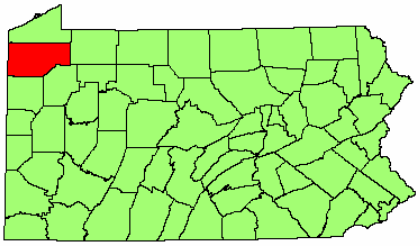
Crawford County

Natural Heritage Inventory 2008



Clockwise from top left: woody wetland, Northern riffleshell, Great Blue Heron Rookery, downy willow herb, showy lady's slipper

photo source: PHNP

Pennsylvania Natural Heritage Program
information for the conservation of biodiversity

Crawford County
Natural Heritage Inventory

Prepared for:

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April 2008

This project was funded through grants from the Office of Wild Resources Conservation, DCNR, and the U.S. Fish and Wildlife Service State Wildlife Grant Program administered by the PA Game Commission.

Copies of this report are available in electronic format through the Pennsylvania Natural Heritage Program web site – http://www.naturalheritage.state.pa.us/ and through the Crawford County Planning Commission.

Preface

Along with The Department of Conservation and Natural Resources (DCNR), the Pennsylvania Game Commission, and the Fish and Boat Commission, Western Pennsylvania Conservancy (WPC) is a partner in the Pennsylvania Natural Heritage Program (PNHP) which is responsible for collecting, tracking, and interpreting information regarding the Commonwealth's biological diversity. County inventory projects are an important part of the work of PNHP. Additionally, PNHP is a member of NatureServe – the organization that coordinates Natural Heritage efforts throughout 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.

The ability of a community to establish a vision of the future and to bring it to fruition hinges upon its capacity to assemble information that will enable it to act effectively and wisely. There are many important resources present in Crawford County that are not addressed in this inventory. Historic, cultural, educational, water supply, agricultural and scenic resources are among the many that the county must address through other projects and programs. This Natural Heritage Inventory focuses on the best examples of living *ecological resources* in Crawford County. Although agricultural lands and open space may be included as part of inventory areas, the emphasis of the designation and delineation of the areas are the ecological values present.

Since 1989, county inventory projects have served as a way to both gather new information and to pass along new and existing information to those responsible for land use decisions as well as to all residents who wish to know more about the natural heritage of their county. Consider the inventory as an invitation for the people of the county to explore and discuss their natural heritage. For those who wish to learn about and participate in the conservation of the living resources of the county, use this report as a guide to some of the special places in the county.

Although the inventory was conducted using a tested and proven methodology, it is best viewed as a preliminary report rather than the final word on the subject of Crawford County's natural heritage. Further investigations could, and likely will, uncover previously unidentified areas of significance. Likewise, in-depth investigations of sites listed in this report could reveal features of further or greater significance than have been documented. We encourage additional inventory work across the county to further the efforts begun with this study.

Ultimately, it will be up to the landowners and residents of Crawford County to determine how to use this information. Some considerations of the application of this information for a number of groups follow:

Planners and Government Staff. Typically, the planning office in a county administers county inventory projects. Often, the inventories are used in conjunction with other resource information (agricultural areas, slope and soil overlays, floodplain maps, etc.) in review for various projects and in comprehensive planning. Natural Heritage Areas may be included under various categories of zoning, such as conservation of forest zones, within parks and greenways, and even within agricultural security areas. There are many possibilities to provide for the conservation of Natural Heritage Areas within the context of public amenities, recreational opportunities, and resource management.

County, State and Federal Agencies. In many counties, Natural Heritage Areas lie within or include state or federal lands. Agencies such as the Pennsylvania Game Commission, the Pennsylvania Bureau of Forestry, and the Army Corp of Engineers can use the inventory to understand the extent of the resource. Agencies can also learn the requirements of the individual plant, animal, or community elements, and the general approach that protection could assume. County Conservation Districts may use the inventories to

focus attention on resources (e.g. high diversity streams or wetlands) and as a reference in encouraging good management practices.

Environmental and Development Consultants. Environmental consultants are called upon to plan for a multitude of development projects including road construction, housing developments, commercial enterprises, and infrastructure expansion. Design of these projects requires that all resources impacted be known and understood. Decisions made with inadequate information can lead to substantial and costly delays. County Natural Heritage Inventories provide a first look at biological resources, including plants and animals listed as rare, threatened, or endangered in Pennsylvania and in the nation. Consultants can therefore see potential conflicts long before establishing footprints or developing detailed plans and before applying for permits. This allows projects to change early on when flexibility is at a maximum.

Environmental consultants are increasing called upon to produce resource plans (e.g. River Conservation Plans) that must integrate a variety of biological, physical and social information. County Natural Heritage Inventories can help to define watershed-level resources and priorities for conservation.

Developers. Working with environmental consultants, developers can consider options for development that add value and protect key resources. Incorporating greenspaces, wetlands, and forest buffers into various kinds of development can attract homeowners and businesses that desire to have natural amenities nearby. Just as parks have traditionally raised property values, so too can natural areas. County Natural Heritage Inventories can suggest opportunities where development and conservation can complement one another.

Educators. Curricula in primary, secondary and college level classes often focus on biological science at the chemical or microbiological level. Field sciences do not always receive the attention that they deserve. Natural areas can provide unique opportunities for students to witness, first-hand, the organisms and natural communities that are critical to maintaining biological diversity. Teachers can use County Natural Heritage Inventories to show students where and why local and regional diversity occur. With proper permission and arrangements, students can visit Natural Heritage Areas and establish appropriate research or monitoring projects.

Conservation Organizations. Organizations that have as part of their missions the conservation of biological diversity can turn to the inventory as a source of prioritized places in the county. Such a reference can help guide internal planning and define the essential resources that can be the focus of protection efforts. Land trusts and conservancies throughout Pennsylvania have made use of the inventories to do just this sort of planning and prioritization, and are now engaged in conservation efforts on highly significant sites in individual counties and regions.

Acknowledgements

We would like to acknowledge the many citizens and landowners of the county and surrounding areas who volunteered information, time, and effort to the inventory and granted permission to access land.

We especially thank:

Crawford County Planning Commission
Dr. Carol Loeffler, pilot for the aerial reconnaissance of the county
Rhonda Hopkins, Grants Administrator - Crawford Co. Planning Commission
Crawford County NHI Advisory Committee:

John Anderson - Crawford Co. Planning Commission
Jerry Bish – PA Game Commission
Darran Crabtree – The Nature Conservancy
Jason Drake – Maplewood High School
Shane Hoachlander – PA Game Commission
Robert Hopkins - Crawford Co. Planning Commission
Norma Kline – Erie National Wildlife Refuge
Jack Lynch - Crawford Co. Planning Commission
Milt Ostrofsky – Allegheny College
Brian Pilarcik – Crawford Co. Conservation District
Peter Quinby – Pymatuning Laboratory of Ecology
Scott Sjolander – Penn State Cooperative Extension
Sarah Sargent – Conneaut Lake/French Creek Cons.
Brenda Schmidt – Crawford Co. Solid Waste Authority
Dale Shreve - Crawford Co. Planning Commission
Cicile Stetler – DCNR Bureau of Forestry
Roger Stranahan – Clear Lake Authority
John Tautin – Conneaut Lake/French Creek Cons.
Michelle Taylor – Crawford Co. Planning Commission
Gordon Whitney – Allegheny College
Roger Williams – Crawford Co. Commissioner

We would also like to thank the Department of Conservation and Natural Resources, Office of Wild Resource Conservation and the Pennsylvania Game Commission, State Wildlife Conservation Grants Program for providing the funding to make this report possible and a very special thank-you to the people of Crawford County for their interest and hospitality.

We want to recognize the Pennsylvania Natural Heritage Program and NatureServe for providing the foundation for the work that we perform for these studies. Additionally, this report has incorporated ideas and approaches developed for conservation science initiatives recently undertaken in other states, most notably the Massachusetts BioMap project and the Maryland Green Infrastructure project, and we gratefully acknowledge the vision of these projects as providing the basis for improved ways to represent conservation information in the County Natural Heritage Inventory reports.

Without the support and help from these people and organizations, the inventory would not have seen completion. We encourage comments and questions. The success of the report will be measured by the use it receives and the utility it serves to those making decisions about resources and land use throughout the county. Thank you for your interest.

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Western Pennsylvania Conservancy

How to use this document

The Crawford County Natural Heritage Inventory is designed to provide information about the biological diversity of the county. The Introduction of the report has an overview of the process behind this inventory as well as an overview of the Natural History of the county. Results are presented at the broad landscape view, then moving into finer scale results presented by township. Natural Heritage Areas that cross municipal boundaries are cross-referenced in each township section.

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Executive Summary

Introduction

Our natural environment is key to human health and sustenance. A healthy environment provides clean air and water, supports fish, game, and non-game species and furnishes renewable sources of materials for countless aspects of our livelihoods and economy. The first steps in ensuring protection of our natural environment are to recognize environmentally sensitive or ecologically important areas and determine their importance. A County Natural Heritage Inventory is designed to identify and map important biotic (living) and ecological resources. This information helps county, state, and municipal government, the public, business, and industry plan development with the preservation of these environmentally important sites in mind. Biotic and ecological resources inherited by the citizens of this region include:

- Lands that support important components of Pennsylvania's native species biodiversity
- Populations of species that are facing imperilment at a state and/or global level and their habitats
- Natural communities (assemblages of plants and animals) that are regionally important to biodiversity because they are exceptionally undisturbed and/or unique within the state
- Areas important for wildlife habitat, open space, education, scientific study, and recreation
- Areas that have been left relatively undisturbed by human activity
- Potential habitats for species of concern

The identification and delineation of Natural Heritage Areas are based on the ecological values present. Important selection criteria include the existence of habitat for plants and animals of special concern, the existence of ecologically significant natural communities, and the size and landscape context of a site. Large, relatively undisturbed areas provide the backbone that links habitats and provide corridors for plants and animals. Although agricultural lands and open space may be included as part of inventory areas, the focus rests on areas that are the best examples of biotic/ecological resources in Crawford County.

Natural Heritage Inventory Classification

To provide the information necessary to plan for conservation of biodiversity at the species, community, and ecosystem levels, two types of Natural Heritage Areas, as well as designations from two other sources, are included in the report.

To conserve the native biological diversity of Crawford County we recommend the use of a two-tiered approach to selecting areas for their contribution to the entire ecological environment. The "fine-filter/coarse-filter" approach focuses attention on both the immediate habitat of the at-risk species, as well as the larger landscape scale processes that help to keep common species common.

- The **fine-filter** approach targets protection for uncommon species that generally occur in specialized and discrete habitats. Focusing conservation efforts on these smaller habitats will help defend these species from local or global extinction. This fine-filter approach has been the focus of our field surveys – to find the locations of these unique species and their habitats, and to draw attention to the potential for their inadvertent destruction. These at-risk species and their habitats are described in the Biological Diversity Areas (BDAs).
- The **coarse-filter** approach suggests that whole suites of species as well as general ecological and environmental processes can be offered protection by focusing conservation efforts on large expanses of quality habitats of all types. We address the coarse filter approach by highlighting the largest unfragmented forest/natural habitats and wetland, creek, stream and river riparian buffers. The highest priority landscape scale habitats in the county are referred to as Landscape Conservation Areas (LCAs).

Besides these highest priority landscapes, all of the habitats of the county will benefit from conservation of large forested blocks and forested riparian buffers. The fine filter approach is characterized on one side of the township maps by highlighting the core and supporting habitats for species of concern. On the reverse side of the maps is the coarse filter approach, with large forest blocks and all riparian corridors highlighted for the township. Through a combined effort of these two approaches, we can help to assure that uncommon species avoid local or global extinction and that common species stay common in Crawford County.

Natural Heritage Areas

Biological Diversity Area (BDA):

An area containing plants or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity. BDAs include both the immediate habitat and surrounding lands important in the support of these special elements.

Conservation Planning Application: BDAs are mapped according to their sensitivity to human activities. "Core" areas delineate essential habitat that cannot absorb significant levels of activity without substantial impact to the elements of concern. "Supporting Natural Landscape" includes areas that maintain vital ecological processes or secondary habitat that may be able to accommodate some types of low-impact activities.

Landscape Conservation Area (LCA):

A large contiguous area that is important because of its size, open space, habitats, and/or inclusion of one or more BDAs. Although an LCA includes a variety of land uses, it typically has not been heavily disturbed and thus retains much of its natural character.

Conservation Planning Application: These large regions in relatively natural condition can be viewed as regional assets. They improve quality of life by providing a landscape imbued with a sense of beauty and wilderness, they provide a sustainable economic base, and their high ecological integrity offers unique capacity to support biodiversity and human health. Planning and stewardship efforts can preserve these functions of the landscape by limiting the overall amount of land converted to other uses, thereby minimizing fragmentation of these areas.

Important Bird Areas (IBA):

The Pennsylvania Audubon Society administers the Pennsylvania IBA Program and defines an IBA as "a site that is part of a global network of places recognized for their outstanding value to bird conservation." An IBA can be large or small, public or private and must meet at least one of five criteria for supporting bird populations (http://pa.audubon.org/Ibamain.htm).

Conservation Planning Application: Planning for these areas should consider how best to maintain their value as bird habitat. The value of some large-scale IBAs may be due to the forest interior habitat contained within them, thus, the recommendations for LCA stewardship to minimize fragmentation are applicable. Natural communities that have a particular habitat value for birds (e.g., wetland) are typically the basis for smaller-scale IBAs, therefore, a high degree of protection should be given to these sites. Conservation plans are in the process of being completed for all IBAs in the state.

Important Mammal Areas (IMA):

The Important Mammal Areas Project (IMAP) is being carried out by a broad based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Areas nominated must

fulfill at least one of five criteria developed by the Mammal Technical Committee of the Pennsylvania Biological Survey (http://www.pawildlife.org/imap.htm).

Conservation Planning Application: Planning for these areas should consider how best to maintain their value as mammal habitat. The value of these sites may be associated with high mammalian diversity, high-density populations, occurrence of species of concern, or educational potential. Stewardship plans are in the process of being completed for all IMAs in the state.

Methods

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

- site selection
- ground survey
- data analysis

Site Selection

A review of the Pennsylvania Natural Heritage Program (PNHP) database (see Appendix II) determined where sites for special concern species and important natural communities were known to exist in Crawford County. Knowledgeable individuals were consulted concerning the occurrence of rare plants and animals and unique natural communities in the county. Geological maps, USGS topographical maps, National Wetlands Inventory maps, USDA soil surveys, recent aerial photos, and published materials were also used to identify areas of potential ecological significance (Reschke 1990). Once preliminary site selection was completed, reconnaissance flights over chosen areas of the county were conducted. Wetlands were of primary interest during fly-overs in Crawford County.

Ground Survey

Areas identified as potential 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. Field survey forms (Appendix III, pg. 277) were completed for each site. The flora, fauna, level of disturbance, approximate age of community and local threats were among the most important data recorded for each site. 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, sites were not ground surveyed.

Data Analysis

Data obtained during the 2002 and 2003 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 selected as Biological Diversity Areas (BDAs). Spatial data on the elements of concern were then compiled in a geographic information system (GIS) format using ESRI ArcView 3.2a software.

The boundaries defining each BDA were based on physical and ecological factors, and specifications for species protection provided by jurisdictional government agencies. The BDAs were then assigned a significance rank based on size, condition, rarity of the unique feature, and quality of the surrounding landscape (see Appendix I, pg. 275, for further description of ranks). Landscape Conservation Areas were designated around landscape features that provide a uniting element within a collection of BDAs, or large blocks of contiguous forest identified using GIS-based spatial analysis. County municipalities served as the organizing unit for the data.

Results

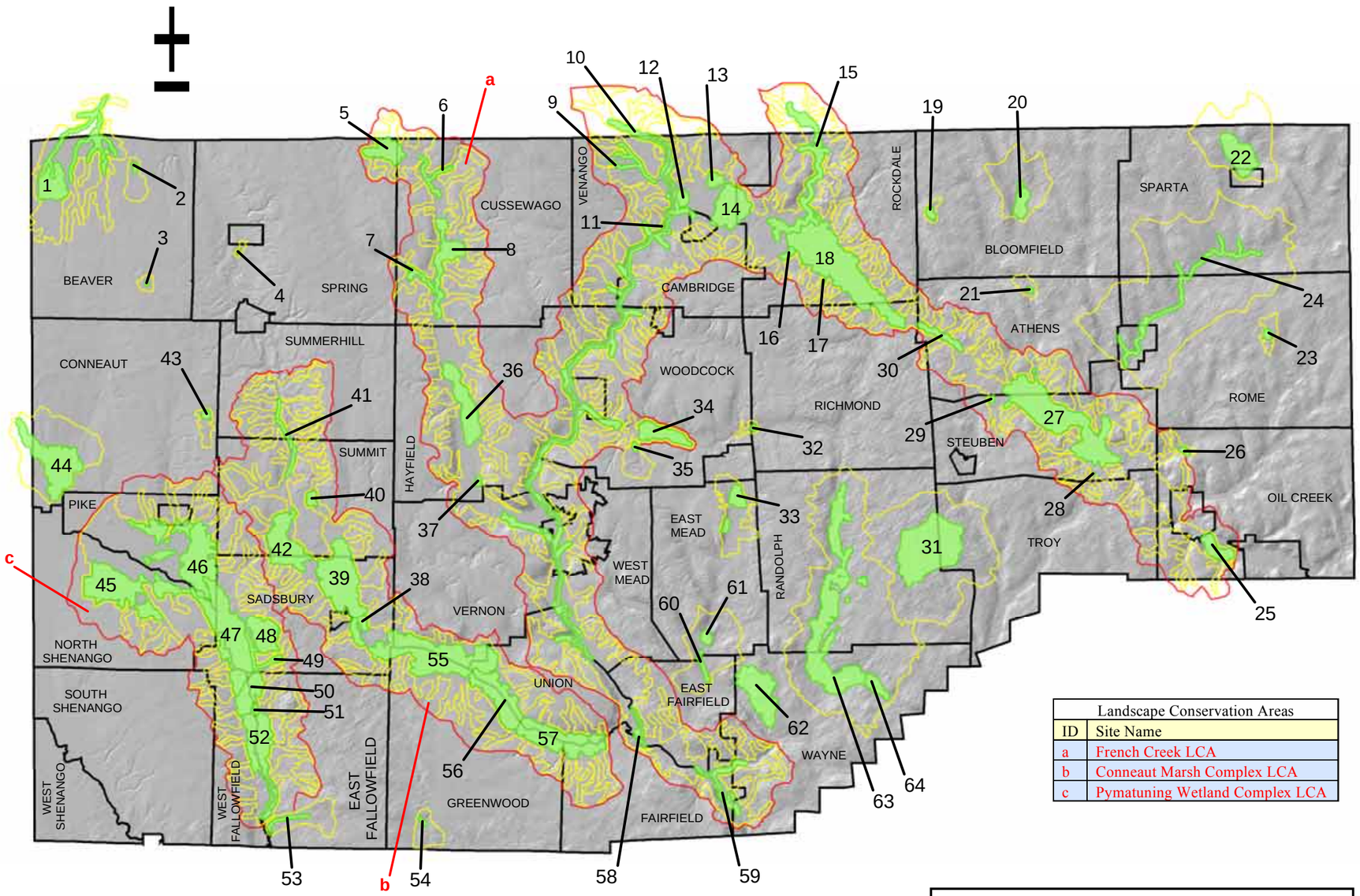
Sixty-seven areas of ecological significance are recognized in the Crawford County Natural Heritage Inventory (Tables 1 and 2). This includes 64 Biological Diversity Areas and three Landscape Conservation Areas that are categorized according to their significance for the protection of the biological diversity and ecological integrity of the region (Tables 1 and 2). Significance ranks are exceptional, high, notable, and local (for a full explanation of these ranks, see Appendix I.

Currently, Crawford County ranks fourth in the state in total occurrences of species of concern, mostly due to the number of high quality wetlands and streams in the county. Hayfield Township has the highest number of species of concern in the county, with 66, ranking 15th among all Townships in the state.

One of the most ecologically rich areas in Crawford County is French Creek. This area contains many rare, threatened, and endangered fish and mussel species, and acts as a global refuge for several aquatic species that occur in very few other locations in the world. The floodplain and other areas surrounding French Creek also support several plant species of concern. Several organizations are currently working in the French Creek watershed to protect this valuable resource. French Creek should continue to be a conservation priority in the county.

Crawford County also has a large number of wetlands that provide habitat to many species of concern. Wetland habitats are becoming more scarce and degraded state-wide, making these wetlands especially important for the many rare wetland species. Although some of these wetlands are located on private land, many are being protected as parts of state parks, state game lands, and wildlife refuges. Privately owned wetlands should be considered conservation targets in Crawford County.

