (*Ellisia nyctelea*)

Plant Species of Concern

State Rank: S2 (impaired), Global Rank: G4G5 (apparently secure/secure)

Identification

Ellisia is a spring annual that grows 4 to 16 inches (1-4 dm) tall. Its stems are light green or light purple and usually hairy along their length. The leaves tend to be oppositely arranged on the lower stem and alternately arranged on the upper stem. The hairy leaves are up to 4 inches (10 cm) long and deeply dissected into toothed lobes.

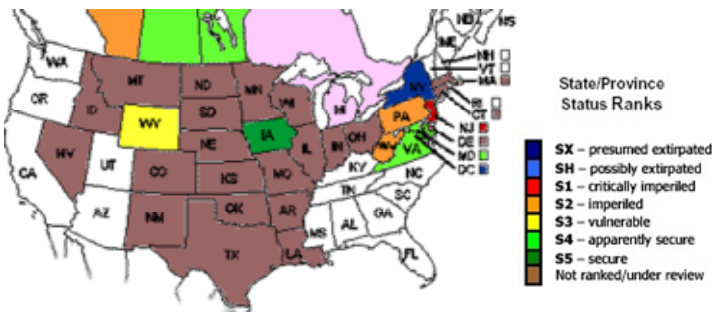
The flowers appear in April and May and grow individually from the upper leaf axils. The ¼ inch (6.5 mm) flowers are whitish-blue and have 5 petal-like lobes that are fused near the base to form a bell shaped flower. The sepals are united near the base and persist on the usually 4-seeded, capsule-like fruit.



photo source: www.missouriplants.com/index.html

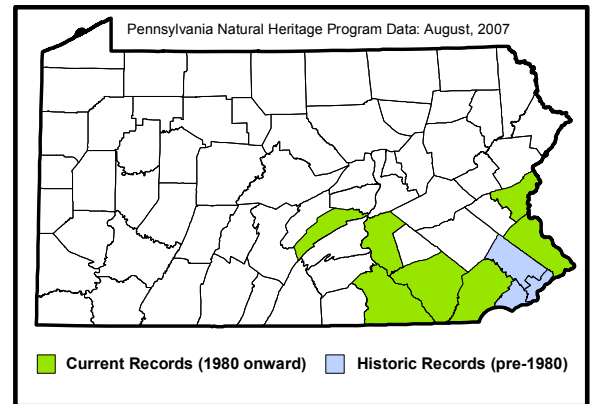
North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Habitat

Ellisia occurs throughout much of the United States, but is absent from northern New England, the Southeast, and the West Coast. In Pennsylvania, it grows on damp, shady stream banks with rich alluvial soils and sometimes in disturbed ground.



Status

The PA Biological Survey considers *ellisia* to be a species of special concern, based on the relatively few occurrences that have been confirmed. It has been assigned a rarity status of Threatened. The rich shady stream banks that *ellisia* depends upon are highly influenced by flooding events. Alteration of the natural flood cycle, dam building, increased erosion, and clearing of floodplain forests all affect the quality of suitable habitat. Populations are also threatened by loss of habitat from development and displacement by invasive plants.

Conservation

Protection of *ellisia* will require maintenance of known populations and preservation of rich, shaded stream bank communities. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.



False Gromwell (*Onosmodium molle* var. *hispidissimum*)

Plant Species of Concern

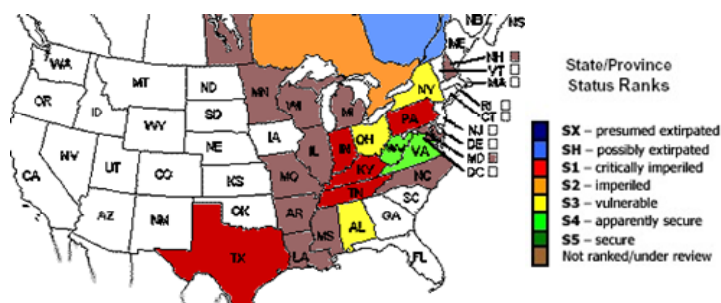
State Rank: S1 (critically imperiled), Global Rank: G4G5T4 (apparently secure/secure)

Identification

False gromwell is a perennial herb that reaches up to 4 feet (1.2 meters) in height. Its woody base gives rise to several leafy stems that are coarsely hairy. The leaves are also hairy and grow on the stem in an alternate arrangement. They are narrowly oval, 3 to 4 inches (8-10cm) long, and attach without a leaf stalk. Lower stem leaves are smaller and fall early. The flowers appear from late June to early July and are held in leafy spikes that curl downward. Individual flowers are small, up to 5/8 inch (16mm), white or greenish, and tube-shaped, with 5 broadly- pointed lobes. Fruits are small, rounded nutlets that are constricted at the base.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



© Thomas G. Barnes

Photo source: The Plants Database plants.usda.gov
Robert H. Mohlenbrock

Habitat

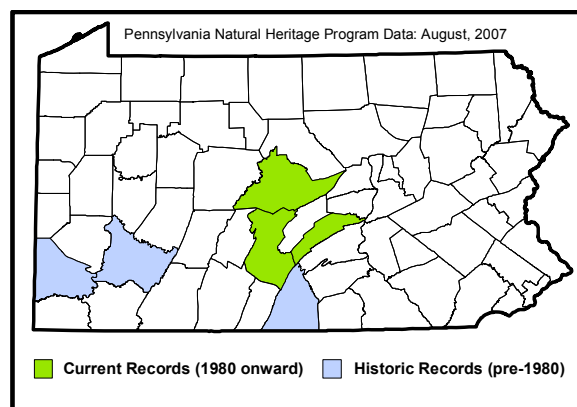
False gromwell occurs in the U. S. from New Hampshire and New York west to Minnesota and Texas. In Pennsylvania, it can be found growing on calcareous dry hillsides and in old pastures.

Status

The PA Biological Survey considers the false gromwell to be a species of special concern, based on the relatively few occurrences that have been confirmed and the very specialized 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 false gromwell 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.



References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Plant Species of Concern

State Rank: S1 (critically imperiled), **Global Rank: G4** (apparently secure)

Identification

False hop sedge is a grass-like plant that grows 1½ to 3 feet (to 1 m) tall. Its common name refers to a superficial resemblance of its flower spikes to fruits of the hop vine. The leaves are linear, elongate, and up to ½ inch (13 mm) wide. The flowers are arranged in bur-like cylindrical spikes at the top of flowering stems. Male and female flowers are found in separate spikes, with usually one slender male spike held above a cluster of 2 to 6 robust female spikes. The female spikes contain densely packed, inflated sac-like structures (perigynia) that have long projecting beaks.