Crawford County Natural Heritage Inventory Site Index



Biological Diversity Areas (BDA)

ID	Site Name
1	West Branch Conneaut Creek BDA
2	Mud Run Wetland BDA
3	East Branch Conneaut Creek Headwaters Wetland BDA
4	Conneaut Creek Slope - Springsboro South BDA
5	Pont Road Wetland BDA
6	Cussewago Creek at Crossingville BDA
7	Carr Run BDA
8	Cussewago Creek Central Riparian Corridor BDA
9	Torry Run BDA
10	French Creek BDA
11	French Creek Floodplain Forest BDA
12	Little Conneauttee Floodplain BDA
13	Cambridge Springs Swamp BDA
14	State Game Lands #277 BDA
15	Upper French Creek BDA
16	Mohawk Run Fen BDA
17	Dead Creek BDA
18	Muddy Creek Wetland BDA
19	Little Federal Run Headwaters Wetland BDA
20	Lake Canadohta BDA
21	Puckerbush Lake Tributary BDA
22	Clear Lake BDA
23	Rendall's Corners North Wetland BDA
24	East Branch Oil Creek BDA
25	Oil Creek at Titusville BDA
26	Bog Hollow Woodlands BDA
27	Koochogey Wetland BDA
28	Dewolfe Run Tributaries - SGL 122 BDA
29	Navy Run Tributary Wetland BDA
30	Muddy Creek BDA
31	State Game Lands 69 BDA
32	Woodcock Creek BDA
33	Little Sugar Creek at Blooming Valley BDA
34	Woodcock Lake BDA
35	Hemlock Natural Area BDA
36	Cussewago Creek - Coons Valley BDA
37	Cussewago Creek at Dennys Corners BDA
38	Conneaut Lake Outlet BDA
39	Conneaut Lake BDA
40	Harmonsburg Wetlands BDA
41	Conneaut Creek at Dickonsburg BDA
42	Meadville Junction BDA
43	Linesville Creek Headwaters Wetland BDA
44	Blackjack Swamp BDA
45	Pymatuning Shoreline - Bottomland Forests BDA
46	Pymatuning Resevoir BDA
47	Pymatuning Wetland Complex - North BDA
48	Tyrone Weber Woods BDA
49	Pymatuning Swamp Tributaries BDA
50	Pymatuning Wetland Central Complex BDA
51	Mud Lake BDA
52	Pymatuning Wetland Complex - South BDA
53	McMillen Hollow BDA
54	Sandy Creek Wetlands BDA
55	Conneaut Marsh Complex North BDA
56	Conneaut Marsh Complex Central BDA
57	Conneaut Marsh Complex South BDA
58	Conneaut Creek - French Creek Confluence BDA
59	Lower French Creek BDA
60	Little Sugar Creek at Pettis Corners BDA
61	Yoset Lake Palustrine Forest BDA
62	Pine Knoll Forest BDA
63	Lake Creek Valley BDA
64	Sugar Lake Glacial Lake BDA

Landscape Conservation Areas

ID	Site Name
a	French Creek LCA
b	Conneaut Marsh Complex LCA
c	Pymatuning Wetland Complex LCA

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape
- Landscape Conservation Area (LCA)
- Township Boundary

1:250,000

0 1.25 2.5 5 Miles

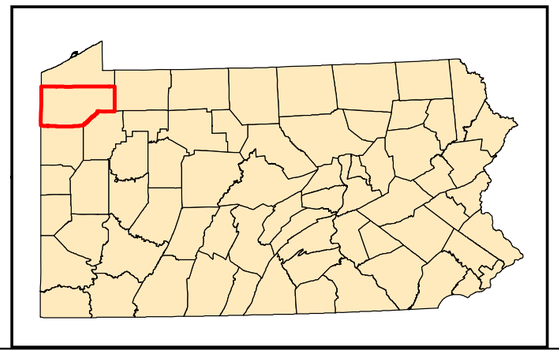


TABLE 1 – NATURAL HERITAGE AREAS CATEGORIZED BY SIGNIFICANCE

Site #	Site Name	Municipality	Description	Page
Exceptional Significance				
44	Blackjack Swamp BDA	Conneaut Township	Wetland complex that provides habitat for nine plants and one animal species of concern.	87
39	Conneaut Lake BDA	Sadsbury Township	Glacial lake, including the immediate shoreline, surrounding marshes, and wetlands, that supports 18 plant and animal species of concern.	173
56	Conneaut Marsh Complex-Central BDA	Greenwood Township and Union Township	Central portion of a large emergent marsh along Conneaut Outlet, which provides habitat to five animal species of concern.	123
55	Conneaut Marsh Complex-North BDA	Greenwood, Sadsbury, Union and Vernon Townships	Northern portion of a large emergent marsh along Conneaut Outlet, which provides habitat to seven animal and ten plant species of concern.	229
57	Conneaut March Complex South-BDA	Fairfield Township, Greenwood Township, and Union Township	Southern portion of a large emergent marsh along Conneaut Outlet, which provides habitat to several animal and plant species of conservation concern.	218
38	Conneaut Lake Outlet BDA	Sadsbury Township	Stream and wetlands at the outflow of Conneaut Lake that support several plant and animal species of concern.	175
8	Cussewago Creek Central Riparian Corridor BDA	Cussewago Township	Riparian corridor of a large stretch of creek that supports four plant species of concern and numerous natural communities.	94
36	Cussewago Creek-Coons Valley BDA	Hayfield Township	Relatively large riparian wetland that provides habitat to eight plants and one animal species of concern.	129
24	East Branch Oil Creek BDA	Rome Township, Sparta Township	Large stretch of stream that provides aquatic habitat to three species of conservation concern.	167
10	French Creek BDA	Cambridge, Hayfield, Venango, Vernon, Wayne, West Mead, and Woodcock Townships	Central riparian corridor of river that provides habitat to numerous aquatic species of concern.	259
40	Harmonsburg Wetlands BDA	Summit Township	Core wetland supporting ten plant species and a natural community of special concern.	207
27	Koochogey Wetlands BDA	Athens Township, Steuben Township	Meandering stream and large surrounding wetland complex providing habitat to 17 plants and one animal of special concern, as well as two natural communities of conservation concern.	198
20	Lake Canadohta BDA	Bloomfield Township	A glacial lake, this community of conservation concern supports an aquatic plant species of concern.	75
63	Lake Creek Valley BDA	Randolph Township, Wayne Township	Extensive emergent marsh surrounding Lake Creek as it flows into Sugar Lake, which provides habitat to numerous plant and animal species. Two natural communities of special concern are also located here.	235

12	Little Conneauttee Floodplain BDA	Cambridge Township	Bottomland forest along Little Conneauttee Creek supporting a plant species of concern and a breeding colony of an animal species of concern.	81
60	Little Sugar Creek at Pettis Corners BDA	East Fairfield Township, East Mead Township	Stretch of stream providing appropriate habitat conditions to support an aquatic species of concern.	103
59	Lower French Creek BDA	East Fairfield Township, Fairfield Township, and Wayne Township	Stretch of French Creek that provides habitat to four aquatic species of concern and the riparian area which supports two plant species of concern.	117
42	Meadville Junction BDA	Summit Township	Wetlands near an old railroad canal supporting eight plant species of concern and an animal colony of special concern.	208
16	Mohawk Run Fen BDA	Rockdale Township	A rare wetland community that supports several plant species of concern.	159
51	Mud Lake BDA	West Fallowfield Township	Two small kettle lakes and the emergent marsh surrounding them, which provides habitat to four plant and five animal species of concern. This area is also hydrologically connected to Pymatuning Marsh.	243
30	Muddy Creek BDA	Athens Township, Richmond Township	Meandering section of the creek with shallow runs and riffles and a cobble substrate supporting two aquatic species of concern.	61
18	Muddy Creek Wetland BDA	Rockdale Township, Richmond Township	A large stream channel wetland that provides habitat to numerous plants, animals, and a natural community of conservation concern.	160
46	Pymatuning Reservoir BDA	North Shenango Township and Pine Township	Eastern portion of reservoir and marsh supporting several bird species of concern.	145
50	Pymatuning Wetland Complex-Central BDA	East Fallowfield Township, West Fallowfield Township	Southern portion of the extensive marsh surrounding the Shenango River, supporting 17 plant and four animal species of concern.	245
47	Pymatuning Wetland Complex-North BDA	North Shenango Township, Sadsbury Township, and West Shenango Township	Northern portion of a large emergent marsh that provides habitat to numerous animal and plant species of concern as well as several natural communities of special concern.	177
52	Pymatuning Wetland Complex-South BDA	East Fallowfield Township, West Fallowfield Township	Southern portion of the extensive marsh surrounding the Shenango River, supporting 13 plant and four bird species of concern.	108
64	Sugar Lake BDA	Wayne Township	Glacial lake and surrounding marshy shoreline that supports a plant and animal species of concern.	238
15	Upper French Creek BDA	Rockdale Township, Erie County	Meandering stream with numerous runs and riffles that provides habitat to 14 aquatic species of concern.	162
1	West Branch Conneaut Creek BDA	Beaver Township	Wetland habitat and stream corridor that supports five plant, two animal, and one natural community of special concern.	69

High Significance				
26	Bog Hollow BDA	Oil Creek Township	Small headwaters wetland that contains a natural community of special concern.	139
7	Carr Run BDA	Cussewago Township	Meandering portion of creek, upstream from Cussewago Creek that supports two aquatic species of concern.	93
22	Clear Lake Swamp BDA	Sparta Township	Wetlands surrounding Clear Lake, which supports a natural community of conservation concern and two plant species of concern.	187
41	Conneaut Creek at Dicksonburg BDA	Summerhill Township	Meandering stretch of stream that provides habitat to two aquatic species of concern.	203
4	Conneaut Creek Slope-Springsboro South BDA	Spring Township	Riparian forest supporting a plant species of conservation concern.	191
6	Cussewago Creek at Crossingville BDA	Cussewago Township	Portion of the stream and an unnamed tributary that provide habitat for an aquatic species of concern	98
17	Dead Creek BDA	Rockdale Township	Slightly disturbed upland ridge of stream channel that provides habitat to a plant species of concern.	159
28	Dewolfe Run Tributaries BDA	Steuben Township	Hardwood forest community supporting a plant species of concern.	197
3	East Branch Conneaut Creek Headwaters Wetland BDA	Beaver Township	Wooded wetland that provides habitat for a plant species of concern.	67
58	Conneaut Creek-French Creek Confluence BDA	Union Township	Small wooded riparian area near confluence that supports a plant species of concern.	217
11	French Creek Floodplain Forest BDA	Venango Township	Small patch of bottomland riparian forest providing habitat to a plant species of concern.	223
35	Hemlock Natural Area BDA	Woodcock Township	Wooded bottomland wetland area that is a natural community of special concern.	260
43	Linesville Creek Headwaters Wetland BDA	Conneaut Township	Wetland community of special concern.	88
19	Little Federal Run Headwaters Wetland BDA	Bloomfield Township	A wetland community of special concern that supports a plant species of conservation concern.	76
53	McMillen Hollow BDA	East Fallowfield Township, West Fallowfield Township	Small stretch of stream supporting a fish species of concern.	107
2	Mud Run Wetland BDA	Beaver Township	Forested wetland that supports a plant species of concern.	68
29	Navy Run Tributaries BDA	Steuben Township	Moist, wooded forest supporting a plant species of concern.	199
5	Pont Road Wetlands BDA	Spring Township	Wetland community providing habitat to a plant and animal species of concern.	192
21	Puckerbush Lake Tributaries BDA	Athens Township	Small wetland community supporting a plant species of concern.	62
45	Pymatuning Shoreline Bottomland Forest BDA	North Shenango Township, Pine Township	Bottomland forests along the shoreline of Pymatuning Reservoir that provides nesting habitat to an animal species of concern.	135
49	Pymatuning Swamp Tributaries BDA	Sadsbury Township	Small portion of a tributary of the Shenango River that supports a population of an aquatic species of concern	176

23	Rendell's Corners Wetland North BDA	Rome Township	Small forested wetland supporting state-vulnerable natural community.	168
54	Sandy Creek Wetlands BDA	Greenwood Township	Forested wetland community supporting two plant species of conservation concern.	125
31	State Game Lands #69 BDA	Randolph Township, Troy Township	Large wetland complex containing six odonate species of concern	149
14	State Game Lands #277 BDA	Cambridge Township	Wetland community adjacent to French Creek that provides habitat for two plant, one bird, and four odonate species of concern.	82
9	Torry Run BDA	Venango Township	Small meandering stream that supports an aquatic animal of special concern	224
32	Woodcock Creek BDA	Richmond Township	Wooded area near a stream confluence that supports an animal species of concern.	153
61	Yoset Lake Palustrine Forests BDA	East Mead Township	Wetland complex south of Yoset Lake that supports two natural communities of conservation concern.	113
Notable Significance				
37	Cussewago Creek at Dennys Corners	Hayfield Township	Forested stream with one plant species of concern.	129
33	Little Sugar Creek at Blooming Valley	East Mead Township	Large forested block containing three natural communities of special concern.	113
25	Oil Creek at Titusville BDA	Oil Creek Township	Stretch of stream containing an aquatic animal species of concern.	140
34	Woodcock Lake BDA	Woodcock	Man-made lake that supports a breeding species of concern.	261
Local Significance				
13	Cambridge Springs Swamp BDA	Cambridge Township	Swampy area that provides nesting habitat to a species that is being considered for tracking.	81
62	Pine Knoll BDA	Wayne Township	Rich mesic forest supporting a diversity of spring wildflowers.	237
48	Tryon Weber Woods BDA	Sadsbury	Several acres of a maturing beech-maple forest with some individuals over 100 years old.	179

Table 2. Landscape Conservation Areas (LCAs)

Site ID	Site Name	Municipality	Description	Page
b	Conneaut Marsh-Geneva Marsh LCA	East Fairfield, Fairfield, Greenwood, Sadsbury, Union, and Vernon Townships	The most extensive freshwater emergent marsh in Pennsylvania, which provides habitat to numerous plant, animal and natural communities of conservation concern.	55
a	French Creek LCA	Cambridge, East Fairfield, Fairfield, Hayfield, , Union, Venango, Vernon, West Mead, and Woodcock Townships	The immediate watershed and its tributaries, Conneauttee, Cussewago, and Muddy Creeks, feeding the main channel of an ecologically significant and extremely diverse stream, which supports numerous species of concern.	55
c	Pymatuning Marsh LCA	Conneaut, East Fallowfield, North Shenango, Pine, Sadsbury, South Shenango, Summit, and West Fallowfield Townships	Extensive marsh complex that follows the Shenango River outlet from Pymatuning Reservoir that supports numerous plants, animals, and natural communities of conservation concern.	56

Discussion and Recommendations

Status of natural features today

The landscape and waterways of Crawford County have undergone considerable change over the course of human settlement, most notably from timber extraction and agriculture. During the timber boom in the early twentieth century, much of the forest in the county underwent general clear-cutting, and subsequent widespread fires. Gravel mining has occurred in Crawford County and has affected the water and species living in it. Throughout the county, the condition of ecological resources today closely reflects the history of human land use.

Planning for biodiversity and ecological health tomorrow

Provision for the future health of ecological resources in Crawford County will require a combination of efforts 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.
Natural communities have redeveloped across large swaths of the landscape previously used for timber extraction, gravel mining, and clay mining. These forested areas also help to maintain water quality in streams. Five out of six Pennsylvania Department of Environmental Protection (DEP) designated exceptional value streams in Crawford County are within these areas. The condition of forest communities varies across the county. While many areas have regenerated into a broad spectrum of natural forest communities, some areas remain fragmented by roads, surface mined areas, artificial clearings, and utility rights-of-way. Additionally, over-browsing by deer poses a threat to biological diversity and forest regeneration in many regions of the county.

Despite the variable condition of the forests, their contiguity is a great asset to the county's ecological integrity and is regionally important in sustaining mid-Atlantic populations for many animal species. Contiguous forested areas offer enhanced habitat value over fragmented forested areas. While a number of generalist species can succeed and reproduce in small patches of forest, many species can only utilize large, unbroken tracts of forest. Because several of the forested areas in Crawford County today are large and contiguous, they support species which are declining in other areas of the state and the continent due to lack of habitat.

The forests of Crawford County have the potential for even greater contribution to biodiversity in the future. Some species can only find appropriate habitat in old-growth forests, because the structures they need for shelter or the food sources they require are not present in younger forests. While there are few areas in Crawford County today that are considered old growth, the large expanses of younger forests provide the potential for future development of this habitat type.

In the forested landscapes, objectives for large-scale planning should include maintaining and increasing contiguity and connectivity of natural land. Connectivity is important for the enhanced habitat values outlined above. Municipal and regional land use plans can support maintenance of forest contiguity by encouraging residential or commercial projects to re-develop in existing town centers or re-use previously altered landscapes, rather than orienting new infrastructure through unfragmented natural landscapes.

Connectivity between habitat patches and maintenance of natural corridors that connect forests, wetlands, and waterways is of critical importance for many species. For example, many amphibians and dragonflies use an aquatic or wetland habitat in one phase of their life then migrate to an upland, forested habitat for their adult life. By enrolling in the Pennsylvania Forest Stewardship Program, a voluntary program that provides information, education, and technical assistance, forest landowners can better manage their forestlands. See Appendix VII (pg. 290) for more details on this program.

Wetland/aquatic communities.
Within the matrix of forest in the county, unique communities including forested seepage wetlands, headwater shrub swamps, and vernal pools occur in conjunction with specific topographic or geologic conditions. Although these communities occupy a comparatively small portion of the natural landscape, they are of particular value to the county's biodiversity because of the species they support. Groups of specialist species—such as amphibians that breed only in vernal ponds, or plant species that live only in acidic wetlands—that would otherwise not be present in the county inhabit these communities.

Due to the impacts of acid deposition and extensive mining in a landscape of naturally acidic geology, most of the county's streams have low pH and support aquatic ecosystems that range from slightly impaired to nearly devoid of life. One-half of Pennsylvania's wetlands have been lost or substantially degraded. Wetland and aquatic species that depend on these habitats are correspondingly declining, making Crawford County's system of wetlands especially important for these species.

Crawford County's waterways include some of the state's most scenic features and some of its greatest ecological challenges. Remediation pollution is the greatest challenge to restoration of water quality and living aquatic ecosystems in many of the county's waterways. In some areas, reduction in the release of other pollutants into runoff, including sediments, nutrients, and chemical contaminants, will also be necessary to improve water quality.

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 pay dividends 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.

Grassland communities.
Historically, most of the Northeast was forested except for scattered openings that existed along river floodplains, wetlands, beaver meadows, and heathlands. Fires set by lightning strikes or burning and clearing by Native Americans also opened up forested areas. With European colonization during the 1800s, grasslands became widespread as land was cleared for pastures and hayfields and grassland species flourished. Today, as farmland reverts back to forest, and agricultural landscapes are being replaced by housing and business developments, species dependent on grasslands are declining. Grassland habitat in Crawford County consists primarily of agricultural land such as hay fields and pastures, and maintained areas such as airfields.

Many grassland birds and other wildlife associated with open areas are experiencing declines due to habitat loss and modern agricultural practices (Jones and Vickery 1997). In parts of western Pennsylvania where a small portion of reclaimed surface mines are maintained as grassland habitat or farmers are participating in the Conservation Reserve Enhancement Program (CREP), several grassland-dependent species have been able to maintain small strongholds. Dedicated, long-term management is needed to maintain these grassland habitats. Objectives for large-scale planning should include restricting mowing during the breeding season, managing grazing using a rotational system, periodic burns, and limiting development in those areas where grassland-dependent species are known to reside.

Evaluating proposed activity within Natural Heritage Areas

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

Always contact the Crawford County Planning Commission. The County Planning Commission should be aware of all activities that may occur within Natural Heritage Areas in the county so that they may work 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.

The Crawford County Natural Heritage Inventory is ***not*** intended as a substitute for environmental review, since information is constantly being updated as natural resources are both destroyed and discovered. The Planning Commission and applicants for building permits should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the Pennsylvania Natural Heritage Program's website, at **http://www.naturalheritage.state.pa.us/.**

If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources. If additional information on species of concern becomes available during environmental review, the review may be reconsidered by the jurisdictional agency.) 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 or animals.
- *Pennsylvania Game Commission* for all state and federally listed birds and mammals.
- *Pennsylvania Fish and Boat Commission* for all state and federally listed reptiles, amphibians, aquatic vertebrate and invertebrate animals.
- *Pennsylvania Bureau of Forestry* for all state and federally listed plants.
- *Department of Conservation & Natural Resources (DCNR)* for all natural communities, terrestrial invertebrates, and species not falling under the above jurisdiction.

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.

If a ground survey is necessary to determine whether significant natural resources are present in the area of the project, an agency biologist 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.

If the decision is made to move forward with a project in a sensitive area, WPC 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.

Using the Natural Heritage Inventory in Crawford County Planning

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

1. Adopt the Crawford County Natural Heritage Inventory (NHI) report by resolution. The county should work to incorporate the NHI into the implementation of the comprehensive plan (in particular the Environmental Plan, Chapter 7) and to use the NHI to guide future planning, subdivision review, acquisition, development, and conservation initiatives while accomplishing the county's goal of maintaining greenspace and viewsheds.

2. Incorporate the Crawford County NHI into the ongoing Northwest Greenways Plan and future Greenway or Open Space plans. An update to NHI data should be done before the update or creation of Comprehensive Plans, Greenways, and Open Space Plans.

3. Revise the county future land use planning map to include the NHI Biological Diversity Areas (BDAs), both core habitats and supporting landscapes, as well as the Landscape Conservation Areas (LCAs). The Crawford County Comprehensive Plan focused on the environmental issues of air, water, and land protection and management, but did not include objectives to preserve rare, threatened, and endangered plants, animals, and communities in the county.

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 Crawford County Planning Commission. Include the NHI report in the inventory of environmental plans and studies available for residents, officials, and agencies to increase land and environmental awareness (pg. 65 of the Crawford County Comprehensive Plan).

5. Provide the NHI report to local watershed organizations and conservation organizations, such as the French Creek Valley Conservancy.

6. Use the NHI to accomplish objective of "re-establishment of stream buffers or riparian zones along water systems" (pg. 67 of the Crawford County Comprehensive Plan). Use NHI data to prioritize riparian buffer plantings. Streams within Landscape Conservation Areas can be used to focus buffer restoration projects to protect environmentally sensitive species and communities.

Introduction

Our natural environment is key to human health and sustenance. A healthy environment provides clean air and water. Supports fish, game, and non-game species, and furnishes renewable sources of materials for countless aspects of our livelihoods and economy. In addition to these direct services, a clean and healthy environment plays a central role in our quality of life, whether through its aesthetic value—found in forested ridges, mountain streams, and encounters with wildlife— or in the opportunities it provides for exploration, recreation, and education. Finally, a healthy natural environment supports economic growth by adding to the region's attractiveness as a location for new business enterprises and provides the basis for the recreation, tourism, and forestry industries—all of which have the potential for long-term sustainability. Fully functional ecosystems are the key indicators of a healthy environment and working to maintain ecosystems is essential to the long-term sustainability of our economies.

An ecosystem is "the complex of interconnected living organisms inhabiting a particular area or unit of space, together with their environment and all their interrelationships and relationships with the environment" (Ostroumov 2002). All the parts of an ecosystem are interconnected—the survival of any species or the continuation of a given natural process depends upon the system as a whole, and in turn, these species and processes contribute to maintaining the system. An important consideration in assessing ecosystem health is the concept of biodiversity. Biodiversity can be defined as the full variety of life that occurs in a given place, and is measured at several scales: genes, species, natural communities, and landscapes.

Genetic diversity refers to the range of variation found within the genetic makeup between individuals and populations of organisms. Genetic diversity is vital to the long-term viability of species because it provides evolutionary potential, without which species may not be able to adapt successfully to environmental changes. In order to conserve genetic diversity, it is important to maintain natural patterns of gene flow. Gene flow occurs through the migration of individuals across the landscape and the dispersal of pollen and seeds—between populations (Thorne et al. 1996). Individual species play a role in sustaining ecosystem processes such as nutrient cycling, decomposition, and plant productivity: declines in native species diversity alter these processes (Naeem et al. 1999).

A natural community is "an interactive assemblage of plant and animal species that share a common environment and occur together repeatedly on the landscape, such as a red maple swamp" (Massachusetts Biomap 2000). As each type of community represents habitat for a different group of species, identification and stewardship of examples of each of the full range of native community types is a good first estimation of the area needed to meet the challenge of conserving habitat for all species.