Habitat

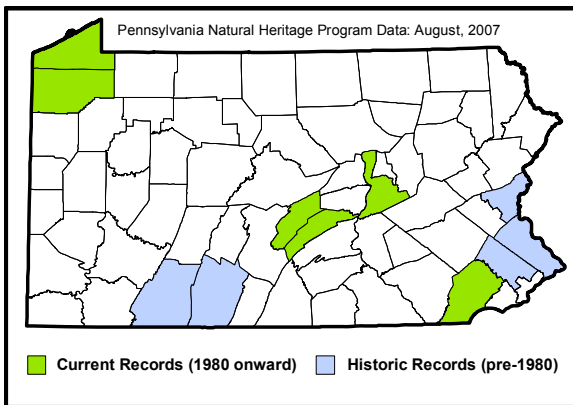
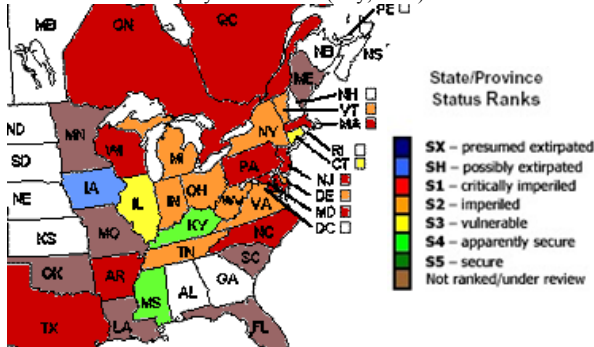
False hop sedge has a distribution from Canada south and west to Florida and Texas. In Pennsylvania, the occurrences are mostly in the southern half of the state. This species grows in wetlands, such as vernal ponds, bottomland pools, swamps, and marshes, especially on calcareous substrates.



photo source: John Kunsman (PNHP)

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers false hop sedge to be a species of special concern, based on the relatively few occurrences that have been confirmed and the wetland habitat. It has been assigned a rarity status of Undetermined, meaning that more information is needed before a more definite rarity status can be designated.

Conservation

More field surveys are needed to determine the range, abundance, and ecological requirements of the false hop sedge. Creating buffers around wetlands, controlling of invasive species, and protecting of wetland hydrology will help to maintain occurrences of the specie

References



- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>
- Pennsylvania Natural Heritage Program. 2007
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Flora. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia

Grooved Yellow Flax (*Linum sulcatum*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G5 (secure)

Identification

Grooved yellow flax is an erect annual herb that grows up to 2½ feet (75 cm) tall. The common name refers to its grooved stems which are purplish near the base. The leaves grow alternately along the stem. They are linear to oblong, have smooth margins, and attach directly to the stem without a petiole. There are two distinctive blackish glands on the stem near the base of each leaf. The flowers are yellow, have 5 smooth petals, and are roughly ½ inch (1-2 cm) wide. They are held in loose clusters near the top of the stem and bloom from May to September.

Habitat

Grooved yellow flax occurs in the U. S. from New Hampshire and Vermont south to Florida and west to North Dakota through Texas. In Pennsylvania, it can be found growing in scattered sites on sandy barrens.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

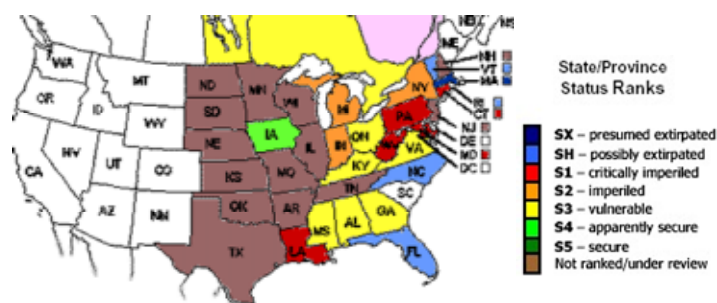
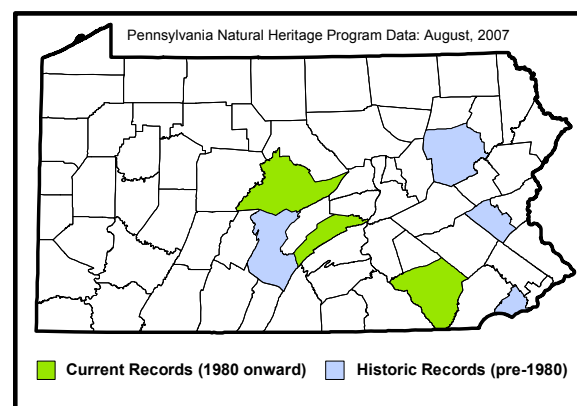


photo source: Robert W. Freckmann Herbarium, UWSP
Merel L. Black

Status

The PA Biological Survey considers the grooved yellow flax to be a species of special concern, based on the relatively few occurrences that have been confirmed and the very specialized habitat. It has been assigned a rarity status of Endangered. Grooved yellow flax populations are threatened by habitat loss and succession. Over time, the open nature of the habitats required by this species may be lost due to encroachment by woody and invasive species. Other potential hazards include trampling, incompatible land management, and habitat fragmentation, which limits seed dispersal.



Conservation

Maintenance of known populations and preservation of the sandy barrens communities where grooved yellow flax 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 open nature of the sites. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
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Hard-stemmed Bulrush (*Schoenoplectus acutus*)

Plant Species of Concern

State Rank: S2 (impaired), Global Rank: G5 (secure)

Identification

Hard-stemmed bulrush is an erect, grass-like perennial that grows from a spreading rhizome. The firm, round stems can reach up to 10 feet (3 meters) in height. Despite the common name, this species is not actually a rush, but a sedge. The leaves grow mostly near the base of the stem. Each plant has only 3 to 4 leaves, which are made up of short blades and longer sheaths. The sheaths are often red-tinged near the base. The flowers can be found in spikelets that are held in a small, branched cluster, or inflorescence. The inflorescence has stiff, upright branches and seems to be growing out of the side of the stem. This is due to a leaf-like bract that originates near the inflorescence and appears as a continuation of the stem. Plants can be found fruiting from June to August.

Habitat

Hard-stemmed bulrush has a distribution throughout North America. In Pennsylvania, the occurrences are localized in the western and central counties. It grows in wetlands and can be found in the shallow water along the edges of lakes or ponds.

North American State/Province Conservation Status

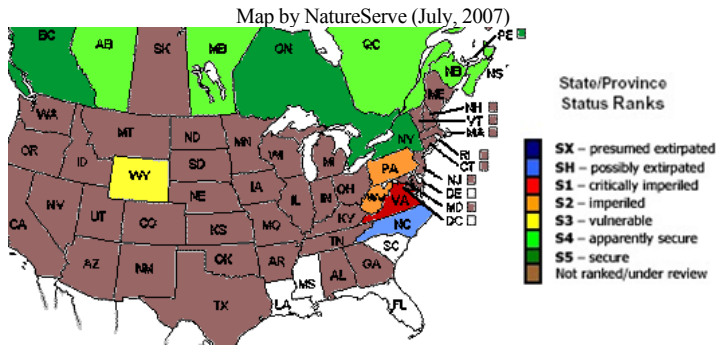


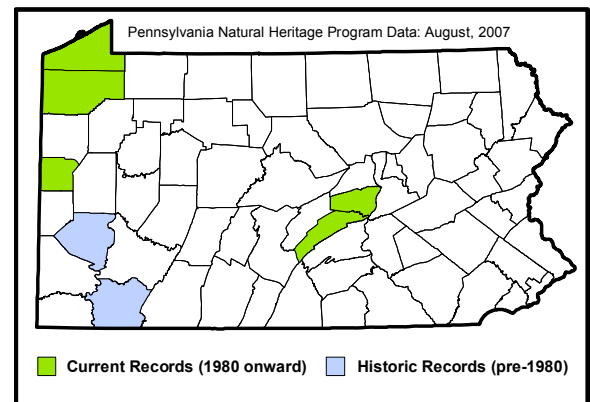
photo source: Robert W. Freckmann Herbarium, UWSP
Robert W. Freckmann

Status

The PA Biological Survey considers hard-stemmed bulrush to be a species of special concern, based on the few occurrences that have been confirmed and the wetland habitat. It has been assigned a rarity status of Endangered.

Conservation

Conservation of hard-stemmed bulrush will require protection of known populations and of their wetland habitat. This may require consideration of the entire pond or lake community. Surrounding these communities with buffers could help to protect them from the effects of run-off or flooding. Sustaining appropriate water levels will also be important for maintaining high quality habitats.



References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
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State Rank: S2 (imperiled), Global Rank: G5 (secure)

207

Pineland Pimpernel (*Samolus parviflorus*)

Plant Species of Concern

State Rank: S2 (imperiled), Global Rank: G5 (secure)

Identification

Pineland pimpernel is a small perennial herb, up to 12 inches (3 dm) tall, that has several upright, branching stems. This wetland species is a member of the primrose family. The leaves grow at the base of the plant and along the stem in an alternate arrangement. They are oval in shape, have smooth margins, and taper toward the base to a petiole. The leaves are light green and about 2¾ inches (7 cm) long. The flowers are held in a large, open, spike-like cluster at the top of the stem. *Parviflorus* means “small flowered” and this plant is appropriately named, with flowers only about 1/10 inch (3 mm) wide. Flowers have 5 white, petal-like lobes and bloom from June to October.

Habitat

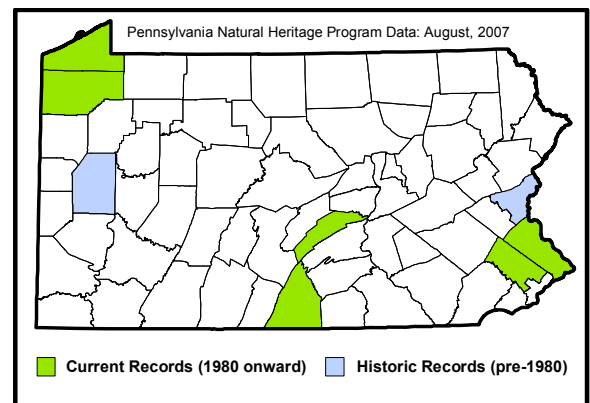
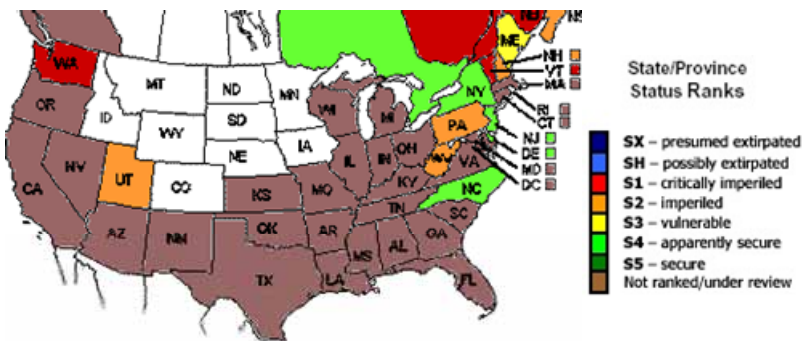
Pineland pimpernel can be found throughout most of the eastern United States. Its range also extends through the Southwest and along the Pacific Coast. In Pennsylvania it grows in seeps and on muddy stream banks, particularly those underlain by diabase.



photo source: PNHP

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers the pineland pimpernel to be a species of special concern, based on the relatively few occurrences that have been documented and the wetland habitat. It has been assigned a rarity status of Endangered.