From an ecological perspective, a landscape is "a large area of land that includes a mosaic of natural community types and a variety of habitats for many species." (Massachusetts Biomap 2000). At this scale, it is important to consider whether communities and habitats are isolated or connected by corridors of natural landscapes traversable by wildlife, and whether the size of a natural landscape is sufficient to support viable populations and ecosystems. Because all the living and non-living elements of an ecosystem are interconnected and interdependent, it is essential to conserve native biodiversity at all these levels if ecosystems are to continue functioning.

Pennsylvania's natural heritage is rich in biodiversity and includes many examples of high quality natural communities and large expanses of natural landscapes. Over 20,000 species are known to occur in the state, and the extensive tracts of forest in the northern and central parts of the state represent a large fraction of the remaining areas of suitable habitat in the mid-Atlantic region for many forest-dependent species of birds and mammals. Unfortunately, biodiversity and ecosystem health are seriously threatened in many parts of the state by pollution and habitat loss. Of the 3500 species of animals and vascular plants that have been documented in the state, more than one in ten are imperiled, 156 have been lost since European settlement, and 351 are threatened or endangered (21st Century Environment Commission 1998). Many of these species are imperiled because available habitat in the state has been reduced and/or degraded.

Fifty-six percent of Pennsylvania's wetlands have been lost or substantially degraded by filling, draining, or conversion to ponds (T.E. Dahl 1990). According to the Pennsylvania Department of Environmental Protection (DEP), 60% of those Pennsylvania lakes which have thus far been assessed for biological health are listed as impaired. Of 83,000 miles of stream in Pennsylvania – more than any other state except Alaska, almost 70,000 miles have been assessed for water quality in response to

the requirements of the Federal Clean Water Act Section 303(b), and nearly 11,000 miles have been designated as impaired (PA DEP 2004). The major causes of impairment are acid precipitation and agricultural and urban runoff (PA DEP 2004).

The species that depend on these habitats are correspondingly under threat: 58% of threatened or endangered plant species are wetland or aquatic species. Thirteen percent of Pennsylvania's 200 native fish species have been lost, while an additional 23% are imperiled, and among freshwater mussels— one of the most globally imperiled groups of organisms— 18 of Pennsylvania's 67 native species are extinct and another 22 are imperiled (Goodrich et al. 2003). Prior to European settlement, over 90% of Pennsylvania's land area was forested. Today, 60% of the state is still forested, but much of this forest is fragmented by non-forest uses such as roads, utility rights-of-way, agriculture, and housing: only 42% is interior forest habitat, and some of the species that depend upon interior forest habitat are in decline (Goodrich et al. 2003). In addition to habitat fragmentation, forest ecosystem health is also threatened by forest pests, acid precipitation (which causes nutrient leaching and stunted growth), overbrowsing by deer, and invasive species.

The Pennsylvania Natural Heritage Program (PNHP) assesses the conservation needs of animal and vascular plant species native to Pennsylvania. While Pennsylvania also hosts a diversity of other life forms such as mosses, fungi, bacteria, and protists, too little is known of these species to assess their conservation status. The goal of this report is to identify areas important in sustaining biodiversity at the species, natural community, and landscape levels and provide that information to more fully inform land use decisions.

Using information from PNHP, County Natural Heritage Inventories (CNHIs) identify areas in the county that support Pennsylvania's rare, threatened, or endangered species as well as natural communities that are considered to be rare in the state or exceptional examples of the more common community types. The areas that support these features are identified as Biological Diversity Areas (BDAs). At a broader scale, CNHIs recognize landscape-level features termed Landscape Conservation Areas (LCAs). LCAs identify areas of relatively intact natural landscape, such as large areas of forest unbroken by roads or other fragmenting features, areas which function as a corridor connecting patches of natural landscape, and regions in which a high number of other biodiversity features are concentrated.

A description of each area's natural features and recommendations for maintaining its viability are provided for each BDA and LCA. Also, in an effort to provide as much information as possible focused on planning for biodiversity conservation, this report includes species and natural community fact sheets, references and links to information on invasive exotic species, and mapping from other conservation planning efforts such as the Pennsylvania Audubon's Important Bird Area Project. Together with other land use information, this report can help to guide the planning and land management necessary to maintain the ecosystems on which our living heritage depends.

The natural landscape is best described as an ecosystem, a term that describes a group of interacting living organisms and the physical environment they inhabit. Climate, topography, geology, and soils are particularly important factors in the development of ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains). These combined factors provide the framework for locating and identifying exemplary natural communities and species of concern in the county. The following sections provide a brief overview of the physiology, soils, surface water, and vegetation of Crawford County.

Natural disturbances, such as tornados, blow-downs, ice storms, and fires, have historically played a large role in the formation of ecosystems. Human-induced disturbances have also significantly influenced the character of ecosystems. Before European settlement, Native Americans cleared land for agriculture and settlement, and may also have set fires. Human activities since European settlement have been even more dramatically influential in forming and altering the character of Crawford County's ecosystems, greatly modifying the natural landscape while causing extinction of some species and the introduction of others.

Physiography and Geology

A physiographic province is a geographic region united by similar geology and other physical characteristics. Physiography influences a region's topography and climate. These two variables, along with bedrock type, significantly affect 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 regimes, certain plant communities are expected to occur within some provinces and not others.

Crawford County lies almost entirely within the Northwestern Glaciated Plateau Section of Pennsylvania's Appalachian Plateaus Province. A small section in the extreme southeastern portion of the county lies within the High Plateau Section of the same province (figure 2, pg 2). The Northwestern Glaciated Plateau Section consists of rounded hills and broad, often linear valleys that tend to run in a northwest to southeast direction. Relief is relatively small with elevations ranging from approximately 900 to 1600 feet. The valley floors contain abundant wetlands. The small section of High Plateau in the county that marks the limit of the Wisconsinan glacial advance is not markedly different although the High Plateau, in general, consists of deeper, more angular valleys.

In general, the underlying geology of the county proceeds from older to younger deposits. Devonian age strata (Berea Sandstone through Riceville Formation) stretches from the northwestern corner and intermingles with Mississippian (Shenango and Cuyahoga formations) and Pennsylvanian (Pottsville formation) strata in the central, southern and eastern parts of the county. A mixture of sandstone, siltstone, and shale with some thin marine-based limestone characterize these major formations. While surficial geology in most areas of the country largely determines the character of soils and drainage characteristics, in glaciated areas, the influence of surficial geology is subdued or masked by the materials deposited from the glaciers.

As far as human and ecological history of northwestern Pennsylvania, glaciation and its influence on surface materials and landforms stands as the most important geologic event. Several episodes of glacial advance occurred over the last 300,000 years: the Illinoian (two separate advances) representing the period from 300,000 to 70,000 years ago and the Wisconsinan (five separate advances), representing the most recent glaciation – 70,000 to 12,000 years ago.

With each advance, the sheets of glacial ice pushed and scraped the land surface, picking up rock and soil, freezing it in place and depositing upon their retreat. Features such as end and terminal moraines are the result of such deposits. These unsorted deposits are known broadly as till. Other features like kames, kame valleys, and eskers are deposits of material from water flowing under, adjacent to or through the glaciers. Because the materials were suspended and moved by water, they tend to be more sorted than typical glacial till and contain high percentages of sand and gravel. The glaciers that extended into northwestern Pennsylvania carried material from the Niagara escarpment in the northern U.S. and Canada. That material contained large amounts of limestone-based (calcareous) material. These calcareous materials continue to supply minerals to streams, lakes, and springs throughout the region and as a result, these natural systems are much more able to resist the rapid swings in pH that those of northeastern Pennsylvania and New York experience from acid precipitation. This fact alone contributes greatly to the high diversity and uniqueness of northwestern Pennsylvania and Crawford County ecology and ecosystems.

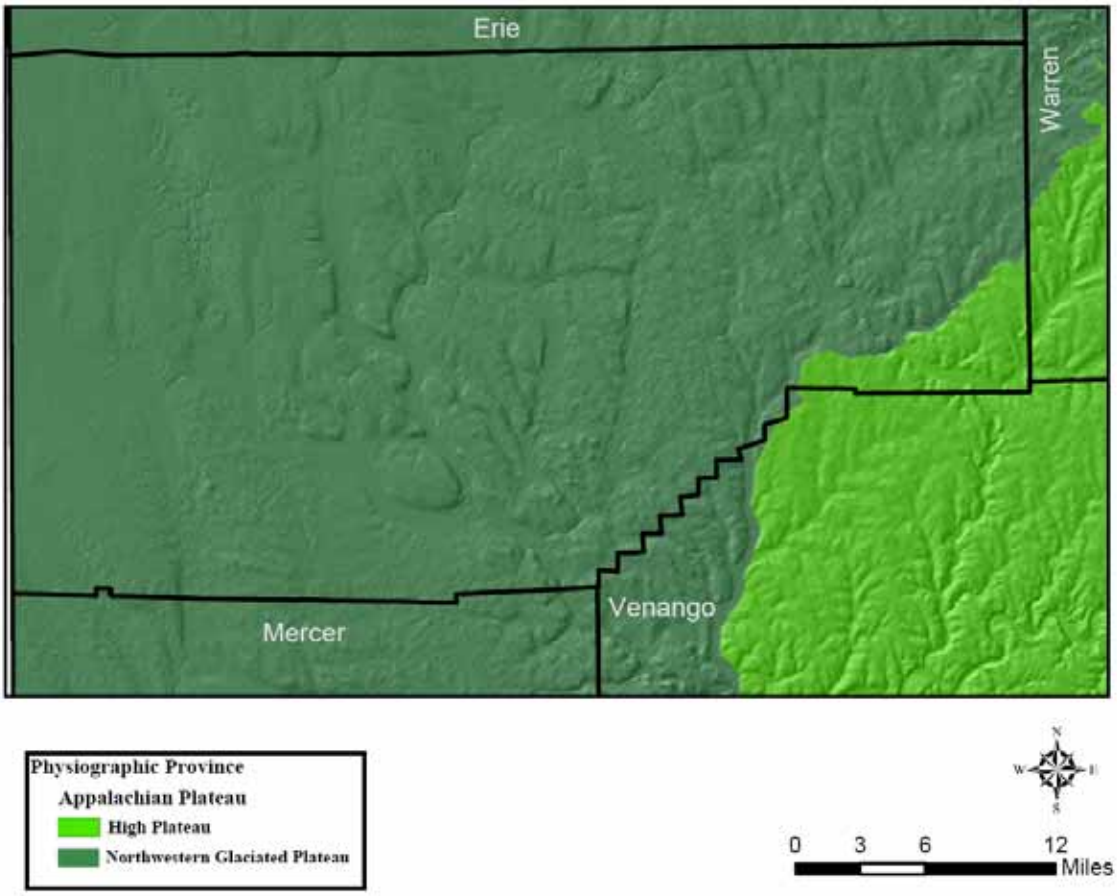


Figure 2. Physiographic Provinces of Crawford County

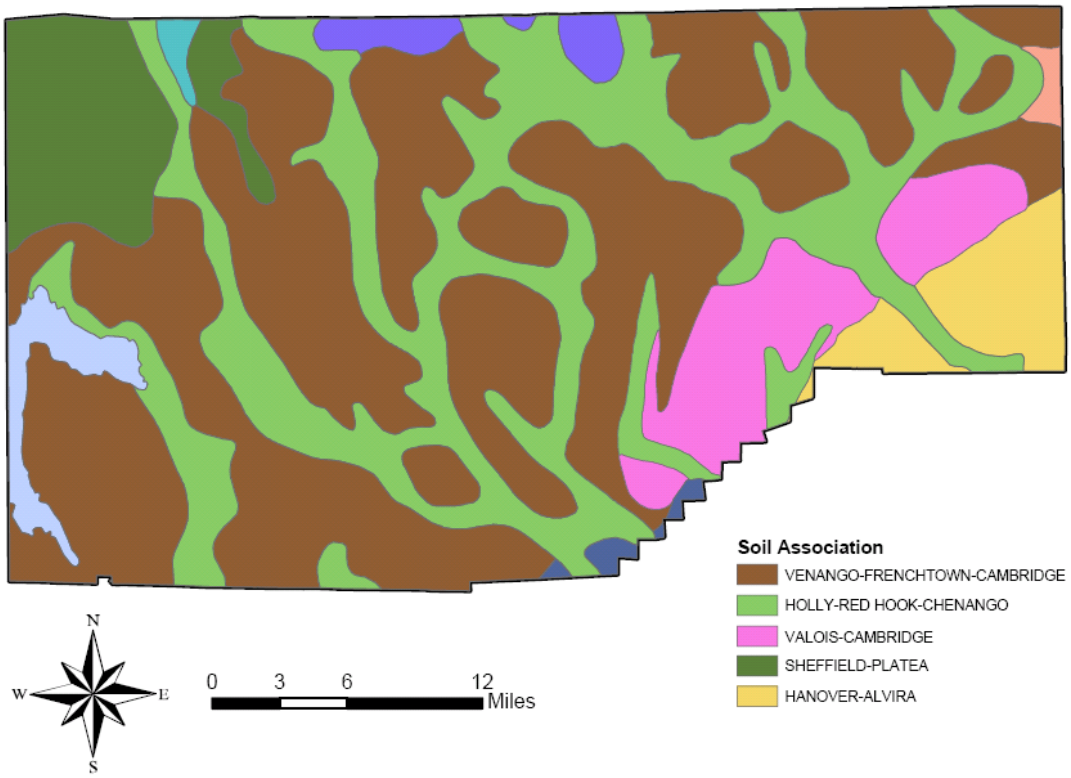


Figure 3. Soil associations of Crawford County

Soils

Soil character exerts a strong influence on vegetation, as all plant species have individual requirements for nutrient availability, moisture levels, and pH level. A soil association is a natural grouping of soils based on similarities in climatic or physiographic factors and soil parent materials. It may include a number of soil types provided they are all present in significant proportions (Canadian Soil Information System, 2003). The soils of Crawford County have been described in the *Soil Survey of Crawford County, Pennsylvania* (USDA, 1988). Table 3 summarizes information from the Soil Survey about soil associations found in Crawford County.

Table 3. Soil Associations of Crawford County

Soil Association	Parent Materials	Description	% of County	Land Use
Venango-Frenchtown-Cambridge	Material weathered from glacial till	Deep, moderately well drained to poorly drained, nearly level to moderately steep soils on uplands	60	Most prevalent usage is dairy farming. More-sloping soils are used for general farming, and steeper areas for pasture, wildlife, or recreation. Cultivation requires artificial drainage and erosion control. Development is limited by restricted permeability and a high water table.
Holly-Red Hook - Chenango	Material weathered from stream deposits and glacial outwash	Deep, very poorly drained to somewhat excessively drained, nearly level to sloping soils on floodplains and terraces	22	Dairy farming is most common on poorly-drained areas; large, level, difficult-to-drain areas also in trees and pasture; cash crops grown on better-drained soils. Sloping and moderately steep areas are a source of sand and gravel. Somewhat excessively drained areas are droughty in dry seasons.
Valois-Cambridge	Formed in materials weathered from glacial till	Deep, well-drained and moderately well-drained, nearly level to very steep soils on uplands	9	The most common agriculture is dairy farming; other farming is limited by intermittent drainage and scattered ponded pockets. Large areas are in trees and pasture or reverting to brush. Development is limited by restricted permeability, hummocky topography, and high water table.
Sheffield-Platea	Formed in materials weathered from glacial till	Deep, poorly drained and somewhat poorly drained, nearly level and gently sloping soils on uplands	5	Dairy farming is the most common agriculture, but large tracts are idle or reverting to brush. Cultivation requires drainage. Soil use is limited by high water table and slow permeability.
Hanover-Alvira	Formed in materials weathered from glacial till	Deep, moderately well drained and somewhat poorly drained, nearly level to moderately steep soils on uplands	4	Oil was discovered in this association in Venango County; pasture or idle land is usually dotted with oil wells. Large tracts of level, poorly drained or steep, well drained soil are in trees. Soil use is limited by slow permeability and seasonally high water table.

Vegetation

Forest Communities

Crawford County occupies the western extent of what can be broadly considered the Hemlock-White Pine-Northern Hardwoods region as recognized by Braun (1950). This region encompasses much of the younger landscapes of the glacial sections of lower New England, although forest composition does not change discernibly across the glacial boundary. However, more southerly species and communities advance northward along major river valleys.

Crawford County has a history of extensive agriculture and few substantial, contiguous forests remain except for those associated with the extensive wetlands within the county. In Crawford County, as well as in the region, good examples of the original forest cover of this region are sparse: Tionesta and Hearts Content Natural Areas demonstrate some of the original character of this region with significant cover supplied by conifers. The presence of rhododendron (*Rhododendron maximum*), mountain winterberry (*Ilex montana*), and hobblebush (*Viburnum lantanoides*) are characteristic of these areas and the western extent of this region, in general. Such remnant areas suggest that High Allegheny Plateau forests were once dominated by hemlock and beech, with white pine stands interspersed. Today those species are much less prevalent, while red maple, black cherry, and sugar maple have greatly increased (Whitney 1990, Braun 1950). The herbaceous layer is typified by a few ubiquitous species such as intermediate wood fern (*Dryopteris intermedia*), wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), and partridgeberry (*Mitchella repens*).

A small section of western Crawford County marks the transition from the Hemlock-White Pine-Northern Hardwoods forest region to the Beech-Maple region that stretches west into the Great Lakes states. These forests are characterized by the dominance of American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) with numerous other tree species present, including tuliptree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), white oak (*Quercus alba*), red maple (*Acer rubrum*), and red oak (*Quercus rubra*). The presence of northern-tending shrubs and herbs like red elderberry (*Sambucus racemosa var. pubens*), wild sarsaparilla (*Aralia nudicaulis*), and round-leaved orchid (*Platanthera orbiculata*) are common. In the southern parts of this region, some components of mixed mesophytic forests appear along rivers and streams that serve as a corridor and milder environment for species movement. In Crawford County, the presence of this association is hard to distinguish from the Hemlock-White Pine-Northern Hardwoods association.

Wetland Communities

Wetlands provide essential habitat for many plant and animal species, as well as valuable ecosystem services such as water filtration and flood control. The ecological character of a wetland is influenced by local soil type, disturbance history, bedrock composition, and hydrological regime. Types of wetlands range from forested seeps where groundwater saturates the surface only when heavy precipitation raises the water table, to open marshes that are continuously flooded, to low areas along stream banks that are flooded during high water events, to beaver meadows where the water level fluctuates over relatively long periods of time. Some types of wetlands, such as those that are created by beaver dams, develop very quickly, and major changes can be observed in their character over mere decades. However, other types of wetlands, such as sphagnum bogs, form extremely slowly, their present-day condition resulting from slow ecological processes operating over many thousands of years.

Crawford County holds some of the most extensive wetland complexes in the state with the total coverage of the county by wetlands exceeding 5%. Included are a multitude of seepage feed wetlands, palustrine shrublands, and palustrine forests. Especially large and prominent are the broad, swampy valleys that extend for many miles along streams like Muddy Creek and Sugar Creek and tie together a variety of wetland types and aquatic habitats. A number of highly unique wetlands known as fens and bogs are documented from the county and many are featured in this report as biologically important areas.

Palustrine Forests and Shrublands

The word “palustrine” comes from the Latin root *Palus* meaning “marsh”. Wetlands that are not aquatic (open water) are usually referred to as palustrine. These community types tend to be most extensive and well-developed within the low-lying valleys and floodplains within the county, although the pock-marked glacial landscape of the county supports examples of many different palustrine community types.

Swamps

Many of the palustrine forests within the county feature strong conifer components, mostly eastern hemlock

(*Tsuga canadensis*) and occasional white pine (*Pinus strobus*). In rare cases, American larch (*Larix laricina*) occurs within these forests. Most communities within this category fit into either Hemlock or Hemlock-Mixed Hardwood community types and feature yellow birch (*Betula allegheniensis*), black ash (*Fraxinus nigra*), and red maple (*Acer rubrum*) as common co-dominant overstory species. These communities, commonly referred to as "swamps" or "hemlock swamps" also support a variety of shrubs including winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), spicebush (*Lindera benzoin*), and nannyberry (*Viburnum lentago*). Herbaceous cover can be quite dense with skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), cinnamon and sensitive fern (*Osmunda cinnamomea* and *Onoclea sensibilis*), and various sedges (especially *Carex* spp., e.g. *Carex bromoides*) being among the most prominent and common across many sites. These communities are considered rare at the state-wide level, but are common throughout Crawford County and tend to occupy depressions and the lower sections of many of the broad valleys in the County.

Crawford County features extensive shrub-dominated wetlands that co-occur with palustrine forests and open water wetlands. These shrublands can be classified as a number of different natural community types with some of the most common being buttonbush, alder-ninebark, and highbush blueberry – meadow-sweet wetlands. Species compositions vary, but common shrubs include red-willow dogwood (*Cornus amomum*), red-osier dogwood (*C. sericea*), buttonbush (*Cephalanthus occidentalis*), speckled alder (*Alnus incana*), smooth alder (*A. serrulata*), and winterberry (*Ilex verticillata*). A wide assortment of herbaceous plants forms an often dense layer under and among the shrubs. In cases where open water is a component of the shrubland, emergent vegetation such as water smartweed (*Polygonum amphibium*), arrowhead (*Sagittaria latifolia*), mannagrass (*Glyceria septentrionalis*), and water plantain (*Alisma plantago-aquatica*) will be present in significant numbers.

Fens and Bogs

These wetlands can be considered broadly as shrublands with patches of open, herbaceous dominated vegetation embedded. Sometimes the open areas are more extensive, but even within those areas shrubs are present in often significant numbers. What makes these wetlands unique and consequently naturally rare on the landscape is their unique hydrology and water chemistry.

Bogs are peat-forming wetlands that lie in depressions where the only significant input of water is from precipitation. Some small inlets and outlets may be present but this represents a minor component of the hydrology of these wetlands. Because of the low oxygen and acidic conditions of these wetlands, nutrient uptake is limited and the ability of plants to thrive there is limited. Certain unique plants can flourish under such conditions of low competition for space and light. Mosses, particularly *Sphagnum* spp., are vital in establishing the strongly acidic conditions and are characteristic of many acidic wetlands, primarily bogs. Decomposing *sphagnum* and/or sedges are the essential component of the peat that serves to further distinguish these wetlands.