Conservation

Conservation of pineland pimpernel will depend upon the protection of existing populations and maintenance of their wetland habitat. This may include removing invasive plants and creating buffers to help protect populations from the effects of run-off or flooding. Sustaining appropriate water levels will also be important for maintaining high quality habitats.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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Purple Bedstraw (*Galium latifolium*)

Plant Species of Concern

State Rank: S2 (impaired), Global Rank: G4G5 (apparently secure/secure)

Identification

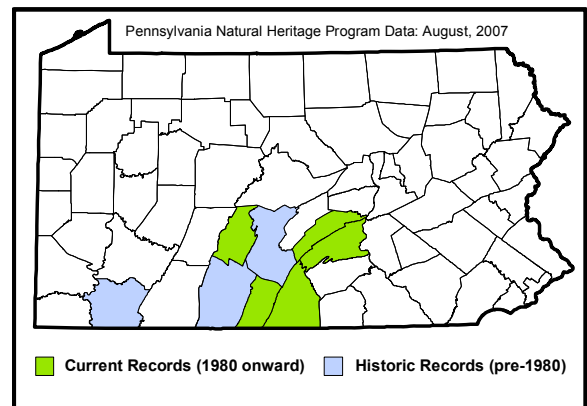
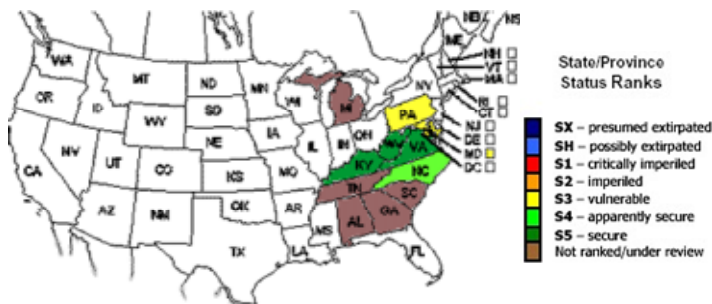
Purple bedstraw is a perennial herb with erect to reclining, 4-sided stems that can reach up to 2 feet (6 dm) long. The leaves are 1 to 2 inches (3 to 6 cm) long, widest near the base and tapering to the tip, have 3 prominent veins, and are arranged in whorls of 4 along the stem. The flowers, which are very small and have four purple lobes with long pointed tips, bloom from June to July and are arranged in open, branched clusters that grow from the upper stem nodes. The 1/8 inch (3-4 mm), round fruits can have a smooth or grainy surface, distinguishing them from related species of bedstraw that have bristly fruits.



photo source: John Kunsman (PNHP)

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Habitat

Purple bedstraw has a distribution mostly in the Appalachian area, from Pennsylvania south into Georgia and Alabama. In Pennsylvania, most occurrences are in the south-central counties in the Ridge and Valley province. The species grows in dryish to moist woodlands, especially on shale and sandstone substrate.

Status

The PA Biological Survey considers purple bedstraw to be a species of special concern, based on the relatively few occurrences that have been confirmed. It has been assigned a rarity status of Undetermined, meaning that more information is needed before a more definitive rarity status can be designated.

Conservation

More field surveys are needed to determine the range, abundance, and ecological requirements of the purple bedstraw before a more definite conservation status, if needed, can be assigned.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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Short Hair Sedge (*Carex crinita* var. *brevicrinis*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G5T5 (secure)

Identification

Short hair sedge is tufted grass-like plant that grows 2¼ to 5 feet (7-15 dm) tall. Its rough stems are 3-sided, particularly near the base.

The leaves grow alternately along the stems. They are linear, hairless, and up to ½ inch (13 mm) wide. There are also long, sheathless, leaf-like bracts that grow near the tops of the flowering stems. The flowers are held in cylindrical spikes near the top of flowering stems. Male and female flowers are found in separate spikes, with a slender male spike held above a small cluster of drooping female spikes. The female spikes are up to 4 inches (10 cm) long and contain many sac-like structures (perigynia) that are each subtended by a scale with a long bristle-tip. The feature that most distinguishes the two variants is the lack of a notch in the nutlet found only in *C. crinita* var. *brevicrinis*.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

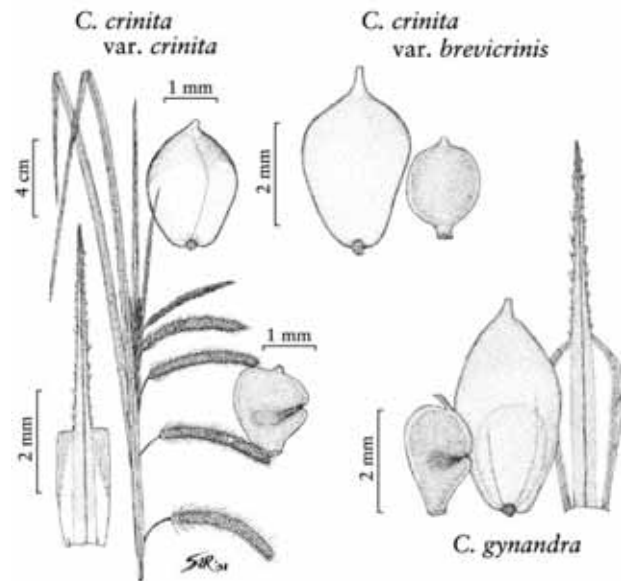
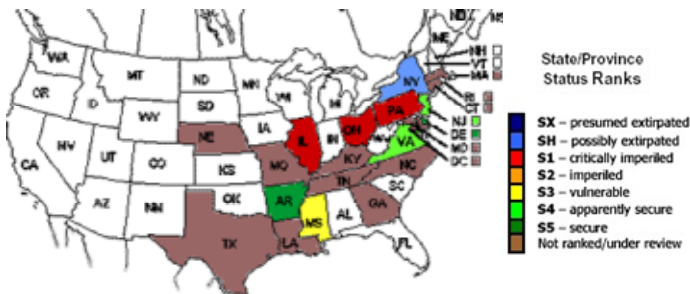


photo source: Flora of North America
www.efloras.org

Habitat

Short hair sedge's range extends from New York south to Georgia and west to Nebraska and Texas. This species is a wetland plant and grows in moist to wet woodlands.

Status

The PA Biological Survey considers the short hair sedge 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. Its wetland habitats are also sensitive to habitat fragmentation and changes in hydrology that could alter water levels or chemistry.

Conservation

Maintenance of known populations and preservation of the communities where short hair sedge grows will be crucial to its survival. Creating buffers around fragmented habitat, removal of invasive species, and protection of wetland hydrology will help to maintain populations and encourage new population growth. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

References

- Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 12+ vols. New York and Oxford.
- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>
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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia



Shortleaf Pine (*Pinus echinata*)

Plant Species of Concern

State Rank: S1S2 (critically imperiled/imperiled), Global Rank: G5 (secure)

Identification

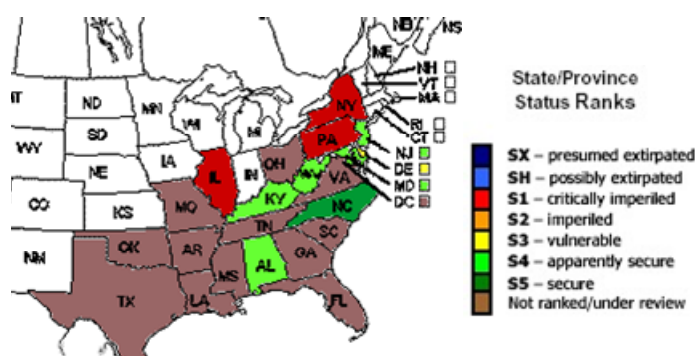
Shortleaf pine is an evergreen coniferous tree that may grow 80 to 100 feet (25-30 meters) tall, often with much of the trunk free of lateral dead branches. The bark is reddish-brown and forms scaly plates. The leaves are evergreen, needle-like, in bundles of 2 or occasionally 3, from 2 to 5 inches (5-12 cm) long, relatively slender, and tend to be straight or only slightly twisted. The cones are narrowly egg-shaped, 1½ to 2½ inches (4-6 cm) long, and made up of thin scales that are spirally arranged and have a thickened tip with a short, sharp spine. The cones may persist on the tree for several years.



photo source: John Kunsman (PNHP)

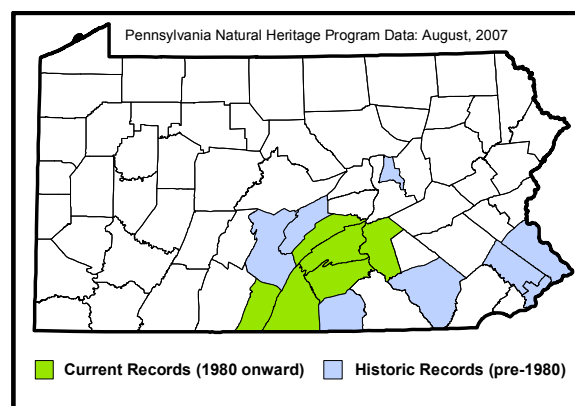
North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Habitat

Shortleaf pine has a distribution from New York south and west into Florida and Texas. In Pennsylvania, where it reaches a northern border of its range, the occurrences are primarily in the south-central counties. It grows mainly in well-drained upland woods and slopes.



Status

The PA Biological Survey considers shortleaf pine to be a species of special concern, based on the relatively few occurrences that have been confirmed and the limited range in the state. It has been assigned a rarity status of Undetermined, meaning that more information is needed before a more definitive rarity status can be designated.

Conservation

More field surveys are needed to determine the range, abundance, and ecological requirements of shortleaf pine. Based on current data, the long-term viability of occurrences will probably require special management, such as prescribed fire, since the species is very intolerant of shade and early successional conditions are necessary for establishment of seedlings.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Short's Sedge (*Carex shortiana*)

Plant Species of Concern

State Rank: S3 (vulnerable), Global Rank: G5 (secure)



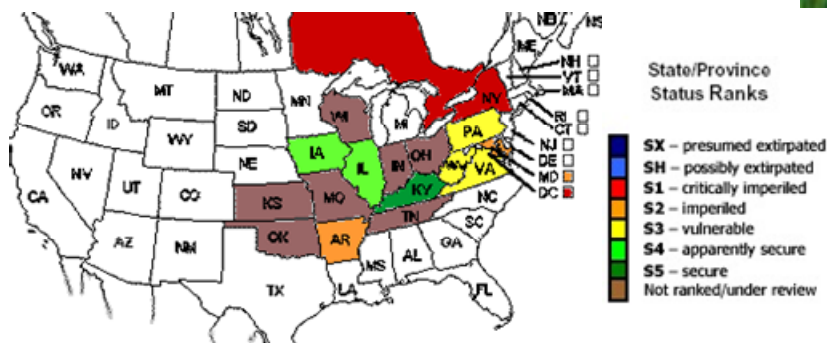
photo source: John Kunsman (PNHP)

Identification

Carex shortiana is a tufted perennial grass-like plant that can reach from 8 to 35 inches (2-9 dm) in height. Its tall flowering stems are light green, hairless, and 3-sided, particularly near the base. The leaves grow from the base and alternately along the stems. The smooth, leaf blades are up to 12 inches (30 cm) long and 1/3 inch (1 cm) wide. Blades are often indented along the central vein, which gives the leaf a channeled appearance. The flowers are held in densely packed, cylindrical spikes that become dark brown as they mature. Clusters of 3 to 6 spikes are produced at the top of each flowering stem. The lower spikes usually contain all female flowers while the upper spikes have female flowers at the top and male flowers below.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Habitat

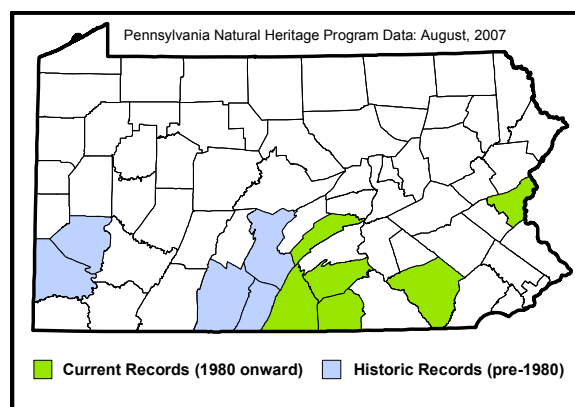
Short's sedge can be found in the U. S. from New York south to Virginia and west to Kansas and Oklahoma. It grows in calcareous wet meadows and swamps or in rich woods.

Status

The PA Biological Survey considers Short's sedge to be a species of special concern, based on the relatively few occurrences that have been confirmed and its relatively infrequent wetland habitat. It has been assigned a rarity status of Rare. 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. Its wetland habitats are also sensitive to habitat fragmentation and changes in hydrology that could alter water levels or chemistry.

Conservation

Maintenance of known populations and preservation of the communities where Short's sedge grows will be crucial to its survival. Creating buffers around fragmented habitat and removal of invasive species will help to maintain populations and encourage new population growth. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.



References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Shumard's Oak (*Quercus shumardii*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G5 (secure)

Identification

Shumard's oak is a large, deciduous tree that reaches up to 100 feet (30 meters) in height. It has gray, furrowed bark and grayish-brown, dull, bud scales on the mature branchlets. The leaves are alternate and deeply lobed. Each leaf has 7 to 9 sharply toothed lobes that tend to widen slightly toward the tip. The 4 to 7 inch (10-18 cm) leaves are dark green above, and paler green below with hairs clustered in the leaf axils.