Fens, like bogs, are peat-forming wetlands. Unlike bogs, they receive other sources of water, most importantly from ground water. Ground water brings nutrients and oxygen into the system and, in certain geological situations, can carry substantial calcium, magnesium and other minerals that buffer and raise the pH of water. These conditions can support some unique plants and natural communities, and there are numerous examples in Crawford County. These are among the most important wetland and community types in the state.

Floodplain Forests

Another category of palustrine forests in the county is floodplain forests. Although not as extensive as the conifer-hardwood swamps described above, they do represent an important element of biological and natural community diversity in the county. Because these communities tend to flood and remain wet only during certain parts of the year, many have been converted to agricultural uses and therefore, good examples of floodplain communities are not common. Also, the geologic history and physical structure of streams define the extent of floodplains that naturally occur along these streams. In Crawford County, Cussewago, Conneauttee, Muddy, and Sugar Creeks tend to have the most extensive and well-developed floodplain forests. French Creek, Oil Creek, and Conneaut Creek have generally narrower floodplain profiles and more agricultural development within the valleys.

These palustrine forests are usually broad-leaf dominated with red and silver maple (*Acer rubrum* and *A. saccharinum*), green and white ash (*Fraxinus pensylvanica* and *F. americana*), shagbark and bitternut hickory (*Carya ovata* and *C. cordiformis*),

basswood (*Tilia americana*), and swamp white oak (*Quercus bicolor*) as characteristic and often dominant species. Interspersed within these forests are vernal pools, shrub swamps, and open water channels that host an additional suite of species and also represent specific natural communities.

Habitat Disturbance

Disturbances, whether natural or man-made, are pivotal in shaping many natural communities. The nature, scale, and frequency of disturbance are influential in the evolution and occurrences of natural communities and associated rare species. Examples of natural and human-influenced disturbance events are presented in Table 4.

Table 4. Examples of natural and anthropogenic disturbances (adapted from Scott et. al. 1999).

Natural Events
Fire
Disease epidemics
Flood
Drought
Hurricane/tornado/landslide
Ice storm

Anthropogenic Events
Residential development
Road, trail, railroad line
Telephone line, utility line
Dam, canal
Commercial development
Modern agriculture
Mining
Logging
Grazing

Natural Disturbances

Natural disturbances such as fire and flooding can benefit certain natural communities and species. For example, periodic fires are needed to maintain pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) barrens. Burns in such areas stimulate new growth in these species and exclude 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 hold excess water, thus reducing the scale of downstream flooding.

In contrast, deer have been blamed for a number of negative impacts on the Pennsylvania flora and fauna (Rhoads and Klein 1993, Latham et al., 2005). Over-browsing can result in a lack of forest regeneration, a reduction in the diversity and density of forest understory, decreased songbird diversity, and direct loss of rare plants (Yahner 1995). For example, forests that were once dominated by oak are now converting to red maple in large part due to deer pressure (Abrams 1998).

Human Influenced Disturbances

In many cases, human-caused disturbance has clearly been destructive to natural habitats and the species associated with them. In Crawford County, logging and mining have played major roles in altering the landscape. Mining, which has altered topography and vegetation, is not as active in the country as it once was. Reclaimed mine lands now provide valuable nesting and wintering habitat for grassland bird species such as the Short-eared Owl (*Asio flammeus*), Northern Harrier (*Circus cyaneus*) and Henslow's Sparrow (*Ammodramus henslowii*).

Although some species, including several rare species, are aided by on-site disturbance (e.g. clearing or mowing), in general, human-caused disturbance negatively impacts natural systems. With wide-ranging anthropogenic disturbance, some plant and animal species may become completely extirpated from an area because they cannot compete or survive under newly created conditions. Human disturbances are now a permanent part of the landscape, but decisions about the type, timing, and extent of future disturbances are important to the remaining ecological diversity.

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

The introduction of non-native species into Pennsylvania began with the initial European settlement in the 17th century (Thompson 2002) and continues to this day. Plants and animals have been deliberately introduced for a variety of reasons including food sources, erosion control, landscaping, and game for hunting and fishing. Other species have been accidentally introduced as 'stowaways' through increases in global trade and transportation. Many of 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 are ones that reproduce rapidly, spread quickly over the landscape and have few, if any, natural controls such as herbivores and diseases to keep them in check. Invasive plants share a number of characteristics that allow them to spread rapidly and make them difficult to remove or control:

1. Spreading aggressively by runners or rhizomes
2. Producing large numbers of seeds that survive to germinate
3. Dispersing seeds away from the parent plant through various means such as wind, water, wildlife, and people

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

Garlic mustard (*Alliaria petiolata*), an invasive herb of forests and woodlands. Photo by Robert Coxe.

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

Control methods for these invasive species can range from hand pulling to mechanical methods (e.g. mowing) to herbicides. A variety of tools have been developed for control of several of these species (e.g. the WeedWrench and the Honeysuckle Popper). Herbicide control should be only 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 each different invasive species present on a site may require a different technique for effective control. Generally speaking, control efforts should be concentrated before these species disperse their seed for the year. Specific control methods for these species can be found at: http://www.invasive.org/eastern/

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

Table 5. Significant current or **potential** invasive plant species in Crawford County.

Species	**Description and Threat**
Tree-of-heaven (*Ailanthus altissima*)	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, out competing native vegetation.
Japanese stiltgrass (*Microstegium vimineum*)	A fast-spreading grass that is typically found along forest roads, streambanks, and other cool moist habitats. Out competes native vegetation and may have an effect on animal species that use streamside microhabitats.
Japanese knotweed (*Polygonum cuspidatum*) Giant Knotweed (*Polygonum sachalinense)*	These large fast-growing exotics displace natural vegetation and greatly alter natural ecosystems. Typically found along stream banks and other low-lying areas, as well as old home sites and waste areas.
Reed canary grass (*Phalaris arundinacea*)	This exotic grass readily colonizes in disturbed areas and grows in thick colonies able to exclude native species.
Mile-a-minute (*Polygonum perfoliatum*)	A vine that invades open and disturbed areas and scrambles over native vegetation in open and disturbed areas, limiting their photosynthesis. This species is listed as a noxious weed in Pennsylvania.
Purple loosestrife (*Lythrum salicaria*)	An herbaceous wetland invasive that is present at scattered sites throughout the county. Once established in a wetland this species is difficult to eradicate and will displace native species.
Eurasian milfoil (*Myriophyllum spicatum*)	An aquatic invasive that was originally imported for the aquarium trade, Eurasian milfoil can quickly spread and out compete native aquatic vegetation.
Garlic mustard (*Alliaria petiolata*)	An increasingly common invasive biennial herb spreading through natural areas throughout the region. Recent scientific evidence has shown that this species can disrupt microrhizyl relationships that trees depend on for their growth.
Japanese honeysuckle (*Lonicera japonica*) Oriental Bittersweet (*Celastrus orbiculatus*)	These species of vines cover and out compete native vegetation as well as girdle trees by twining up them.
Bush honeysuckles (*Lonicera tatarica, L. morrowii, and L. maackii*)	Found in a variety of environments from wetlands to uplands. Competes with native plants for moisture, nutrients, and pollinators. Fruits do not provide high energy food for migrating birds.
Canada thistle (*Cirsium arvense*)	A Pennsylvania listed noxious weed. Invades a variety of dry to moist habitats displacing native plants and disrupting community processes.
Spotted knapweed (*Centaurea biebersteinii*)	Competes with native species by capturing moisture and nutrients. Poses a high threat to shale barrens and other dry habitats.
Autumn olive (*Elaeagnus umbellata*)	A drought-tolerant species that thrives in many soil conditions. It threatens native ecosystems through competition and alteration of natural succession patterns and nutrient cycling.
Japanese barberry (*Berberis thunbergii*)	Commonly planted ornamental that escapes and forms dense stands in a variety of habitats, including forests and wetlands, displacing native vegetation.
Winged burning bush (*Euonymus alatus*)	A shrub that can form dense thickets that displace native woody and herbaceous plants.
Multiflora rose (*Rosa multiflora*)	Widely planted shrub that invades a variety of habitats excluding most native shrubs and herbs. May be detrimental to the nest of native birds.
Privet (*Ligustrum spp.*)	These species can form dense thickets in floodplains, forests, wetlands, and fields that can out compete native vegetation.

Invasive Animal Species

In additional to invasive plants, Pennsylvania is now home to several exotic species of animals including mammals, birds, fish, and reptiles. 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 encounters in our homes and built areas.

Table 6. Significant current or **potential** invasive animal species in Armstrong County.

Species	Description and Threat
Hemlock Woolly Adelgid (*Adelges tsugae*)	This species is causing severe damage to Eastern Hemlock (*Tsuga canadensis*) killing up to 90% of infected trees greatly modifying ecosystems.
Gypsy Moth (*Lymantria dispar*)	Feeding preferentially on oak trees (*Quercus 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 (*Tomicus piniperda*)	A pest of pine trees (*Pinus spp.*) this species damages terminal shoots stunting the growth of trees thus weakening them and increasing their susceptibility to other pests.
Sirex Woodwasp (*Sirex noctilio*)	An up-and-coming pest, this species attacks living pines and is likely to cause great amounts of damage to pine plantations throughout the nation.
Emerald Ash Borer (*Agrilus planipennis*)	Currently known to a few sites in Pennsylvania, Emerald Ash Borer has caused large scale ash mortality in neighboring states.
Multicolored Asian Ladybird Beetle (*Harmonia axyridis*)	Preying on native insects and invading our houses each winter, this species was likely introduced in an attempt to control non-native aphids.
Zebra Mussel (*Dreissena polymorpha*)	Introduced from dumped ballast water, this species has the potential for disastrous effects on aquatic ecosystems and local economies.
Asian Clam (*Corbicula fluminea*)	Found in extremely high densities along major tributaries and rivers, this species is directly competing with native mussels for food and habitat.
Rusty Crayfish (*Orconectes rusticus*)	Found in many of our streams, this recent invader is displacing native crayfish, reducing fish populations by feeding on young fish, and generally disrupting aquatic systems.
Round and Tubenose Gobies (*Neogobius melanostomus* and *Proterorhinus marmoratus*)	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 (*Ctenopharyngodon idella*)	A voracious herbivore, this species was introduced to control weeds in eutrophied lakes. However, it now causes significant damage to native wetland vegetation responsible for reducing nutrients in water-bodies.
Common Carp (*Cyprinus carpio*)	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 (*Channa spp.*)	Prized as a food species in Asia, this species was recently introduced to the East Coast and has become established quickly. Currently not found in Crawford it should be monitored for.
House Sparrow (*Passer domesticus*)	Generally found any place humans are, this species can cause crop damage, but mainly competes with small, native cavity nesting birds.
European Starling (*Sturnus vulgaris*)	Competing directly with native cavity-nesting birds, this species also causes severe crop damage.
Rock Dove (Pigeon) (*Columba livia*)	Generally found around human structures, this species can cause crop damage, is a known carrier for several serious human diseases, and causes a general mess where it nests and roosts.
Mute Swan (*Cygnus olor*)	While considered pretty by some, this European invader causes significant damage to wetland vegetation that it "grubs" out during feeding. Additionally, it is fiercely competitive and will exclude all other native waterfowl from its nesting territory to the point of killing intruders.
House Mouse (*Mus musculus*)	Ubiquitous throughout the world, this species carries many diseases, competes directly with many native species, and can cause a significant damage to crops and structures.
Norway Rat (*Rattus norvegicus*)	Generally a pest of human infrastructure, the Norway Rat is also found around rivers and other water systems. Known as a carrier for many diseases, this species is a threat anywhere it occurs.
House Cat (*Felis silvestris*)	House Cats, both domestic and feral, can individually kill several small animals each day. Summed among the great number of House Cats out-of-doors, this adds up to *billions* of small amphibians, reptiles, birds, butterflies, and mammals each year in the United States.

Overall Invasive Species Recommendations

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

Hemlock Woolly Adelgid infestation along a hemlock branch. Photo courtesy of the Connecticut Agricultural Experiment Station Archives

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

- Biological Diversity Areas (BDAs) identified in this report can serve as useful high conservation value "focus areas" for the control of invasive species.

- Many education resources exist regarding invasive exotic species. Regional groups such as the Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) can help with funding opportunities and educational outreach on invasive species.

- 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, purple loosestrife (*Lythrum salicaria*), giant hogweed (*Heracleum mantegazzianum*), kudzu (*Pueraria lobata*), mile-a-minute (*Polygonum perfoliatum*), Canadian thistle (*Cirsium arvense*), and multiflora rose (*Rosa multiflora*) are on the list.

- The Pennsylvania Fish & Boat Commission maintains a list of aquatic nuisance species that are prohibited from possession, sale, barter, or distribution within the Commonwealth (PA Code 58.71.6). This list includes the zebra mussel and the rusty crayfish among others.

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.

References:

PA Department of Conservation and Natural Resources. (n.d.). Hemlock Woolly Adelgid. Retrieved February 14, 2007 from http://www.dcnr.state.pa.us/forestry/woollyadelgid/index.aspx).

Swearingen, J., K. Reshetiloff, B. Slattery, and S. Zwicker. 2002. Plant Invaders of Mid-Atlantic Natural Areas. National Park Service and U.S. Fish & Wildlife Service, Washington, D.C. 82 pp.

Thompson, Sue A., editor. 2002. *Biodiversity in Pennsylvania: Snapshot 2002*.Pennsylvania Biodiversity Partnership, Pittsburgh, Pennsylvania.

Review of the Animals of Crawford County

Although this Natural Heritage Inventory focuses on the rare, threatened, and endangered species and habitats that compose the biodiversity found within Crawford County, this region is home to a number of more common species. This section provides an overview of these species and makes general conservation recommendations for these taxa.

Mammals of Crawford County

Crawford County's mammal habitats can best be described as wetlands and floodplains in a glacial landscape. With over 90% of the county contained within the glaciated Pittsburgh Plateaus section of the Appalachian Plateaus Province and only a small portion of the eastern border in the Pittsburgh Low Plateaus, the landscape is very different from the more heavily forested counties to the west and south where forest cover is deep and substantial. Since approximately 20% of the county is contained within public lands including State Game Lands, Pymatuning State Park, Erie National Wildlife Refuge, and county parks, there are many opportunities for wildlife watching and recreation in the county. Pymatuning Reservoir, a former glacial wetland that has been dammed and enlarged, is the most imposing feature of the county and provides a diverse range of habitat types ranging from marshes and other wetlands to broad meadows and small woodlots, although development has encroached along portions of the shoreline.


White-footed mouse
photo source: Dick Cooper, USFS

Deer hunting remains one of the county's significant non-agricultural resources. During the 2002 season, over 13,000 deer were taken in the various seasons, although over 10,000 of these were antlerless deer. Bear, however, appear to be somewhat limited, with harvests ranging from 0 to 7 bears annually. Since accessibility would not seem to be an issue for hunting bear in Crawford County, it is more likely that habitat plays a significant part in available numbers. Although wetlands appear to be plentiful across much of the county, development and high human population densities may limit the occurrence of bear. Waterfowl hunting is likely a more popular draw in Crawford County for those hunters after something other than deer.

Many of the species occurring throughout the county are quite unremarkable in that they possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout Pennsylvania. These species are termed "generalists" and include the northern short-tailed shrew (*Blarina brevicauda*) and several other shrew and mole species, white-footed mouse (*Peromyscus leucopus*), as well as skunks, red fox, coyote, and the ubiquitous eastern chipmunk. All of these species occur throughout the diverse forests and widespread marshes and other wetland habitats within Crawford County and are in no jeopardy of disappearing from the landscape.


Snowshoe hare
photo source: Harry Walker, WPC

Other species have fairly restricted habitat needs and are termed "habitat specialists". They may be restricted to grassland type habitats, 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 (grasslands and meadows), muskrats and beaver (wetlands and streams) and most, if not all, of the bat species (caves and mines).

Wetlands and streams provide habitat for mammals and serve as corridors for dispersal. 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 is highest. It is not uncommon to find 6 species of shrews, 9-10 species of rodents, including the beaver (*Castor canadensis*), 4-5 species of weasels, including the mink (*Mustela vison*), 6-7 species of bats as well as sign of various medium-sized carnivores, squirrels, bear and deer in these habitats.

Openland in the form of wet meadows and reverting grasslands are habitat types that are fairly common in Crawford County. Normally a product of former and present agricultural practices, these habitats are also found in areas that are somewhat flood-controlled. The most well known mammal occurring in these openlands is the meadow vole (*Microtus pennsylvanicus*). Meadow voles are so successful at dispersing throughout the state that they are sometimes

found in grassy forest clearings within large tracts of forest, having made their way there along the forest roads, pipelines, and power right-of-ways. Several other species of mammal are known to occur within openlands, including the eastern cottontail rabbit (*Sylvilagus floridanus*), ground hog (*Marmota monax*), and red fox (*Vulpes vulpes*).

While openlands as mentioned above are familiar to many, one type that is more often than not overlooked is scrub-shrub openlands. Although commonly made up of scrub oak, blueberry and other low-growing plants, they do not have the large expanses of canopy high overhead as found in forests. The understory in these types of habitats is fairly open in that there are few very low-growing plants except in areas that may have suffered from recent burns, common along these dry sites. These habitats are extremely important to several species as either foraging areas or nesting sites including the black bear (*Ursus americanus*), Appalachian cottontail (*Sylvilagus obscurus*), and varying, or snowshoe, hare (*Lepus americanus*).

Bats are a common component of the wetlands, streams, and forests of Crawford County, most often encountered during the summer months along the streams and open bodies of water. During the summer, floodplain forests along the Pymatuning Reservoir may provide roost sites for many bat species as they raise their young. One rarely encountered bat species, the silver-haired bat (*Lasionycteris noctivagans*) may occur within Crawford 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, bats most likely disappear from the majority of the county as the caves and mines that are important to them during the winter are lacking. Hibernating bat species, such as the little brown bat (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*), probably migrate either to large limestone mines in nearby counties or south to caves in Fayette and Somerset Counties. Several species such as the hoary bat (*Lasiurus cinereus*) and red bat (*Lasiurus borealis*) don't over-winter in the state at all and migrate further south to the Carolinas and Florida and are thought to spend their winter months in hibernation under deep patches of leaf and forest floor litter.

Silver-haired bat

Historically, several species have either disappeared from much of Pennsylvania or their populations had become so low that they were thought to be gone from the state entirely. Two of these species, the fisher (*Martes pennanti*) and the river otter (*Lontra canadensis*) have recently been reintroduced in the state by the Pennsylvania Game Commission in portions of their range where necessary habitat still occurs. Although both of these species have expanded across much of the northern tier counties it is unlikely that the fisher will ever be very plentiful in Crawford County.

Crawford County is very diverse in terms of the habitats available to the mammals of Pennsylvania. In many portions of the state, habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix 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 localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat, or increased predation. These populations may be doomed to what is termed "localized extinction". If enough of these populations disappear from the landscape, these species' existence may be in jeopardy.

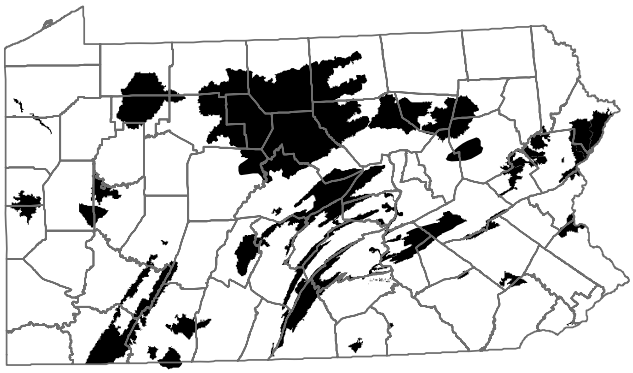

River otter
photo source: John White, California Academy of Sciences

Crawford County has become a popular destination for residents of Pennsylvania during various hunting seasons and has a brisk tourist trade. As the area continues to attract people for its scenic beauty, in the future it may suffer from continued expansion of developments and accompanying infrastructure. Large blocks of forested wetlands and vegetated stream corridors can serve as dispersal corridors to the diverse mammals that occur in the county. These corridors may be seriously impacted as human population densities continue to rise. Continued vigilance and proper management will ensure that the mammals found in Crawford County will not disappear and may grow in the future, providing opportunities to all Pennsylvanians for viewing the state's mammalian wildlife.

Important Mammal Areas (IMAs) of Crawford County

Crawford County includes portions of two Important Mammal Areas (IMAs): Pymatuning Wildlife Management Area/SGL 214 and Maurice K. Goddard State Park. (Figure 7). Some of the IMAs extend beyond Crawford County; therefore, features described below pertain to the entire IBA and are not necessarily confined to the county.

Note: This information is adapted from the IMA Project site descriptions in Murray 2002. Additional information can be found at http://www.pawildlife.org/imap.htm.