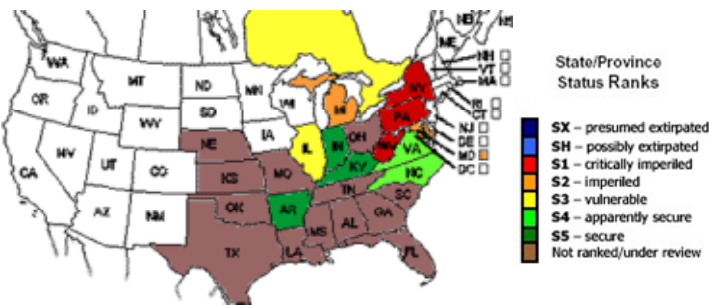
The flowers are produced when leaves emerge in spring. Male and female flowers are produced separately, with female flowers held singly or in pairs and male flowers held in clusters of long, drooping catkins. Acorns are about 1 inch (2.5 cm) long and have scaly, saucer-shaped caps that cover less than 1/3 of the acorn.



Photo source: John Kunsman (PNHP)

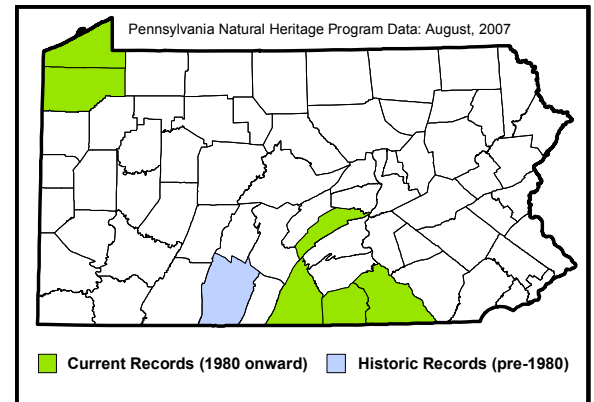
North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Habitat

Shumard's oak has a distribution from Ontario and New York south into Texas and Florida. In Pennsylvania, it has been found in the south-central and northwestern counties. The species grows in moist to wet woods along streams, bottomlands, and lower slopes, often on calcareous substrate.



Status

The PA Biological Survey considers Shumard's oak to be a species of special concern, based on the relatively few occurrences that have been confirmed. It has been assigned a rarity status of Endangered.

Conservation

Maintenance of known populations and preservation of the communities where Shumard's oak grows will be crucial to its survival. Creating buffers around fragmented habitat and removal of invasive species will help to maintain populations and encourage new population growth. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Sida; Virginia Mallow (*Sida hermaphrodita*)

Plant Species of Concern

State Rank: S2 (imperiled), Global Rank: G3 (vulnerable)

Identification

Sida is a large perennial herb that grows 3 to 10 feet (1-3 meters) tall. Its stems are hairy when young but become smooth with age. The leaves grow alternately on the stem and resemble long-pointed maple leaves. They usually have 3 to 7 irregularly toothed lobes, with the middle lobe being the longest. The white flowers, which bloom from July to October, are arranged in stalked clusters that grow from the upper stem leaf axils. Each flower has 5 petals that are each about 1/3 inch (8 mm) long.

Habitat

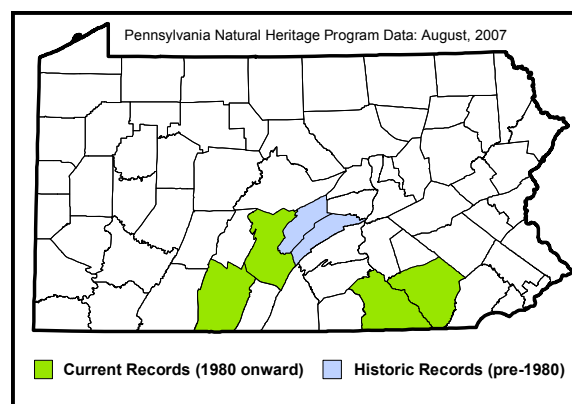
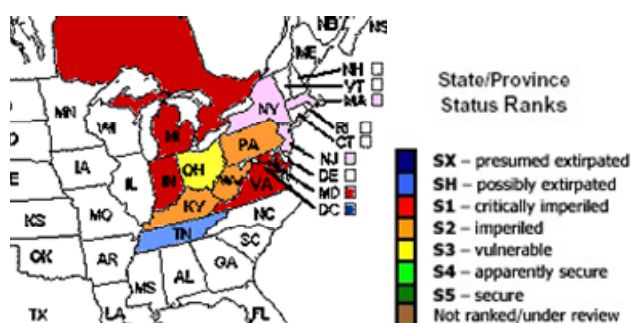
Sida has a rather localized distribution in Midwestern and mid-Atlantic portions of eastern North America. In Pennsylvania, the occurrences are restricted to the Juniata River and lower Susquehanna River watersheds. The species grows on streambanks and bottomlands, as well as disturbed places like roadsides and railroad grades that are in proximity to the stream corridors.



photo source: John Kunsman (PNHP)

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers *Sida* to be a species of special concern, based on the relatively few occurrences that have been confirmed and the localized distribution in the state, as well as rarity throughout its global range. It has been assigned a rarity status of Endangered.

Conservation

Maintenance of known populations and preservation of the unique habitat where *Sida* thrives will be crucial to its survival. Removal of encroaching invasive species along river corridors and the establishment of buffers surrounding known sites will help to improve habitat quality. Recognition and protection of populations along roadsides and in other unprotected areas will also be important.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Spotted Pondweed (*Potamogeton pulcher*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G5 (secure)

Identification

Spotted pondweed is an aquatic perennial herb that grows in standing water. The stems of this species are up to 20 inches (5 dm) long and have dark purple spots. The leaves are of two types, floating and submersed. The floating leaves are oval to elliptic, rounded, or heart-shaped at the base, and have long, purple-spotted stalks. The submersed leaves are broadly lance-shaped, up to 1½ inches (3 cm) wide, and short-stalked or stalkless. The flowers are produced in dense spikes that are ¾ to 1½ inches (2-4 cm) long. Individual flowers are inconspicuous and have 4 small, greenish petals or sepals. Spikes are held above the water and can be seen June through August.