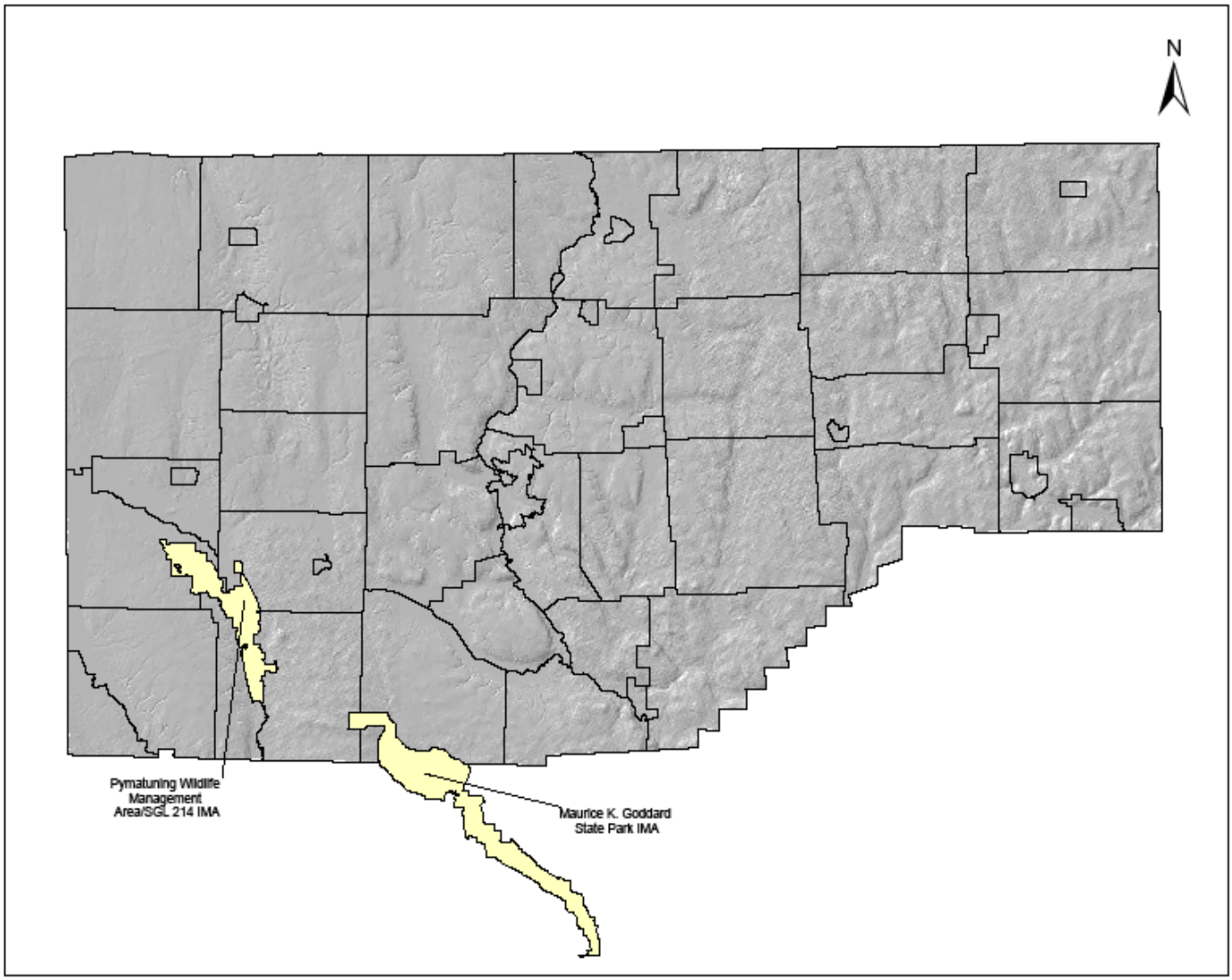


Figure 7. Important Mammal Areas of Pennsylvania (top) and in Crawford County (above)

Maurice K. Goddard State Park IMA

Maurice K. Goddard IMA crosses into southern Crawford County, but most of this site is located in Mercer County. This IMA contains a variety of habitats that provide habitat for many mammal species. Habitat types include deciduous, mixed hardwood, and riparian forests, as well as open fields, an upland swamp, an extensive rhododendron grove, and early and mid-successional habitats. State Game Land #270 is also included within this site. M.K. Goddard State Park also offers numerous wildlife programs every year.

This area satisfies the following IMA criteria:

- There are significant populations of species or subspecies with specific habitat requirements.
- There are significant aggregations of mammals in one or more seasons.
- There is a confirmed viable local population of species listed as declining, vulnerable, or candidate species.
- Declining, vulnerable, or candidate species or subspecies regularly occur at the site during one or more season.

Conservation Concerns
Ownership of Maurice K. Goddard IMA is almost equally distributed between public and private entities. Presently, forestry practices, recreation, wildlife conservation, conservation/natural area, and public water supply are the primary uses for this land while agriculture plays a secondary role. Potential threats to this site include invasive plant species, non-point source pollution, unsustainable forestry practices, and residential development.

Pymatuning Wildlife Management Area/SGL #214 IMA

The Pymatuning State Park and State Game Land (SGL) #214 IMA is a 33,000 acre section of state-owned land located in the southeastern portion of the wetland. In addition to the man-made lake, several remnant emergent, forested, and shrub-scrub wetlands provide habitat to wetland species. There is also an abundance of other habitat types, including deciduous and coniferous forests and old fields. Hardwood forest exists on the fringes, and on numerous islands found in both the upper and lower impoundments. The heavily managed Controlled Hunting Area of SGL # 214 contains a mix of grasslands and agricultural fields that support grassland species.

This area satisfies the following IMA criteria:

- There are significant populations of species or subspecies with specific habitat requirements.
- There are significant aggregations of mammals in one or more seasons.
- There is a confirmed viable local population of species listed as declining, vulnerable, or candidate species.
- Declining, vulnerable, or candidate species or subspecies regularly occur at the site during one or more season.
- There are wild populations of mammals that can be viewed in their natural habitat for education.
- The site is a natural area associated with an established educational program that interprets the natural history of resident mammals.

Conservation Concerns
Although most of the Pymatuning, Hartstown Complex is State-owned and protected, some threats to mammals and their habitats still exist. Invasive species dominate much of the vegetation on both Pymatuning State Park and SGL #214. Canada goose and the common carp are in high numbers that some consider threats to the habitat of other wetland species. The combination of diverse habitats, the resources and interests of Pymatuning State Park and the Game Commission, a supportive local community, and an already high visitation rate, present opportunities for expanding awareness and education is this IMA. Threats to this site are closure of the open habitats due to natural succession and exotic species


American beaver
photo source: Kansas Dept of Parks and Recreation

Birds of Crawford County

The Pennsylvania landscape is a mosaic of unique environments that provide habitat to a rich diversity of wildlife species. Due to the nature of these varying habitats, Pennsylvania is an important state for breeding, migrating, and wintering birds. There are several habitat types in Pennsylvania important for bird conservation. These areas include large contiguous forest blocks, early-successional shrublands and grassland, as well as wetland habitats (Rosenberg and Robertson 2003). These critical habitats are increasingly threatened by agricultural, industrial, and residential development. Protection and responsible management of these ecosystems is necessary for the maintenance of healthy bird populations throughout the state.

Crawford County lies within the glaciated Pittsburgh Plateau physiographic region of Pennsylvania. The last Ice Age had an enormous impact on the topography of this county and has left a number of unique natural communities. The general landscape is hilly and rolling with numerous streams that have cut relatively deep valleys throughout the county. Palustrine forests, fens, bogs, emergent marshes, and northern hardwood forests are just a few of the unique natural communities found within this county. Due to the size and quality of these habitats, the Audubon Society of Pennsylvania has named five areas within the county as Important Bird Areas, because they serve as important wintering and breeding grounds for a number of species. This includes Pymatuning State Park, Conneaut Marsh, the Cussewago Creek Valley, the Erie National Wildlife Refuge (ENWR), and part of M.K. Goddard State Park.

Sora photo source: Ron Austing

Marsh and Wetland Dependent Birds

Of the many natural communities in Crawford County, wetlands are by far the most abundant habitats available to birds. A combination of geology, topography, and human influenced landscape changes has created a number of large wetland complexes throughout the county. However, wetlands and marshes are an imperiled habitat across the state due to filling or draining for agriculture, land development, highway construction, dams, peat mining, and human degradation. From 1956-1979, 38% of Pennsylvania's wetlands with emergent vegetation were drained, filled, or succumbed to succession. This is equivalent to a loss of 1800 acres a year (PA Department of Conservation and Natural Resources 2006). Changes to the supporting landscape of wetlands also have negative effects on the hydrology and water quality of these habitats. Habitat loss, degradation, and poor water quality are some of the biggest threats to populations of marsh and wetland dependent birds.

Least Bittern
photo source: Ron Austing

Wetlands are extremely important habitats for avian species. Of the 1,900 species of breeding birds in North America, 138 have been recognized as wetland dependent (Stewart 2001). These birds use wetlands for feeding, nesting, breeding, or shelter at some point during the breeding season. Wetlands are also important wintering grounds for a number of waterfowl and northern species and stopover points for migrating birds. Additionally, many species that do not explicitly require wetlands for nesting often use surrounding habitats such as shrub-scrub areas for breeding and associated activities.

Wetlands are classified as transitional lands between terrestrial and aquatic systems. They are communities dominated by water for some part of the growing season throughout each year. Saturation by water determines the soil development, which in turn influences the type of plants and animals using that habitat. Wetlands differ regionally based on topography, geology, climate, hydrology, vegetation, and human influences (Stewart 2001). Typical plants found in wetlands include sedges, grasses, ferns, shrubs, and some trees (Fike 1999). Snags, or dead trees, are also fairly common and are

utilized by many cavity-nesting birds, such as woodpeckers (*Picidae* sp.) and Wood Ducks (*Aix sponsa*). The complexity of wetlands allows different species to utilize microhabitats within the larger ecosystem.

Sedge Wren
Photo source: Ron Austing

Common species using wetlands include waterfowl, shorebirds, herons, rails, bitterns, blackbirds, swallows, and sparrows. Many marsh or wetland dependent birds are secretive, cryptic, and often are not flushed when disturbed. Marshes can also be difficult areas to survey. Many wetland dependent birds are focal species of concern for the Pennsylvania Natural Heritage Program (PNHP). These include, Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), American and Least Bittern (*Botaurus lentiginosus* and *Ixobrychus exilis*), Black Tern (*Chlidonias niger*), Sedge and Marsh Wren (*Cistothorus platensis* and *C. palustris*), Prothonotary Warbler (*Protonotaria citrea*), Virginia and King Rail (*Rallus limicola* and *R. elegans*), Sora (*Porzana carolina*), Common Moorhen (*Gallinula chloropus*), and American Coot (*Fulica americana*). Most of these species have been seen in Crawford County and some are currently or have historically been known to breed here.

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 (Kushlan et al. 2001). Programs such as the North American Waterbird Conservation Plan (NAWCP), is a cooperative international initiative that sets goals and a conservation framework for waterbirds and their habitats at all regional levels throughout the Americas. Integrated management plans and continued research on these secretive birds are necessary for further conservation and management for these populations of declining birds.

Forest Interior Species

Forest interior is defined as large, contiguous forest that is 300 feet from a road or edge (DCNR 2006). It is generally related to the size and shape of a patch of forest, with a large patch of forest having more interior forest. Forest interior species, specifically birds, tend to nest away from edges and some species require a minimum amount of interior forest in order to nest. Large, contiguous interior forest is a critical habitat for many neotropical songbirds and birds of prey. However, interior forest is declining on a statewide basis due to suburban sprawl and land development, such as building roads and utility corridors. Approximately seventy percent of Pennsylvania's remaining core forest is found in small patches of 5,000 acres or less (PA DCNR 2006). Crawford County does not retain a large amount of interior forest, and roads and agriculture have fragmented much of the forested land. However, several large forest blocks are located in the northeast and northwest corners of the county. Since there is little interior forest remaining in the county, those areas become increasingly important for both residents and migrants.

Cerulean Warbler
Photo source: Ron Austing

Forest interior dwelling bird species are dependent upon large tracts of forest for reproduction. These birds include neotropical migrant songbirds, residents, and short-distance migrants. Recent declines in these population can be attributed to forest fragmentation and direct habitat loss (Jones et. al. 2000). Increased forest edges, created by forest management practices, such as logging and gas line development, can expose nesting birds to greater dangers, such as brood parasitism and nest predation. For example, many forest songbirds nesting near edges, easily fall prey to nest parasitism by Brown-headed Cowbirds (*Molothrus ater*), which eject host nest eggs and lay their own for other birds to raise (Robertson and Norman 1976). Birds such as Chestnut-sided Warbler (*Dendroica pennsylvanica*) and Wood Thrush

(*Hylocichla mustelina*), cannot recognize cowbird eggs, so they raise them as their own (Jones et al. 2000). Past research has identified numerous negative impacts of forest fragmentation on forest interior bird species.

Worm-eating Warbler
Photo source: Ron Austing

The avifaunal diversity of interior forest blocks is vast. The general composition of these communities includes a variety of warblers, vireos, owls, woodpeckers, and hawks. Several species of commonly occurring forest birds in Pennsylvania are high priorities in the multi-agency Partners in Flight (PIF) program launched to identify declining populations of migratory birds and address the conservation and management needs of species before they become threatened or endangered. Forest interior bird species on the PIF list in Pennsylvania include Kentucky Warbler (*Oporornis formosus*), Worm-eating Warbler (*Helmitheros vermivorus*), Wood Thrush (*Hylocichla mustelina*), Canada Warbler (*Wilsonia canadensis*), and Cerulean Warbler (*Dendroica caerulea*). Other forest interior songbirds occurring in Pennsylvania include Scarlet Tanager (*Piranga olivacea*), Blue-headed Vireo (*Vireo solitarius*), Acadian Flycatcher (*Empidonax virescens*), Hooded Warbler (*Wilsonia citrina*), Black-throated Blue Warbler (*Dendroica caerulescens*), and Louisiana Waterthrush (*Seiurus motacilla*).

Although the conservation of rare and endangered species is important, there is also a need for sustaining populations of more common species. Efforts, such as projects by Partners in Flight, Audubon Pennsylvania, and The North American Bird Conservation Initiative (NABCI) are focused on reversing the decline of neo-tropical landbird migrants and sustaining healthy populations of native birds (Rosenberg et al.1999). Common forest birds include the Scarlet Tanager (*Piranga olivacea),* Ovenbird (*Seiurus aurocapillus*), Black-throated Green Warbler (*Dendroica virens*), Black and White Warbler (*Mniotilta varia*), Acadian Flycatcher (*Empidonax virescens*), Hairy Woodpecker (*Picoides villosus*), Pileated Woodpecker (*Dryocopus pileatus*), Broad-winged Hawk (*Buteo platypterus*), and Barred Owl (*Strix varia*), to name a few. In addition to conservation efforts for rare species, maintaining viable populations of common birds increases natural community diversity and habitat quality.

Sustaining viable populations of birds requires maintaining forest structure to provide a diversity of microhabitats to be exploited by different species. The structural diversity of the forest, such as natural openings that are not caused by edges and complex vertical layering of trees, provides more types of feeding, perching, and nesting habitats (Yahner 2001). Contiguous forest tracks are necessary to support a wider variety of breeding songbirds and more foraging areas for larger birds of prey, like the Northern Goshawk (*Accipiter gentilis).* In addition, there are several forest management implications for the maintenance of healthy breeding populations of songbirds. This includes maximizing the size of forest tracks by keeping larger forest patches near other forest patches, creating irregular edges when timber harvesting, avoiding clear-cutting by leaving some trees of varying species and different size classes, and retaining snags or dead standing trees (Rodewald 2001). Furthermore, pet owners should keep cats inside to prevent predation of songbirds and their nestlings.

Bobolink
photo source: Ron Austing

Grassland birds

Grasslands, open fields, and abandoned farmlands create a unique habitat for a variety of bird species of concern. Historically, grasslands were not a dominant part of the northeastern United States landscape, but they did exist in scattered openings around wet areas such as river floodplains, beaver meadows, wetlands, and coastal sandplains (MA Audubon Society 2006). Other grassland areas may have been created by lightening strikes and burning and clearing by Native Americans. Since colonization, the Northeastern forests have been cleared for agricultural practices that have increased the number of grassland habitats in the region (Eastman 2000).

Although more grasslands have been created in recent years, a large number of grassland birds appear to be declining throughout the East, as documented in the American Breeding Bird Survey (BBS) (Peterjohn and Saur 1999). Most grassland birds, including common species, are facing a decline in population numbers (Brennan and Kuvlesky 2005). Their decline has resulted from changes occurring in grassland habitats. This includes changes in agricultural practices, fragmentation, pesticide application, natural fire suppression, and human development.

Upland Sandpiper
photo source: Ron Austing

Grassland birds are frequently seen in agricultural fields, specifically pastureland, and abandoned fields. These species include the Eastern Meadowlark (*Sturnella magna*), Bobolink (*Dolichonyx oryzivorus*), a number of sparrows, including the Grasshopper and Field Sparrows, (*Ammodramus savannarum* and *Spizella pusilla*), Killdeer (*Charadrius vociferous*), American Kestrel (*Falco sparverius*), and swallows (*Hirundinidae* sp.). There are a number of grassland bird species that are facing endangerment in the state. Those known to breed in Crawford County include Northern Harrier (*Circus cyanus*) and Upland Sandpiper (*Bartramia longicauda*).

In the Eastern United States, there have been some successes in maintaining grassland habitats and creating them from impacted sites. For example, the Henslow's Sparrow (*Ammodramus henslowii*), identified as one of the highest priority species on the National Audubon Society Watch List, has been using reclaimed surface mines for nesting in western Pennsylvania (Matisse et al. 2005, Pahley 1996). Since coal mining is not prevalent in Crawford County, other methods of preserving grassland habitat must be used. Other examples include late mowing of airport fields and crop fields to minimize impact on nesting, brooding, and fledging activities. The Conservation Reserve Enhancement Program (CREP) has also been integral in the conservation and restoration of areas used by breeding grassland birds. This program provides assistance to landowners who restore important bird habitat areas such as grasslands and wetlands (PA CREP 2006).

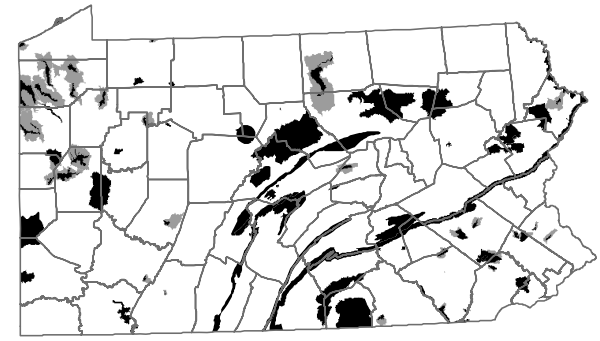
There are many current needs for grassland bird conservation, including research and cooperation on a multi-agency level. Grassland maintenance is difficult due to the natural succession of forests, timing of agricultural practices, and conflicting views of land managers. Programs like CREP will hopefully provide incentive to farmers to restore habitats to healthy conditions. One focus is to restrict mowing fields until late July when most young birds have fledged. A program within Partners in Flight is working to acquire, manage, and restore grasslands and pasturelands in the Northern Ridge and Valley Province to support breeding populations of Henslow's Sparrows and Upland Sandpipers.

Crawford County provides habitat for a large number of species throughout the year. The link below leads to a web site with a list of the bird species that have been documented in Crawford County since 1900.
http://ebird.org/ebird/GuideMe?cmd=decisionPage&getLocations=counties&counties=US-PA-039&locRSID=RS2529247&bYear=1900&eYear=2007&bMonth=1&eMonth=12&reportType=location&parentState=US-PA&chartID=692070720&rowsPerPage=221

Important Bird Areas (IBAs) of Crawford County

Crawford County includes portions of six Important Bird Areas (IBAs): Conneaut Marsh-Geneva Marsh, Cussewago Bottom, Erie National Wildlife Refuge, Hemlock Hill Research Area, M.K. Goddard State Park, and Pymatuning Hartstown Complex. (Figure 8). Some of the IBAs extend beyond Crawford County, therefore, features described below pertain to the entire IBA and are not necessarily confined to the county.

Note: the following information is adapted from the Audubon Pennsylvania IBA site descriptions (Audubon 2002).Additional information can be found at http://pa.audubon.org/iba/.



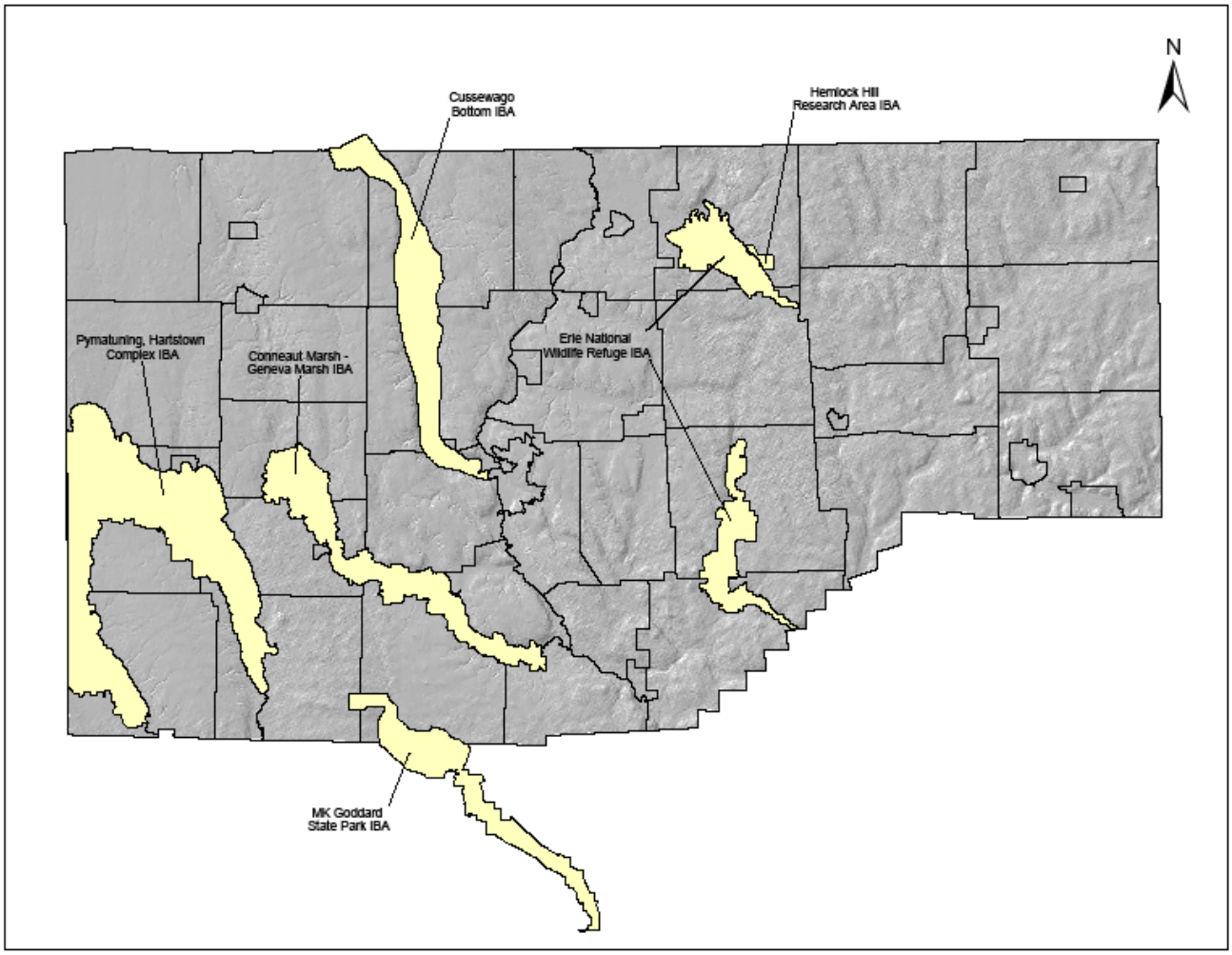


Figure 8. Important Bird Areas of Pennsylvania (top) and in Crawford County (above)

Conneaut Marsh-Geneva Marsh IBA


Great Egret
photo source: Ron Austing

Located about 7 miles southwest of Meadville, Conneaut Marsh-Geneva Marsh is a large (5,559 acre ~2,251 hectares) wetland complex running approximately 13 miles from the outlet of Conneaut Lake almost to French Creek. The Marsh is owned by the Pennsylvania Game Commission (PGC) and managed as State Game Lands (SGL) # 213. The original marsh was formed by glacial outwash. Today, two low-level, roadway dams maintain water levels. The most important avian habitat in the Conneaut Marsh-Geneva Marsh IBA is the extensive wetlands that dominate the area. Approximately 1/3 of the site consists of Pennsylvania's largest remaining emergent marsh, covered by vegetation such as cat-tail and spatter-dock; 1/4 of the site is forested wetland, 1/5 is scrub-shrub wetland, and the remainder includes some open water, mixed forest, and old fields reverting to forest.

This area satisfies the following IBA criteria:

- The IBA supports a significant concentration of waterfowl during the spring and fall migration including: Ring-necked Duck, Wood Duck, American Black Duck, American Wigeon, Hooded Merganser
- The IBA supports numerous shorebirds during the spring migration
- The site supports the state threatened Bald Eagle, state endangered Black Tern, state endangered American Bittern, state endangered Least Bittern, and state endangered Great Egret
- The IBA supports Pennsylvania species of concern including four species with candidate – rare status; Prothonotary Warbler, American Coot, and Marsh Wren
- The IBA is exceptional in size and diversity of wetland types, including emergent, scrub-shrub and forested

Conservation Concerns:
Invasive plant species are presently the greatest threat to the Conneaut Marsh. Left unchecked, both the exotic invasive and native wetland plants form dense stands, encroach on open water areas, and reduce water to vegetation edges. Development along the border of the state lands presents threats to the water quality and long-term integrity of the site.

Cussewago Bottom IBA

Cussewago Creek, its floodplain, and adjacent uplands comprise the 12,682 acre Cussewago Bottoms IBA (referred to as the Bottoms). Cussewago Creek, a low-gradient stream, snakes its way south-southeast through a long and narrow glacial outwash valley, joining French Creek at Meadville. Through the natural processes of stream meander, many cutoffs, oxbows, and backwaters have been created in the Bottoms. Side streams dammed by beavers and frequent flooding maintain the Bottoms' abundant wetlands. Some emergent herbaceous wetlands occur in the Bottoms, notably at State Game Lands #269, but most of the wetlands are shrub-scrub or woody wetlands. Tracts of upland forest and agricultural lands add diversity to the landscape. Shrub-scrub, forested and emergent wetlands comprise the most important avian habitats in Cussewago Bottoms. The open waters of Cussewago Creek and the small lake at SGL 269 are especially important to Bald Eagles and waterfowl. Adjacent upland forests and an abundance of land in early successional stages are important to a variety of neotropical migrants. Seasonally flooded pastures and agricultural fields provide most of the habitat used by migrating shorebirds.

This area satisfies the following IBA criteria:

- The site regularly supports numerous shorebirds during migration periods including Common Snipe, Lesser Yellowlegs, Greater Yellowlegs and occasionally Dunlin
- The IBA is recognized as having exceptional concentration and diversity of birdlife in Pennsylvania with nearly 200 species identified, including a high number of neotropical migrants
- The site supports the state threatened Bald Eagle
- The IBA represents a prime example of lowland stream, floodplain, and wetlands-uplands complex in glaciated northwest Pennsylvania, with extensive bottomland hardwood forest and many habitat types


American Woodcock
photo source: Ron Austing

Conservation Concerns:
Siltation and pollution from agriculture, gas well development, gravel mining, logging, land clearing, and filling occur with varying frequency and effect in the Bottoms. Invasive species, particularly common reed and reed canary grass, have taken over some areas. Residential development is perhaps the greatest future threat to this IBA, as idle farms that currently provide a diversity of bird habitat are beginning to be sub-divided.

Erie National Wildlife Refuge IBA

Erie National Wildlife Refuge (ENWR) was established in 1959 amid a mixture of forests, wetlands, farms, and rural residential land in central Crawford County. ENWR consists of two separate divisions. Located near Guys Mills, the Sugar Lake Division is the larger (5,206 acres, 2,107 hectares) and more heavily managed division. The Seneca Division, located several miles east of Cambridge Springs and ten miles north of the Sugar Lake Division, is situated in a forested valley with wetlands associated with low-gradient, meandering Muddy Creek and Dead Creek. Together the two ENWR Divisions have a wide range of forest, grassland, and wetland habitats, including a critically endangered shrub fen. ENWR contains high-quality forest, shrub lands, grasslands, and wetlands critical to maintaining the abundance and diversity of birds found on this IBA. The Refuge contains over 2,500 acres (1,012 hectares) of good quality, diverse wetlands that consist of beaver flooding, marshes, swamps, creeks, wet meadows, and man-made impoundments. The Refuge qualified as an IBA primarily because of its importance to wetland associated species such as waterfowl, shorebirds, and the Bald Eagle.

This area satisfies the following IBA criteria:
- The site regularly supports numerous waterfowl: ducks, Canada Goose
- The site regularly supports numerous shorebirds
- The site is recognized as having an exceptional concentration and diversity of birdlife with 112 nesting species and 237 total species of birds
- The IBA supports the state threatened Bald Eagle, and state threatened Sedge Wren
- The site supports species of concern in Pennsylvania such as the Candidate-rare, Marsh Wren, Candidate-at risk, Northern Harrier, Candidate-rare, Pied-billed Grebe, and Candidate-rare, Common Snipe
- The site contains diverse wetlands covering an extensive area. Biologically rare/endangered habitats of the IBA, according to the Western Pennsylvania Conservancy, include a shrub fen, graminoid marsh, circumneutral shrub swamp, circumneutral broadleaf-conifer swamp, and medium gradient, clear-water creek
- Avian research and monitoring projects include banding and research on the Northern Saw-whet Owl migration, banding and research on the effects of hunting on the American Woodcock, a marsh bird monitoring project, and two grassland bird monitoring projects.

Conservation Concerns:
Invasive plant species are presently the greatest threat to the ENWR IBA. Although no single species has overwhelmed the landscape at ENWR, the number and variety of invasive plants collectively represent a serious threat. In view of the large amount of wetlands and wetland associated birds at ENWR, the potential degradation of water quality in the areas immediately adjacent to ENWR and in the broader French Creek Watershed poses a perennial threat to this IBA.

Hemlock Hill Research Area IBA

This site is located adjacent to the Erie National Wildlife Refuge. It is an area of mixed woodland (beech, maple, hemlock) mature forest grading to pole timber, and fields in the early stages of succession. Noteworthy primarily because of important ongoing ornithological research that has been conducted on-site since 1982, Hemlock Hill also supports a diverse avifauna ranging from Carolinian to Boreal species.

This area satisfies the following IBA criteria:
- Ornithological research on Hooded Warbler since 1982. Research published in Journal of Field Ornithology, Ornithological Monographs, Auk, Condor, Wilson Bulletin, etc.

Conservation Concerns:
This privately owned site is used for limited gas extraction. Commercial and residential development are potential threats to the site.

M. K. Goddard State Park IBA

M. K. Goddard IBA contains a variety of habitats that are conducive to both breeding and migrating birds. Habitat types include deciduous, mixed hardwood, and riparian forests, as well as open fields, upland swamp, extensive rhododendron grove, early and mid-successional habitats, and Lake Wilhelm. McKeever Environmental Learning Center (owned by the Commonwealth of Pennsylvania, Slippery Rock University) is located in primarily deciduous and mixed hardwood forests. State Game Land #270 is also located within this site. The site is a major stopover for exceptional concentrations of migrating songbirds including flycatchers, thrushes, vireos, warblers, blackbirds, tanagers, grosbeaks, orioles, and finches. Large aggregations of waterfowl can be observed on Lake Wilhelm during spring and autumn migration.

This area satisfies the following IBA criteria:

- Exceptional concentration of waterfowl, large numbers of shorebirds, and high concentration and/or diversity of songbirds occur during spring and autumn migration (25+ species of warblers during spring migration). At least 132 species of birds are known to breed within this IBA
- Nesting pairs of both the state threatened Bald Eagle and the state threatened Osprey
- Prothonotary Warbler
- Exceptional representative habitats include an upland swamp and an extensive rhododendron grove
- Long term monitoring and avian research have been conducted at McKeever Environmental Learning Center since the 1980s

Conservation Concerns:

Ownership of M. K. Goddard IBA is almost equally distributed between public (4707 acres) and private (4611 acres) entities. Presently, forestry practices, recreation, wildlife conservation, conservation/natural area, and public water supply are the primary uses for this land while agriculture plays a secondary role. Potential threats to this site are invasive plant species, non-point source pollution, and residential development.

Pymatuning, Hartstown Complex IBA

Pymatuning State Park and State Game Lands (SGL) #214 comprise the bulk of the large, diverse, horseshoe-shaped Pymatuning, Hartstown Complex IBA. In addition to the man-made lake, several remnant emergent, forested, and shrub-scrub wetlands are important to wetland associated birds. Also, the large expanses of open water that now cover the original wetlands provide some mitigating benefits to birds, especially the large numbers of breeding, migrating and wintering waterfowl. An abundance of lake fishes benefits piscivorous (fish-eating) birds. Hardwood forest exists on the fringes, and on numerous islands found in both the upper and lower impoundments. Clark Island, in particular, has 161 acres (65 hectares) of protected mature hardwood/ white pine forest. The heavily managed Controlled Hunting Area of SGL #214 contains a mix of grasslands and agricultural fields that support grassland species of birds such as the Bobolink and Upland Sandpiper.

This area satisfies the following IBA criteria:

- The site regularly supports numerous waterfowl, including Common Goldeneye, Canada Goose, Hooded Merganser, and Tundra Swan
- The site supports numerous shorebirds
- The IBA supports the state threatened Bald Eagle, state endangered Black Tern, state endangered American Bittern, state endangered Least Bittern, and state threatened Upland Sandpiper
- The site supports Pennsylvania species of concern including candidate-at-risk Black-crowned Night-heron, candidate-rare Pied-billed Grebe, candidate-rare Marsh Wren, and candidate-rare Prothonotary Warbler
- The IBA contains an extensive, intact wetland complex, supporting breeding species such as Virginia Rail, Sora, Common Moorhen, etc.

Conservation Concerns:

Although most of the Pymatuning, Hartstown Complex is State-owned and protected, some threats to birds and their habitats exist. Invasive species dominate much of the vegetation on both Pymatuning State Park and SGL #214. Canada goose and common carp are in high numbers that some consider threats to the habitat of other wetland species. More can be done to enhance bird habitats on and around the Upper Reservoir and SGL #214. The combination of diverse bird populations and habitats, the resources and interests of Pymatuning State Park and the Pennsylvania Game Commission, a supportive local community, and an already high visitation rate present opportunities for expanding awareness and conservation of birds in this IBA.

The Reptiles and Amphibians of Crawford County

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

Green Frog
photo source: Charlie Eichelberger

Crawford County is home to many common, generalist species, such as the Eastern Garter Snake (*Thamnophis sirtalis*), the Red-spotted Newt (*Notophthalmus viridescens*), the Bull and Green Frogs (*Rana catesbeiana*, *R. clamitans*), and the Painted and Snapping Turtles (*Chrysemys picta*, *Chelydra serpentina*). These species occur in many different habitats, exist throughout the entire state, and are the most commonly encountered reptiles and amphibians in the Commonwealth. Along with these common species, Crawford 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 development. Crawford County has lost most of its large forested tracts, creating a highly fragmented landscape that poses difficulty in managing the county's remaining biodiversity. There remains a good deal of forest in the county but these tracts are relatively small and are considered unsuitable for many species. Nevertheless, the residual forested areas still provide habitat for a number of generalist and specialist herptile species.

Northern Red Salamander
photo source: PNHP

Salamanders:

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 and Slimy Salamanders (*Plethodon cinereus*, *P. glutinosus*) are the most common woodland species throughout Crawford County's forests.

The numerous wooded waterways and small mountain streams of Crawford County provide habitat for the brook salamanders, including the Northern and Mountain Dusky Salamanders (*Desmognathus fuscus*, *D. ochrophaeus*), the Northern Two-lined and Long-tailed Salamanders (*Eurycea bislineata*, *E. longicauda*), and the Northern Spring Salamander (*Gyrinophilus porphyriticus*). In the cold-water 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 and 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. Another strictly aquatic salamander, the Mudpuppy (*Necturus*

maculosus) inhabits many of the same habitats as the Hellbender. This salamander may reach a foot in length and retains its gills throughout the adult stage. This is the only species in Pennsylvania which regularly keeps its gills throughout all life stages. Amphibians as a whole are particularly sensitive to toxins. Consequently, acid deposition is detrimental to the salamanders, including the Hellbender and Mudpuppy, which may inhabit affected streams.

Portions of the county support complexes of ephemeral/fluctuating natural pools, more commonly known as vernal pools. These wetlands are critical to a group of amphibians that rely on the wet/dry annual cycle that eliminates the possibility of fish populations being established. The Wood Frog (*Rana sylvatica*), and the Jefferson and Spotted Salamanders (*Ambystoma jeffersonianum*, and *A. maculatum*), all of which are vernal pool obligates, are known from Crawford 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 salamander lays its eggs in peat mosses (*Sphagnum* spp.) and can be found in the margins of seeps, springs, streamsides, and vernal pools 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 this species, 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*), and Spotted Turtle (*Clemmys guttata*) are regular visitors to vernal pools and may use these wetlands to breed and forage.

Frogs and Toads:

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 Western Chorus Frog (*Pseudacris triseriata*) can be found using herbaceous marshes and riparian backwaters where there is plenty of cover among the grasses and sedges. This species breeds in temporary wetlands and has declined precipitously in the past few decades for unknown reasons. 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 species of frog, the Northern Leopard Frog has rapidly disappeared from much of its range for mysterious reasons. Many herpetologists are now concerned with the future of this species.

Lizards:

The Five-lined Skink (*Eumeces fasciatus*) is the only lizard species known from Crawford County. This species occurs 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. This species is particularly susceptible to localized extinction because of the population's small sizes and isolation from other lizard populations.

Five-lined Skink
photo source: Charlie Eichelberger

Turtles:

The Stinkpot Turtle (*Sternotherus odoratus*) inhabits most moderate-to-large wetlands, though it is infrequently encountered because of its secretive nature. The semi-aquatic Wood Turtle (*Glyptemys insculpta*) relies on wooded creeks and rivers, and can be locally common in areas. This turtle gets its name from the rough, sculpted appearance of its shell, resembling a carved piece of wood. The Spiny Softshell Turtle (*Apalone spinifera*) is known from Crawford County and can be found in the large lakes and rivers that have sand or mud bottoms. This species is more closely tied to water than the wood turtle, though the species does bask when conditions are suitable and many can be seen sprawled on sandbars and teetering on logs overhanging water. Riverine turtle nests are generally laid in suitable soft substrates along waterways. These sites are frequently used by many nesting females and are easily targeted by overpopulations of raccoons, skunks, and opossums. The Eastern Box Turtle (*Terrapene carolina*) is an easily recognized, generalist species found throughout the county. While this

species is still considered common, with a lifespan that may reach beyond a century, many biologists believe that Box Turtle populations have been in a steady decline due to road mortality and predation on nests and juveniles. There is growing concern for many of Pennsylvania's turtles, because numerous populations are nearly void of juvenile turtles, indicating that there is little successful reproduction occurring.

Bog Turtle
photo source: Charlie Eichelberger

One of the rarest turtles in the world, the Bog Turtle (*Glyptemys muhlenbergii*), has been lost from Crawford County. The population that occurred in the northwest portion of the state was considered disjunct, and while not connected to the heart of the Bog Turtle's range, this outlying population represented a very interesting occurrence. This population of turtles settled in a small pocket of marshlands during the retreat of the glaciers in the last ice age. Crawford County's Bog Turtle population inhabited the wetlands that were destroyed during the flooding of Pymatuning Reservoir. These were the only Pennsylvania Bog Turtles to exist west of the Allegheny Mountains, but have not been recorded from this region since the 1920's. Another rare turtle species, the Blanding's Turtle (*Emydoidea blandingii*), has also been lost from Crawford County. This species inhabits extensive marsh systems and was thought to have lived in the wetlands associated with the Erie Canal. The Blanding's Turtle has not been found in Crawford County in nearly 100 years. Crawford County formerly represented a stronghold for both of these species in the state. Both of these species are extreme habitat specialists and were likely never very common. Conservation efforts should be made to ensure that the County's remaining reptiles and amphibians are not lost.

Snakes:

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 Crawford County. This species hunts along open waterways, searching for amphibians and small fish.

Eastern Ribbon Snake
photo source: Charlie Eichelberger, PNHP

Pennsylvania accounts for about 90% of the global range for the Shorthead Garter Snake (*Thamnophis brachystoma*). This species can be locally common and is considered a habitat generalist, but its extremely restricted range makes this a globally vulnerable species. The Shorthead Garter Snake feeds exclusively on earthworms. The Queen Snake (*Regina septemvittata*), a primarily aquatic species that feeds on crayfish, is known from the county but is considered vulnerable for a number of reasons including increases in mammalian predator populations and introductions of exotic crayfish. This species should be monitored to establish the status of the species and to determine whether or not it warrants protection.

The Smooth Green Snake (*Liochlorophis vernalis*) is likely common in grassy areas but is difficult to locate because their camouflage allows them 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*), and the Ring-necked Snake (*Diadophis punctatus*). These species are fairly common residents and can be found beneath rocks and decaying wood and bark.

The Eastern Massasauga (*Sistrurus catenatus*) is a very small rattlesnake that inhabits low lying wet soils in the spring and fall, and switches to dry, sparse fields in the heat of the summer. This species is associated with the prairies of the Midwest, and the population in Pennsylvania is considered to be quite unique because of it's separation from the more western populations. This species poses very little threat to humans and encounters are infrequent, partially because of the habitat the snakes utilize. The Eastern Massasauga is in severe decline in Pennsylvania and today only exists in a handful of locations. This decline has prompted the Fish and Boat Commission to list the Massasauga as an endangered species in Pennsylvania. Massasaugas were once found throughout the northwestern portion of the Commonwealth, but may have been lost from Crawford County. More survey work is necessary to determine if any populations still exist in Crawford County.

Eastern Box Turtle
photo source: Charlie Eichelberger

Crawford County is a significant spot in the state for the Commonwealth's reptiles and amphibians. The numerous small forested tracts and waterways provide critical habitat for the reptiles and amphibians. Of utmost importance to the conservation of the county's herpetofauna is the protection of the region's remaining forests and wetlands, including the communities of seasonal pools. The rich and diverse herpetofauna of Crawford County is unique to Pennsylvania and should be considered in the long term planning 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. Therefore, there could be other herptile species that occur in the county that have not yet been recorded.

Pennsylvania Fish and Boat Commission Regulations
In Pennsylvania, the Fish and Boat Commission has jurisdiction over the reptiles and amphibians. Recently, regulations concerning the herptiles were reviewed and there have been considerable changes 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://webspace.ship.edu/tjmare/herp.htm.

Aquatic Community Classification of Crawford County (*Source: Walsh et al. 2007)*

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 of watersheds in the county.

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

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

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

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

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

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

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

Over any natural habitat, variations are caused by human alterations to aquatic environments. Many changes within a watershed can be detected within its streams and rivers. If implemented improperly, timber harvest,

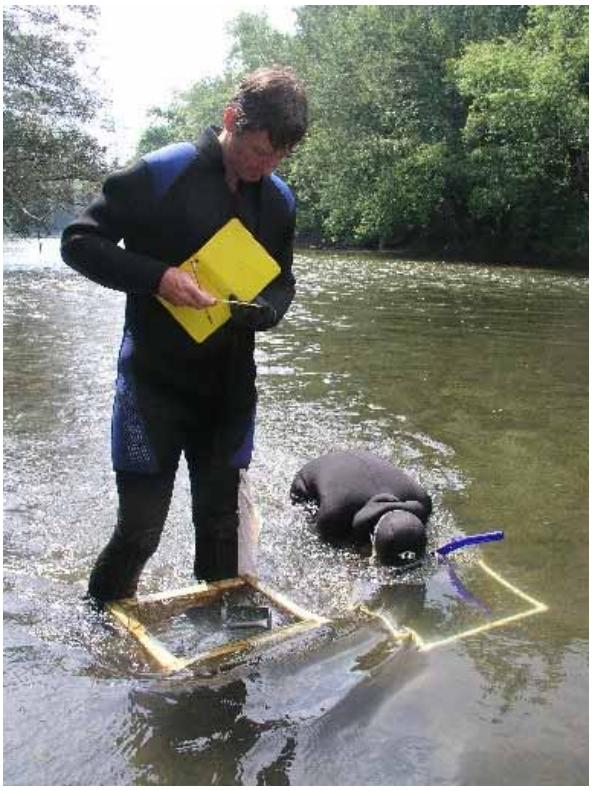
agriculture, urban development, roads, are among some alterations that may cause changes in water quality and stream habitats from non-point source pollution. A number of pollutants enter aquatic systems from point sources to flowing waters, such as discharges from sewage treatment plants, mines, and industrial sources.

How are communities described?
Communities are named by the commonly occurring animals in the community type. Other organisms that may be found in the community are also listed. While not every organism described in a community will occur in every community location, organisms listed by community types give a general account of what organisms to expect in a community habitat.

Species of concern (considered state or globally rare) that may occur with each community type are listed. State and global rank definitions are available at: http://www.naturalheritage.state.pa.us/RankStatusDef.aspx

Environmental and water quality habitats typically associated with the community type are also described.

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), elevation are a few habitat characteristics that may be important to the community type. Local conditions are also mentioned.



PNHP staff surveying for freshwater mussels in French Creek. Photo source: Tam Smith, PNHP

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.

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

What is the relationship between Pennsylvania Aquatic Fish Community Classes and stream designations?
Pennsylvania protects aquatic life as a "designated use" of waters in the Commonwealth under the federal Clean Water Act. Enforced by PA DEP is the regulation that four types of aquatic life should be propagated and maintained based on their designation in Pennsylvania (PA Code 93.3; http://www.pacode.com/secure/data/025/chapter93/s93.3.html, accessed 4/17/07):

Cold Water Fishes (CWF): Fishes and associated aquatic flora and fauna preferring colder waters (included in the cold water fishes are trout species).

Warm Water Fishes (WWF): Fishes and associated aquatic flora and fauna preferring warmer waters.

Trout Stocked Fishes (TSF): Stocked trout species (maintained from Feb 15 to July 31) and warm-water flora and fauna.