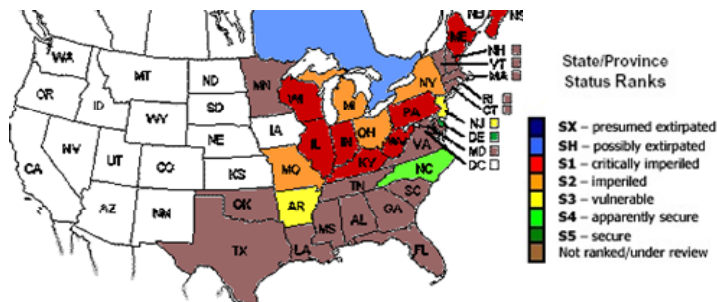
photo source: Andrew Strassman (PNHP)

Habitat

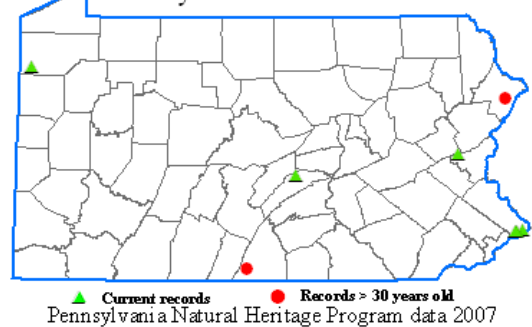
Spotted pondweed occurs from Maine south to Florida and west to Minnesota and Texas. In Pennsylvania, it grows in shallow, acidic streams, vernal ponds, in swamps and on muddy shores.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Pennsylvania Distribution



Status

The PA Biological Survey considers the spotted pondweed to be species of special concern, based on the relatively few occurrences that have been confirmed, the wetland habitat, and the regional rarity. It has been assigned a rarity status of Endangered.

Conservation

Conservation of spotted pondweed will depend upon the protection of existing populations and maintenance of their wetland habitat. This may include removing invasive plants and creating buffers to help protect populations from the effects of run-off or flooding. Sustaining appropriate water levels will also be important for maintaining high quality habitats.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



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.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

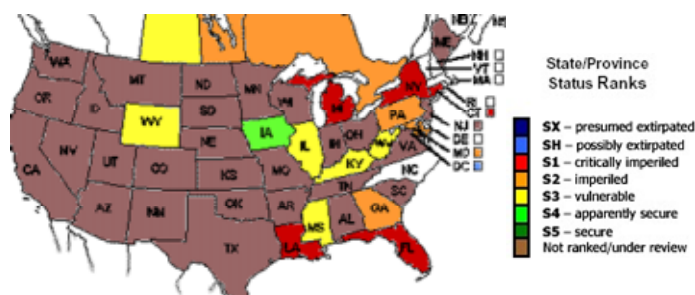


photo source: Andrew Strassman (PNHP)

Habitat

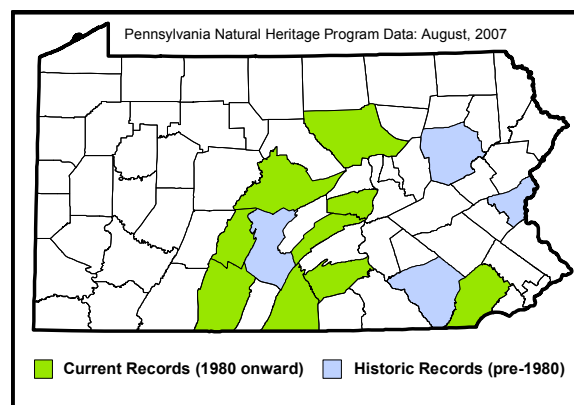
Tall grama can be found throughout most of the United States. In Pennsylvania, most of the known occurrences are in the central and southeastern counties. The species grows in dry, open, rocky, places, especially on limestone and serpentine geology.

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.



References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
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White Trout-lily (*Erythronium albidum*)

Plant Species of Concern

State Rank: S3 (vulnerable), Global Rank: G5 (secure)

Identification

White trout-lily is a perennial herb, producing a stem 4 to 6 inches (10-15 cm) tall. The leaves are basal and paired, usually spotted or mottled, elliptic or lance-shaped and up to 6 inches (15 cm) long. The white (sometimes slightly tinged with blue or pink) flowers are produced singly at the end of long stalks in late April and early May. The flowers nod downward and have white 6 petals/sepals that curve strongly upward.

Habitat

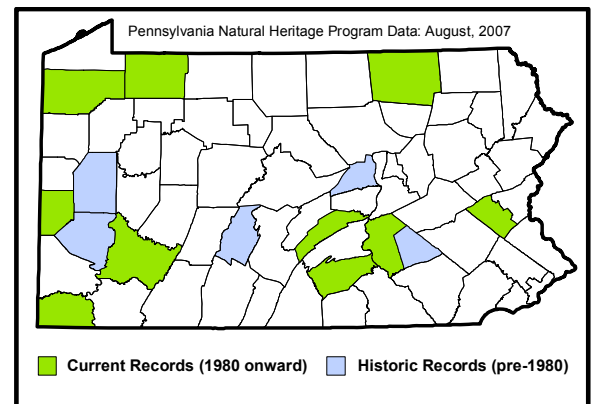
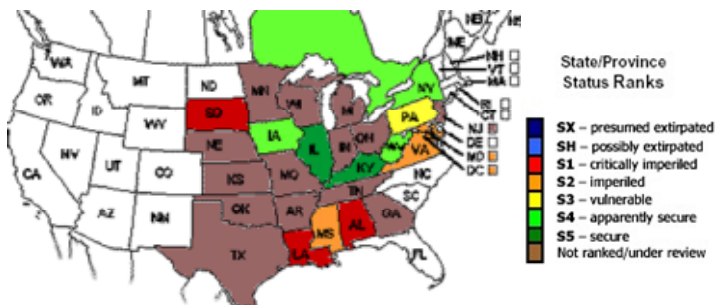
White trout-lily has a distribution from Ontario and New York south into Texas and the Gulf Coast states. In Pennsylvania, the occurrences are scattered throughout the state, particularly along the major rivers and streams. The species grows in bottomlands, floodplains, and lower slopes, especially on limestone substrates.



Photo Source: PNHP

North American State/Province Conservation Status

Map by NatureServe (July, 2007)



Status

The PA Biological Survey considers white trout-lily to be a species of special concern, based on the relatively few occurrences that have been confirmed. It has been assigned a rarity status of Undetermined, meaning that more information is needed before a more definitive rarity status can be designated.

Conservation

More field surveys are needed to determine the range, abundance, and ecological requirements of the white trout-lily before a more definitive conservation status, if needed, can be assigned.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Wild Senna (*Senna marilandica*)

Plant Species of Concern

State Rank: S1 (critically imperiled), Global Rank: G5 (secure)

Identification

Wild senna is an erect, bushy perennial herb that can grow up to 6 ½ feet (2 meters) tall. The leaves are alternate, have dome-shaped gland near the base of the leaf stalk, and are divided into 4 to 8 pairs of oblong to elliptic leaflets. The flowers are yellow, appear in July, and are up to 1 inch (2.5 cm) wide, with five yellow petals and 10 dark-red stamens. The fruit is a flattened pod marked with distinct segments.

Habitat

Wild senna has a distribution from New York west into Nebraska and south into Florida and Texas. In Pennsylvania, the occurrences are well distributed in the state. It grows in a variety of habitats, including clearings, woods borders, road banks, open slopes, and in thickets.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

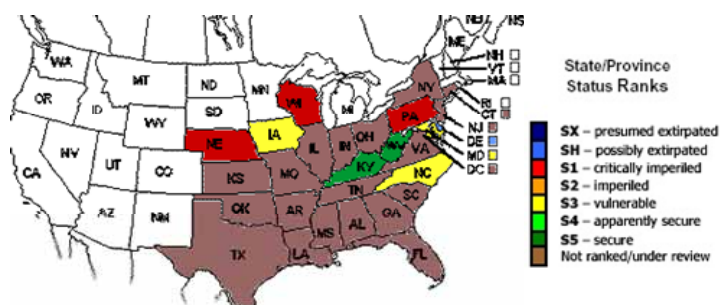


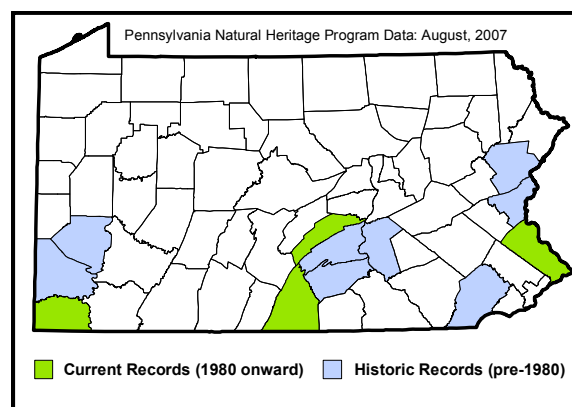
photo source: Robert W. Freckmann Herbarium, UWSP
Emmet J. Judziewicz

Status

The PA Biological Survey considers the wild senna to be a species of special concern, based on the relatively few occurrences that have been documented. It has been assigned a rarity status of Endangered.

Conservation

Wild senna will benefit from protection of its habitat and of known populations. Removal of overgrowth and invasive species with the integration of fire regimes, when appropriate, will help to preserve the integrity of the sites.



References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.



Yellow Water-crowfoot (*Ranunculus flabellaris*)

Plant Species of Concern

State Rank: S2 (impaired), Global Rank: G5 (secure)

Identification

Yellow water-crowfoot is an aquatic perennial that usually grows submersed in water. Its floating stems are 12 to 27 inches (3-7 dm) long and can root to the ground at their lower nodes. This species belongs to the buttercup family. The leaves are mostly submersed. Submersed leaves are finely dissected and have a bushy, feathered appearance. Those that are emergent have 3 lobes and are roughly kidney shaped in outline. The flowers resemble buttercups and are held above the water's surface singly or in small clusters. Flowers bloom in May and have 5 to 8 shiny, yellow petals that are ¼ to ⅝ inch (7-15 mm) long. The small seed-like fruits have a curved beak on one end.

Habitat

Yellow water-crowfoot occurs throughout much of the continental United States. It is absent from the extreme Southeast and from some Rocky Mountain States. It can be found growing in the shallow water of slow streams, marshes, and ponds or growing on their muddy shores.

North American State/Province Conservation Status

Map by NatureServe (July, 2007)

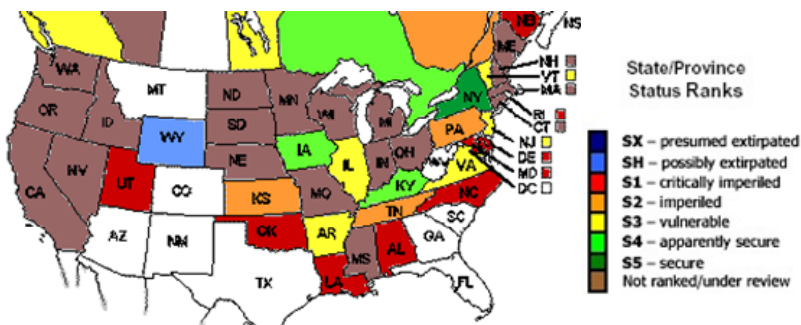
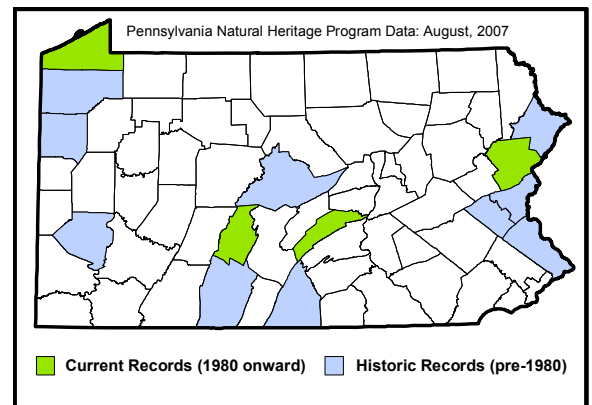


photo source: Robert W. Freckmann Herbarium, UWSP
Joanne Kline



Status

The PA Biological Survey considers the yellow water-crowfoot to be a species of special concern, based on the relatively few confirmed occurrences and the specialized wetland habitat. It has been assigned a rarity status of Threatened.

Conservation

Conservation of yellow water-crowfoot will depend upon the protection of existing populations and maintenance of their wetland habitat. This may include removing invasive plants and creating buffers to help protect populations from the effects of run-off or flooding. Sustaining appropriate water levels will also be important for maintaining high quality habitats.

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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