Migratory Fishes (MF): Fishes (those having anadromous, catadromous, or similar life histories) which must migrate through flowing waters to their breeding habitats.

Additionally, some waterbodies receive additional special protections as "Exception Value" or "High Quality" waters because they are especially valued for aquatic life, water quality, and/or recreation. Meeting relatively high water quality and other standards qualify the water bodies for additional protections from degradation beyond the aquatic life uses (PA Code 93.4b, http://www.pacode.com/secure/data/025/chapter93/s93.4b.html, accessed 4/17/07).

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 ACC fish assemblages and are used in water quality regulation.

Table 7. 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 Stocked Fishes, MF= Migratory Fishes)

Increasing watershed area ▼	Fish Communities	EV	HQ	CWF	WWF	TSF	MF
	Coldwater	x	x	x			
	Coolwater		x	x	x	x	x
	Warmwater			x	x	x	x
	Large River				x		x
					x		x

Threats and Conservation of Freshwater Mussels

(Source: Walsh et al. 2007)

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. For mussel species in the United States, nearly 25% have a Federal endangered or threatened status and 75% are listed as endangered, threatened, or special concern by individual states (Nedeau et al. 2005).

Mussel communities are generally indicative of habitat types that are rare in the Commonwealth and becoming increasingly rarer. Mussel species are generally found in watersheds at least 75 sq. km. in size that have medium or large size streams. Mussel richness generally increases with increasing watershed size (Strayer and Jirka 1997), so the largest rivers in Pennsylvania, like the Ohio, Allegheny, Susquehanna, and Delaware Rivers generally have the most rich mussel communities. Large streams and rivers of good quality without major habitat alterations are few.

Water quality threats to mussels include toxic and organic 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 seemingly undisturbed, compared to other aquatic organisms, by agricultural pollution. But excessive sedimentation and habitat alteration from agricultural practices can also be detrimental to mussel communities. Runoff from urban and suburban developments appears to be more damaging to mussels, most likely due to combined effects of altered hydrology, excess sediment and nutrients, and warm water temperatures (Strayer and Jirka 1997).

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

Invasive mussel species like the zebra mussel (*Dreissena polymorpha*) and the Asian clam (*Corbicula fluminea*) may be damaging to populations of native mollusks. 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 habitat (Hakenkamp et al. 2001) and may also deteriorate endemic mussel populations.

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

Three species of mussels from French Creek: two clubshells (*Pleurobema clava*) -top, snuffbox (*Epioblasma triquetra)* -bottom left, and a rayed bean (*Villosa fabalis)* -bottom right.

Photo source: Tam Smith, PNHP

Many experts believe that effective aquatic conservation will result only from the protection of ecological and evolutionary contexts, which they equate with biological organization above the level of individual species (e.g. Angermeier and Schlosser 1995). Targeting biological communities 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. By conserving the processes that support these species, we are better able to conserve the species. Thus, we believe that it is important to protect examples of each mussel community and protect watersheds that contain rich mussel populations to effectively protect the biodiversity of the state, and the nation.

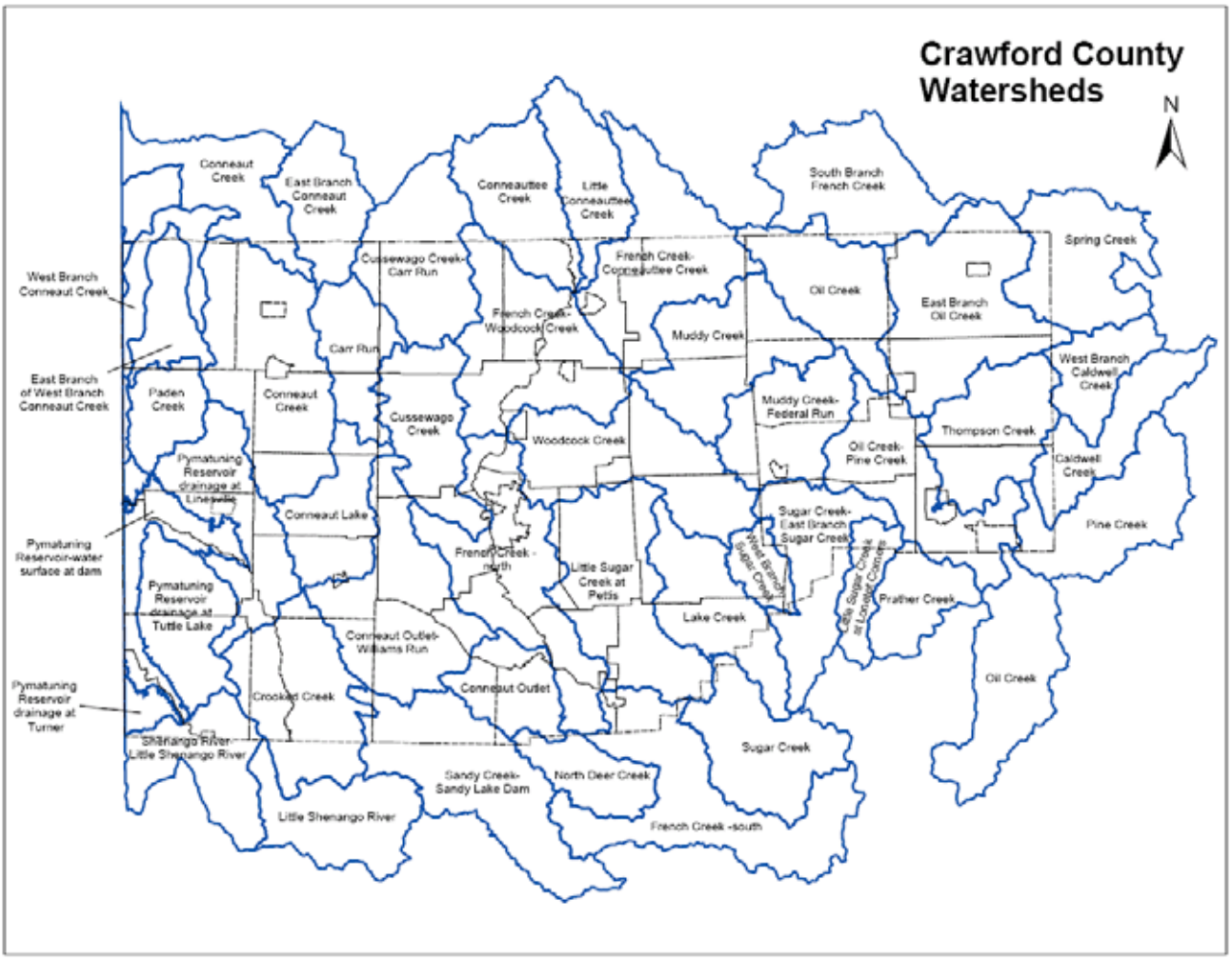


Figure 9 (above). Watersheds of Crawford County

Table 8. Watersheds of Crawford County

Watershed Name	Stocked Fish Present? *	Ohio Basin Fish Community	Macroinvertebrate Community	Ohio Basin Mussel Community
Caldwell Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
Carr Run	Y	not assessed	High Quality Headwater Stream Community	not assessed
Conneaut Creek at Conneautville	Y	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
Conneaut Creek at Pennside	Y	Warmwater Community	not assessed	Spike Mussel Community
Conneaut Lake	N	not assessed	High Quality Headwater Stream Community	not assessed
Conneaut Outlet	N	not assessed	High Quality Headwater Stream Community	Giant Floater Community

Watershed Name	Stocked Fish Present? *	Ohio Basin Fish Community	Macroinvertebrate Community	Ohio Basin Mussel Community
Conneaut Outlet-Williams Run	N	not assessed	Low Gradient Valley Stream Community	Giant Floater Community
Conneauttee Creek	Y	Coolwater Stream Community	High Quality Mid-Sized Stream Community	Giant Floater Community
Crooked Creek	N	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
Cussewago Creek	Y	Coolwater Stream Community	High Quality Headwater Stream Community	Giant Floater Community
Cussewago Creek-Carr Run	Y	Warmwater Community	High Quality Headwater Stream Community	not assessed
East Branch Conneaut Creek	N	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
East Branch Oil Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
East Branch of West Branch Conneaut Creek	N	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
French Creek - north	Y	Large River Community	High Quality Headwater Stream Community	Flutedshell Community
French Creek - south	Y	Warmwater Community	High Quality Headwater Stream Community	Flutedshell Community
French Creek-Conneauttee Creek	Y	Warmwater Community	High Quality Small Stream Community	Flutedshell Community
French Creek-Woodcock Creek	Y	Warmwater Community	Common Large Stream Community	Flutedshell Community
Lake Creek		Coolwater Stream Community	Low Gradient Valley Stream Community	not assessed
Little Conneauttee Creek	N	Coolwater Stream Community	not assessed	not assessed
Little Shenango River	Y	Warmwater Community	not assessed	not assessed
Little Sugar Creek at Lonetot Corners	Y	Coldwater Community	not assessed	not assessed
Little Sugar Creek at Pettis	Y	Coolwater Stream Community	High Quality Mid-Sized Stream Community	not assessed
Muddy Creek	Y	Large River Community	not assessed	Giant Floater Community
Muddy Creek-Federal Run	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
North Deer Creek	Y	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
Oil Creek at Lakeville	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed

Watershed Name	Stocked Fish Present? *	Ohio Basin Fish Community	Macroinvertebrate Community	Ohio Basin Mussel Community
Oil Creek at Titusville	Y	Large River Community	High Quality Headwater Stream Community	not assessed
Oil Creek-Pine Creek	Y	Warmwater Community	High Quality Headwater Stream Community	not assessed
Paden Creek	N	not yet assessed	Low Gradient Valley Stream Community	not assessed
Pine Creek	Y	Coolwater Stream Community	not assessed	not assessed
Prather Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
Pymatuning Reservoir drainage at Linesville	N	Coolwater Stream Community	Common Large Stream Community	not assessed
Pymatuning Reservoir drainage at Turner	N	not assessed	Common Large Stream Community	not assessed
Pymatuning Reservoir drainage at Tuttle Lake	N	not assessed	Common Large Stream Community	not assessed
Pymatuning Reservoir-water surface at dam	N	not assessed	not assessed	not assessed
Sandy Creek-Sandy Lake Dam	N	not assessed	Common Large Stream Community	not assessed
Shenango River-Little Shenango River	Y	Large River Community	Low Gradient Valley Stream Community	Giant Floater Community
South Branch French Creek	Y	Warmwater Community	not assessed	Spike Mussel Community
Spring Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
Sugar Creek	Y	Coolwater Stream Community	High Quality Headwater Stream Community	not assessed
Sugar Creek-East Branch Sugar Creek	Y	Coolwater Stream Community	High Quality Mid-Sized Stream Community	not assessed
Thompson Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
West Branch Caldwell Creek	Y	Coolwater Stream Community	High Quality Small Stream Community	not assessed
West Branch Conneaut Creek	N	Warmwater Community	High Quality Headwater Stream Community	not assessed
West Branch Sugar Creek	Y	not assessed	High Quality Mid-Sized Stream Community	not assessed
Woodcock Creek	Y	Warmwater Community	not assessed	not assessed

*Surveys by the Pennsylvania Fish and Boat Commission found one or more fish (trout or warmwater gamesfish) 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.

Coldwater Community

Typified by: brook trout (*Salvelinus fontinalis*) mottled sculpin (*Cottus bairdii*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*)

Species of concern: none

Community Description and Habitat: This headwater stream community occurs in small swift headwater streams. Water temperatures are the coldest among the fish communities. The Coldwater Community represents small, swift streams with brook trout and slightly larger streams with both brook trout and brown trout or with brown trout only. The Coldwater Community occurs in Little Sugar Creek. Other streams are designated as Coldwater Fisheries by PA DEP in Crawford County. While they may support trout fisheries, in many cases the streams also have cool and warm water fish communities according to the Pennsylvania Aquatic Community Classification.

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 headwater streams and have a unique water chemistry signature with few dissolved cations and low buffering capacity.

A natural landscape often surrounds the streams where the Coldwater community is found and supports the stream habitat. Forested riparian buffers and watersheds preserve the cold and well oxygenated waters and maintain high quality stream habitats and water quality. Natural cover, like logs and woody debris from the forest, and loose gravels required for spawning habitat should be abundant to support the fish community. Forage fish and invertebrates serve as a food supply for the brook and brown trout.

Stream quality rating: High

Threats and Disturbances: Headwater streams may be acidic from acid deposition. Acidic precipitation may be occurring in headwater streams in Crawford County, but is buffered by glaciated soils. Other problems with small streams may be disturbances from suburban developments and agriculture. Runoff from roads results in siltation and poor water quality. Habitat and water quality may also be threatened by poor agricultural practices in small streams.

Conservation Recommendations: Protecting headwater streams with natural landcover should be a priority for Crawford County. Preventing pollution and habitat disturbance in high quality, small streams will protect the Coldwater Community. However, fixing ongoing watershed problems at the headwaters is beneficial for downstream waters. Addressing road and impervious surface runoff in Crawford County is especially important when new homes and commercial centers are built. Riparian buffers, rotational grazing, erosion control and other strategies may be necessary to minimize agricultural impacts to streams.

Streams in these watersheds may have wild-reproducing populations of brook and brown trout and may be a recreational fishery resource. Because cold, headwater streams often occur in terrain unsuitable for most types of human developments, they are not usually subject to the same types of water pollution issues as 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 from western North America. Habitats for native brook trout have been restricted by competition with other trout species.

Typified by: Blacknose dace *(Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), stocked brown trout (*Salmo trutta*), white sucker (*Catostomus commersoni*), redside dace (*Clinostomus elongatus*), longnose dace (*Rhinichthys cataractae*), fathead minnow (*Pimephales promelas*), pearl dace (*Margariscus margarita*), and slimy sculpin (*Cottus cognatus*)

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

Species of concern: none

Community Description and Habitat:
In Crawford County, many streams were classified as the Coolwater Stream Community. For instance, the Coolwater fish community was found in Conneauttee Creek Torry Run, Conneaut Creek, N Deer Creek, Muddy Creek, Little Sugar Creek, E Branch Sugar Creek, Oil Creek, Thompson Creek, and Britton Run.

This community type has varied habitat characterized by generalist fish species, and, therefore, can represent a variety of stream conditions. The community can best be described by small to medium size streams that are faster than warm water streams and have temperature intermediate between warm and cold streams. These streams may be called "Cold Water Fishery" by PA DEP, typically meaning that they support brown trout. In many cases, fish tolerant of cool and warm temperatures are also present. Valley streams that have cobble and gravel substrates and cover for fish habitat represent the best examples of Coolwater Stream Communities. In some cases, agriculture warms otherwise cold streams and may degrade stream habitats resulting in a loss of natural fish community. Transitional habitats between small headwater streams and warm large streams and rivers may also be called a Coolwater Stream Community.

Stream quality rating: Low-medium

Threats and Disturbances: This community occurs downstream of headwaters, and these streams are not usually protected from human influences. A number of pollution types are found in watersheds where this community occurs. Acid mine drainage is a common associate of the Coolwater Community, which shows that the community can tolerate some poor water quality conditions.

In addition, the community occurs in streams impaired by agricultural and urban runoff, as well as various disturbances such as land development or wastewater outfalls. Stream temperature may be warmer than natural temperatures because riparian vegetation was removed. Stream habitats may also have been altered where this community is found. In Crooked Creek, the Coolwater Stream community habitat is impaired by hydromodification, siltation, low dissolved oxygen, according to PA DEP (2006). The headwaters of Muddy Creek are degraded from road runoff and resulting siltation (PA DEP 2006).

Conservation Recommendations: Restoration of stream temperature, habitat, and water quality to natural conditions is recommended. Management of storm water runoff and riparian vegetation restoration are critical to improvement of community conditions. Addressing sediment and nutrient loading will improve water quality for this community type.

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

Ohio Warmwater Community

Typified by: Greenside darter (*Etheostoma blennioides*), central stoneroller (*Campo-stoma anomalum*), rainbow darter (*Etheostoma caeruleum*), rosyface shiner (*Notropis rubellus*), johnny darter (*Etheostoma nig-rum*), fantail darter (*Etheostoma flabellare*), logperch (*Percina caprodes*), stonecat (*Noturus flavus*), silver shiner (*Notropis photogenis*), golden redhorse (*Moxostoma erythrurum*), mimic shiner (*Notropis volucellus*), pumpkinseed (*Lepomis gibbosus*), yellow bullhead (*Ameiurus natalis*), large-mouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), tonguetied minnow (*Exoglossum laurae*), Ohio lamprey (*Ichthyomyzon bdellium*)

Northern Hogsucker
Photo Source: http://www.ohiodnr.com/dnap

Species of concern: none

Community Description and Habitat: The Ohio Warmwater Community usually occurs in medium to large valley streams, like French Creek, W Branch Conneaut Creek, Little Shenango River, Woodcock Creek, and sections of Oil Creek. The streams are characterized by a diverse fish community, ranging from game fish to small, bottom-dwelling darters and minnows.

Warm water temperatures are characteristic of this community group. Thermal tolerances of fish in the community group are higher than the cold- and cool-water communities. The habitat of community fish is a range of conditions. This stream community, in undisturbed condition, probably represents small to medium-size warmwater systems with little silt and turbidity. In impaired systems, poorer water quality conditions and increased turbidity and low DO occur.

Stream quality rating: Medium

Threats and Disturbances: Water quality and habitat may be influenced by non-point source pollution. Runoff from impervious surfaces and poorly managed agricultural areas can be a threat to this community. The watersheds that support this community have a relatively large amount of agricultural land within them. Tributaries to the Little Shenango River and French Creek are impaired by siltation, low DO, organic enrichment, and hydromodification (PA DEP 2006) from agricultural sources.

Potential point sources from municipal and industrial discharges may negatively influence water quality in some Warmwater community habitats. Sewage treatment plans may be damaging to streams through nutrient loading.

Medium-sized streams without many groundwater inputs are typical of Warmwater Community 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

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 protection in Pennsylvania.

Since warmwater streams mainly occur in valleys downstream of human influences, they are often subject to pollution from non-point sources, such as agriculture and urban runoff. Storm water management, restoration of riparian buffer zones, erosion control, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution. Managing storm water is especially important for valley streams.

Ohio Large River Community

Typified by: Channel catfish (*Ictalurus punctatus*), sauger (*Sander canadensis*), freshwater drum (*Aplodinotus grunniens*), walleye (*Stizostedion vitreus),* quillback carpsucker (*Carpiodes cyprinus*), smallmouth buffalo (*Ictiobus bubalus*), river redhorse (*Moxostoma carinatum*), mooneye (*Hiodon tergisus*), white crappie (*Pomoxis annularis*), longnose gar (*Lepisosteus osseus*), brook silverside (*Labisthesthes sicculus*)

Species of concern: mooneye (S2? G5), smallmouth buffalo (S2 G5), longnose gar S2S3 G5), river redhorse (S3 G4), channel darter (S1S2 G4)

Sauger
Photo Source: http://sites.state.pa.us/PA_Exec/Fish_Boat

Community Description and Habitat: The Ohio Large River Community occurs most commonly in large streams and rivers in Crawford County. In some cases, smaller streams with game fish may also be described by this community. The Shenango River, French Creek, and Muddy Creek have fish characteristic of the Large River Community. Crappie, bass, walleye, yellow perch, and other game fish were common in these creeks.

Rivers and streams with diverse habitats are typical for this community. The large rivers offer varied habitats including shallow shorelines, deep channels, impoundments. The natural richness in Ohio basin streams has been augmented by the addition of stocked and/or introduced game fish, which occur with this community group.

Stream quality rating: Medium

Threats and Disturbances: In typical large streams and rivers, the cumulative degradation from a number of upstream watershed sources make managing habitat of this community challenging. Impoundments like Pymatuning Reservoir alter natural fish communities, their habitats, and natural stream processes. However, dams creating recreation resources are unlikely to be removed in the near future. Management of flow and water quality in the receiving waters of impoundments is important for maintaining healthy fish communities and populations. The Shenango River may be suffering ill effects from the Pymatuning impoundment. Impairment of the waterway is caused by hydromodification, organic enrichment, and low DO, according to PA DEP (2006).

Rivers and streams, like the French Creek, are common habitats of this community type.
Photo source: PNHP

Non-point source pollution in upstream portions of the large river basins contributes nutrients and sediment. Agricultural non-point source pollution and habitat degradation is common the watersheds in Crawford County. Air pollution also contributes to degraded water quality and bioaccumulation of contaminants in fish. It is the likely source of mercury causing the fish consumption restrictions for French Creek (PA DEP 2006).

Although dredging may be uncommon in Crawford County, river dredging in the Allegheny and Ohio River watersheds for gravel mining may also be a threat to this community type in some locations. Removing cover and bottom substrate, and altering natural river contours is very detrimental to the habitat of some Large River Community fish.

Conservation recommendations: Addressing flow and water quality issues resulting in stream impairment and fish consumption should be a priority for Crawford County. Watershed managers should work with operators of the Pymatuning Reservoir dam to improve conditions in the Shenango River. Additionally, reducing excessive sediment and nutrient loading from agricultural sources through best management practices is recommended to benefit the community. Air pollution sources of mercury are difficult to address and may need to be addressed through state and federal air pollution regulations. Additionally, minimizing major habitat destruction from dredging and water quality disturbances will improve in-stream habitats for the Large River Community.

Other community members: Rolledwinged stonefly (Leuctridae), small minnow mayfly (Baetidae), crayfish (Cambaridae), trumpetnet caddisfly (Polycentropodidae), darner dragon-flies (Aeshnidae)

Small minnow mayfly
Photo Source: www. guillaume.doucet.free.fr

Habitat: Typically found in small, swift streams, this community is indicative of high quality stream habitats. This community is typified by a diverse group of macroinvertebrates that are sensitive to organic pollution. Small tributaries to Cussewago Creek, Carr Run, Conneaut Creek, French Creek, Oil Creek and to Pymatuning Reservoir typified the community habitat in Crawford County.

Stream quality rating: High

Community rarity: No

Threats: This community type occurs in watersheds with moderate urban and agricultural influences. In some locations, siltation and excess nutrients from agriculture may be impairing stream systems. Urban influences can include runoff from roads and stormwater from other impervious surfaces.

Conservation recommendations: Conserving small headwater streams in good condition is important for maintaining watershed health and the Community habitats. Reducing runoff from poorly buffered agricultural land would be most beneficial for improving stream quality for the High Quality Headwater Stream Community. In areas such as these, runoff and stream bank erosion can be controlled by installing riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. Stream habitats will improve over time with the addition of riparian buffers.

Management of stormwater from roads and urban developments and mitigation of any direct stream discharges are recommended. Retention and treatment of storm water would ideally ameliorate water quality in streams receiving urban effluents. In addition, improvements in water quality from sewage treatment effluents would also better community conditions.

Small, high-gradient streams with rocky habitats are typical of this community type.

Photo source: PNHP

High Quality Small Stream Community

Typified by: Brushlegged mayfly (Isonychiidae), fingernet caddisfly (Philopotamidae), dobsonfly (Corydalidae), saddlecase maker (Glossosomatidae), watersnipe fly (Athericidae), common burrower (Ephemeridae), snail-case maker caddisfly (Helicopsychidae)

Community Description and Habitat: This community is found in small to medium-size streams with intermediate gradient. It is found in slightly larger streams than the High Quality Headwater Stream Community. Kelly Run, Mohawk Run, Temple Creek, West Branch Conneaut Creek, East Branch Muddy Creek, Muddy Creek, Pine Hollow Run, Britton Run, and Fivemile Creek are some examples of the community habitat. Some streams with this community type, like Muddy Creek, meander through wetlands.

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

The High Quality Small Stream Community is typically found in streams with mainly 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 intolerant of pollution.

Stream quality rating: High

Threats and Disturbances: Organisms in this community type are sensitive to organic pollution and habitat degradation. Low levels of water quality degradation may occur in watersheds where the community is present. Few threats to the community are known at this time.

In Crawford County, this community occurs in watersheds with moderate amounts of agricultural land cover, which may alter the in-stream habitat. Impairments resulting from poorly buffered agricultural land may include excess nutrient and sediment input from cropland or livestock pastures. In some locations, municipal point sources (e.g. sewage treatment plants) and road runoff may also affect water quality.

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

Conservation Recommendations: While some non-point source pollution occurs in watersheds supporting the High Quality Small Stream Community, the pollution problems here are less severe than in other stream types. Protecting high quality small streams should be a priority for watershed managers. Measures should include pollution and habitat degradation prevention.

In areas where non-point source agricultural pollution is occurring, runoff and stream bank erosion can be controlled by installing riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. Stream habitats will improve over time with the addition of riparian buffers.

Management of storm water from roads and urban developments and mitigation of any direct stream discharges are recommended. Retention and treatment of storm water would ideally ameliorate water quality in streams receiving urban effluents.

Common Large Stream Community

Typified by: Nemourid broadback stonefly (Nemouridae), Ameletid mayfly (Ameletidae), Taeniopterygid broadback stonefly (Taeniopterygidae)

Nemourid broadback stonefly
Photo source: www.dec.state.nv.us

Community Description and Habitat: The streams that support the Common Large Stream Community have high gradient with a diverse assemblage of organisms. These medium to large streams in good condition are habitats for the Common Large Stream Community. Macroinvertebrates are slightly more tolerant of organic pollution than the High Quality Mid-Sized Stream community. As with other valley streams in Crawford County, the community habitat may be surrounded by agriculture, potentially influencing water quality and habitat. This community type is usually indicative of medium to large streams that are of good quality. However, in some cases this stream type may be degraded by watershed agriculture. Gravel Run, Boles Run, Conneauttee Creek, and tributaries to Sandy Creek Lake were associated with this community.

Stream quality rating: Medium

Threats and Disturbances: Because of the rural nature of Crawford County, excess siltation and nutrients from agricultural sources may disturb valley streams, where this community is found. Impervious surfaces also contribute to poor water quality and stream flashiness in some valley streams. In several community locations, like Boles Run and Gravel Run, siltation, flow variability, organic enrichment, and low dissolved oxygen were found to be impairing stream life from agricultural and road runoff sources (PA DEP 2006). At Sandy Creek Lake, the stream flowing from the dam outlet was impaired by the impoundment and nutrients (PA DEP 2006).

Large to medium sized high gradient streams are typical of the community type. Non-point source pollution can cause excess stream sediment or other poor water quality conditions.
Photo source: PNHP

Conservation Recommendations: While non-point source pollution problems occur in watersheds with the Common Large Stream community, pollution is less severe than in other valley streams. In areas where non-point source agricultural pollution occurs, runoff and stream bank erosion can be controlled by installing vegetative buffers of an adequate width along streams in pastures and crop fields. Excluding livestock from streams and riparian zones will also help improve stream habitats over time.

In areas of suburban or urban development pressure, the establishment or maintenance of vegetative riparian buffers and storm water detention will help to mitigate the effects of increased levels of stormwater. Efforts to create water recharge into the watershed (where impervious surfaces are creating runoff) should be considered. Impoundments creating recreation resources are not likely to be removed in the near future, despite alterations in natural conditions. If possible, watershed managers may seek to manage dam release to improve water quality at the Sandy Creek Lake outlet.

Low Gradient Valley Stream Community

Typified by: Riffle beetle (Elmidae), waterpenny beetle (Psephenidae) netspinning 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. The intermediate gradients of valley streams characterize this stream community. Dissolved ions are higher in this type of stream than streams associated with other communities. Community members can tolerate some organic pollution and are not considered very sensitive organisms.

Riffle Beetle
Photo source: www.epa.gov

Streams associated with this community in Crawford County are Paden Creek, tributaries to Conneaut Outlet, tributaries to Lake Creek, and the Shenango River below Pymatuning Reservoir.

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 a variety of sources. In streams where this community is found, water quality may be moderately degraded from excess nutrients, habitat modification, and siltation due to poorly maintained agricultural practices. In heavily populated areas, municipal point sources such as sewage treatment plants and urban storm water effluents may contaminate community streams. The Shenango River is impaired below the Pymatuning Reservoir because of hydromodification, organic enrichment, and low dissolved oxygen.

Conservation Recommendations: Where this community is common, non-point source pollution from the surrounding watershed may be 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.

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

Watersheds with large amounts of agriculture and roads have the potential for non-point source pollution. In agricultural streams, runoff and stream bank erosion can be controlled by installing riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones.

Management of storm water from roads and urban developments and mitigation of any direct stream discharges are recommended. Retention and treatment of storm water would ideally ameliorate water quality in streams receiving urban effluents. Impoundments creating recreation resources are not likely to be removed in the near future, despite alterations in natural conditions. If possible, watershed managers should manage dam release to improve water quality at the Sandy Creek Lake outlet.

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)

Community Description and Habitat: The High Quality Mid-Sized Stream Community in most locations is found in small to medium-sized streams, like Little Sugar Creek and West Branch Sugar Creek. Streams are generally high gradient systems with good habitat quality. The community watersheds typically are undisturbed by humans and are often in mainly forested basins. The one exception to the typical community habitat is a tributary to Edinboro Lake, which has much agriculture in the watershed. Community taxa are a combination of stoneflies, mayflies, caddisflies, and other organisms that are pollution sensitive.

Giant black stonefly (Pteronarcyidae)
Photo source: www.dec.state.ny.us

Stream quality rating: High

Threats and Disturbances: Streams with the High Quality Stonefly Community generally have few threats, compared to other communities. Relatively natural watershed landcover in Little Sugar Creek and West Branch Sugar Creek watersheds help protect the water quality and stream habitat. Preventing detrimental disturbances from farming practices, roads and other impervious surfaces will maintain a relatively high quality stream community in mid-sized streams. Discharges from sewage treatment plants can also influence the aquatic assemblages and degrade water quality. In particular, the tributary to Edinboro Lake, where this community is present is impaired for recreational use because of pathogens (PA DEP 2006). Pathogens may be linked to the discharge from a sewage treatment plant on the creek.

Mid-sized, high gradient streams with high quality habitats and water quality are the typical habitat of this community.
Photo source: PNHP

Conservation Recommendations: Watershed managers should work to conserve high quality small to medium size streams in good condition. Managing agricultural practices that may contribute sediment, nutrients, and runoff is one method to maintain relatively high quality streams in rural watersheds. Encouraging stream bank fencing and riparian buffers, and crop and soil erosion best management practices are some examples of agricultural management. We also recommend minimizing road and impervious surface runoff by careful development planning and storm water detention. Steps should be taken to address nutrients and pathogens from sewage treatment plants.

Spike Mussel Community

Typified by: Spike mussel (*Elliptio dilatata*), and black sandshell (*Ligumia recta*)

Eastern Elliptio
Photo source: http://www.inhs.uiuc.edu

Several other mussels including the mucket (*Actinonaias ligamentina*), fatmucket (*Lampsilis siliquoidea*), fluted-shell (*Lasmigona costata*) and pocketbook (*Lampsilis cardium*), are also found in this community, but are common components of other communities as well. Species of concern: black sandshell (S3S4 G5), mucket (S4 G5), fatmucket (S4 G5), fluted-shell (S4 G5)

Stream quality rating: High

Habitat: The habitat range for the Spike Community includes medium streams to large rivers. Waters are usually relatively slow and low gradient. In Crawford County, the community was found in Conneaut Creek and the South Branch French Creek. In other locations, the community also occurs in the Allegheny River and its larger tributaries, as well as the Beaver River basin.

The species in this community are typically found in medium to large rivers in sand and gravel substrate, and are often associated with riffles. The spike mussel exists in a wide range of habitats, of varied size and depth. It is one of the most abundant mussels in the Allegheny basin (Strayer and Jirka 1997).A number of rare and intolerant taxa are often associated with this community. Thus, this community is found in ecosystems that are still able to support species that cannot survive in other areas, and is a high protection priority.

The spike community is found in low gradient areas of the Allegheny River and some of its tributaries, as well as some stream reaches in the Beaver River basin.
Photo source: PNHP

Threats:
The community habitats in the South Branch French Creek are threatened by road runoff and by agricultural sources. Tributaries to the South Branch French Creek are impaired from agricultural sources and have organic enrichment and low dissolved oxygen (PA DEP 2006). Siltation from road runoff also impairs South Branch French Creek tributaries (PA DEP 2006). Conneaut Creek has a fish consumption advisory because of high mercury levels (PA DEP 2006). The mercury is likely brought to the region by air pollution and is deposited in waterways, then, it bioaccumulates in aquatic organisms. In addition to fish, mussel populations and communities may also be negatively influenced by mercury pollution.

Conservation Recommendations: This community is characterized by high mussel diversity, many rare species, and few species that can tolerate pollution, and is a high conservation priority. This community occurs in sections of the watershed that are currently well protected, and less affected by the threats noted above than communities that occur further downstream or in highly disturbed areas. Protection of current high quality mussel habitat is important for the long-term viability of the Spike Mussel Community in large river systems.

Managing agricultural and road runoff are a priority for the Spike Community watersheds. Stream habitats and water quality should be improved where streams are impaired. Strategies for retention of stormwater and encouraging groundwater recharge could be applied where impervious surfaces create runoff. Proactive approaches to reducing sediment and nutrient loading from agriculture, including management of livestock, crops, and soils to minimize stream degradation, are also suggested. Mercury deposition may have to be addressed through state and federal regulation of air pollution.

Fluted Shell
Photo source: http://www.inhs.uiuc.edu

Typified by: fluted shell (*Lasmigona costata*), kidneyshell (*Ptychobranchus fasciolaris*), mucket (*Actinonaias ligamentina*), elktoe (*Alasmidonta marginata*), creeper (*Strophitus undulatus*), pocketbook (*Lampsilis ovata*), plain pocketbook (*Lampsilis cardium*), wavy-rayed lamp-mussel (*Lampsilis fasciola*)

Species of concern: fluted shell (S4 G5), kidneyshell (S4 G4G5), mucket (S4 G5), elktoe (S4 G4), creeper (S2S4 G5), pocketbook (S3S4 G5), plain pocketbook (S3S4 G5), wavy-rayed lamp-mussel (S4 G4)

Community Description and Habitat: The Flutedshell Mussel community is characteristic of large streams and medium size rivers. It is found throughout the upper Allegheny River. In Crawford County, it occurs in French Creek and in Conneauttee Creek. Community habitats have sand and gravel beds, and occur at low gradients. A number of rare and intolerant taxa are associated with this community. Thus, this community may be found in ecosystems that are still able to support species that cannot survive in other areas.

Stream quality rating: High

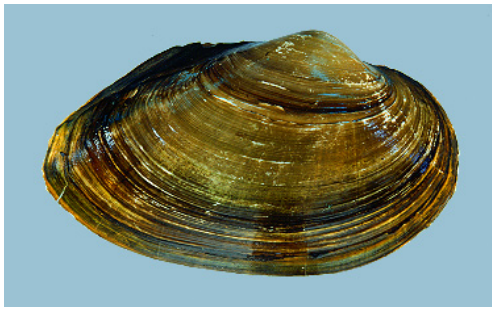
Threats and Disturbances: The watersheds associated with this community contain much agriculture and may be challenged by poor water quality and habitat degradation. Road runoff may also be problematic in some locations. In Conneauttee Creek and its tributaries, livestock grazing and other types of agriculture impair the stream by contributing silt and nutrients (DEP 2006). Organic enrichment creates low dissolved oxygen conditions. Sections of French Creek have a fish consumption advisory because of mercury contamination. Some of the tributaries to French Creek in the lower part of the watershed are impaired by channelization and road runoff (PA DEP 2006).

This community type is common in French Creek (above), in low gradient habitats with sand and gravel substrates.
Photo source: PNHP

Conservation Recommendations: This community is characterized by high mussel diversity, many rare species, and very few species that can tolerate pollution, and is a high conservation priority. The upper community watersheds have special conservation value because of its diverse mussel. The French Creek watershed is one area of notable mussel diversity and is also a habitat for the spike mussel community. Protection of this current high quality mussel habitat is important for the long-term viability of the spike mussel community in the large river systems. Habitat disturbance from agriculture and channelization, and other forms of disturbance should be minimized.

Managing agricultural and road runoff are a priority for the Flutedshell Mussel Community watersheds Strategies for retention of stormwater and encouraging recharge could be applied where impervious surfaces create runoff. Proactive approaches to reducing sediment and nutrient loading from agriculture, including management of livestock, crops, and soils to minimize stream degradation, are also suggested. Mercury deposition may have to be addressed through state and federal regulation of air pollution.

Giant Floater Mussel Community



Giant Floater
Photo source:http://www.inhs.uiuc.edu

Community Indicators: giant floater *(Pyganodon grandis),* fatmucket *(Lampsilis siliquoidea*), three-ridge *(Amblema plicata),* Wabash pigtoe *(Fusconaia flava*) Species of concern: Wabash pigtoe (S2 G5), three-ridge (S2S3 and G5)

Preferring quiet muddy waters in Pennsylvania, the giant floater Community inhabits various size, low gradient rivers, but usually occurs in rivers 4th order or greater. In Crawford County, the community occurs in Conneaut Outlet, Shenango River, Muddy Creek, Cussewago Creek, and Conneauttee Creek-

The community occurs in rivers with sand and gravel substrate, but reaches greatest abundance in standing water, in clay, silt, or mud substrate (Parmalee and Bogan 1998). The giant floater species prefers quiet or slow moving water with mud bottom, and avoids riffles (Parmalee and Bogan 1998). This species is ecologically widespread, occurs in a variety of habitats (Strayer and Jirka 1997).

The primary indicators are moderately strong indicators that this community is present, but are sometimes found in other community types (especially the fatmucket mussel). A moderate number of rare and intolerant taxa are associated with this community. The Giant Floater Community was common in many parts of the Ohio basin.

Stream quality rating: Undetermined

Community rarity: No

Threats: Similar to other mussel communities in the county, the Giant Floater Community is threatened by road runoff and pollution from agricultural sources. The headwaters of Conneaut Outlet are impaired by siltation from road runoff (PA DEP 2006). In Conneauttee Creek, excess nutrients and siltation from agriculture contribute to stream impairment (PA DEP 2006). The Shenango River below Pymatuning Reservoir is impaired as a result of hydromodification and organic enrichment. It suffers from low dissolved oxygen (PA DEP 2006).

Slow-backwaters of rivers and streams, like Le Bouef Creek (a tributary to French Creek in NW Pennsylvania), are the primary habitat for the giant floater community.
Photo source: PNHP

Conservation recommendations: Conserving naturally low-gradient streams and the backwaters of rivers is a priority for the Giant Floater Community. Managing non-point sources in watersheds with potential runoff from agriculture and urban sources will maintain conditions for the Giant Floater Community to thrive. In addition, preventing severe in-stream and riparian habitat disturbance near community habitats will also ensure community survival over the long term**.** Maintaining and restoring wetlands and riparian buffers within these watersheds will ensure that runoff is filtered before entering the stream, affording an additional level of protection to the mussel communities. Other agricultural best management practices, such as utilizing grassed waterways, no-till, and fencing cattle from streams will further protect these communities. Impoundments creating recreation resources are not likely to be removed in the near future, despite alterations in natural conditions. If possible, watershed managers should manage dam release to improve water quality in Shenango Creek.

Fifty-six county inventories have been completed in Pennsylvania to date. The methods used in the Crawford County Natural Heritage Inventory followed established Pennsylvania Natural Heritage Program procedures, which are based on those used by Anonymous (1985), Reese et al. (1988), and Davis et al. (1990). Natural Heritage Inventories proceed in three stages: 1) site selection based on existing data, map and aerial photo interpretation, recommendations from local experts, 2) ground surveys; and 3) data analysis and mapping.

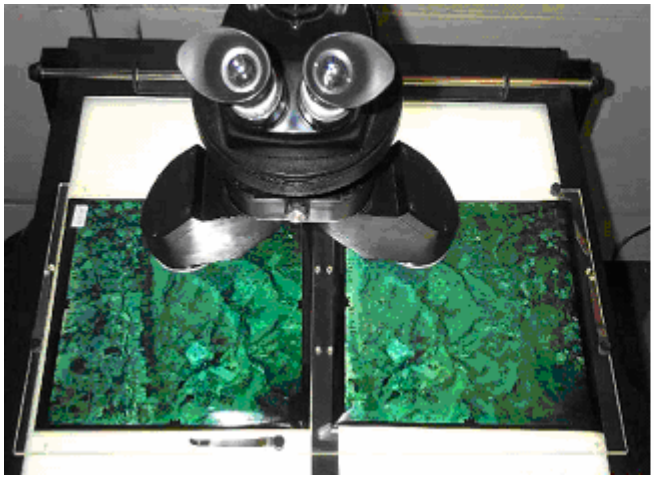
Site Selection

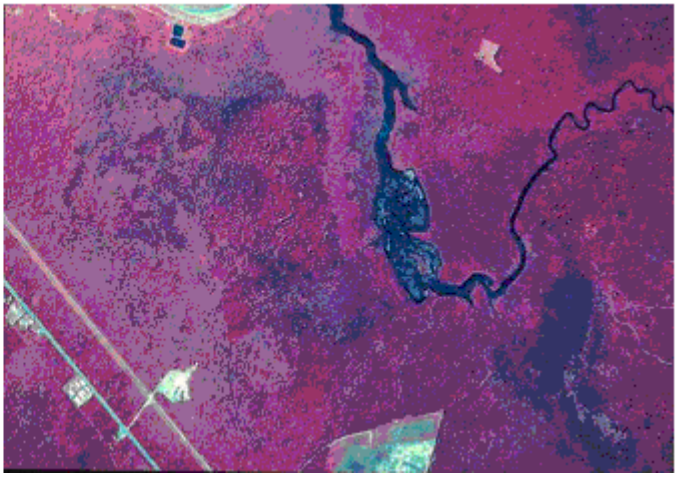
Inventory site selection is guided by information from a variety of sources. A review of the Pennsylvania Natural Heritage Program database (see Appendix II, pg. 276) determined what locations were previously known for species of concern and important natural communities in Crawford County. Local citizens knowledgeable about the flora and fauna of Crawford County were contacted for site suggestions. Individuals from academic institutions and state and federal agencies that steward natural resources (e.g., Pennsylvania Game Commission, Pennsylvania Bureau of Forestry, Carnegie Museum of Natural History) were also contacted to obtain information about lands or resources they manage. National Wetland Inventory maps, compiled by the U.S. Fish and Wildlife Service, were used to locate wetlands of potential ecological significance within the county. General information from other sources such as soil maps, geology maps, earlier field studies, and published materials on the natural history of the area helped to provide a better understanding of the area's natural environment.

Aerial photographs were reviewed to identify sites for ground survey. Initial study of aerial photos revealed large-scale natural features (e.g., contiguous forest, wetlands), disturbances (e.g., utility line rights-of-way, surface mines, timbered areas) and a variety of easily interpretable features. Once preliminary site selection was completed, reconnaissance flights over chosen areas of the county were undertaken. Information concerning extent, quality, and context within the landscape can be gathered easily from the air. Wetlands and contiguous blocks of forest were of primary interest during fly-overs in Crawford County. Based on aerial photo interpretation and aerial surveys, some sites were eliminated from consideration if they proved to be highly disturbed, fragmented, lacked the targeted natural feature, or were purely attributable to human-made features (e.g., impoundments, clearings, farm fields).

Ground Surveys

Areas identified as potential inventory sites were scheduled for ground surveys. Ecologists conducted field surveys throughout Crawford County from 2002 through 2003. After obtaining permission from landowners, sites were examined to evaluate the condition and quality of the habitat and to classify the communities present. Field survey forms (Appendix III, pg. 277) were completed for each site. Boundaries for each site were drawn on USGS 1:24,000 topographic maps. If a species of concern was recorded and the population was of sufficient size and vigor, a voucher specimen was collected to be archived in the herbarium of the Carnegie Museum of Natural History. The flora, fauna, level of disturbance, approximate age of forest community, and local threats were among the most important data recorded for each site. In cases where landowner permission for site visits was not obtained or enough information was available from other sources, sites were not ground surveyed.





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

Data Analysis and Mapping

Data on species of concern and natural communities obtained during the 2002 and 2003 field seasons were combined with prior existing data and summarized. All sites with rare species and/or natural communities, as well as exceptional examples of more common natural communities were selected for inclusion in Biological Diversity Areas (BDAs). Plant species nomenclature follows Rhoads and Block (2000). Spatial data on the element of concern were then compiled in a GIS format using ESRI ArcGIS 9.1 software. From the occupied habitat data, boundaries defining core habitat and supporting natural landscape for each BDA were determined based upon physical factors (e.g., slope, aspect, hydrology), ecological factors (e.g., species composition, disturbance regime), and buffer specifications 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. BDAs were then assigned a significance rank to help prioritize future conservation efforts. This ranking is based on the extent, condition, and rarity of the unique feature, as well as the quality of the surrounding landscape.

Landscape Conservations Areas (LCAs) were delineated around landscape features that function as a linking element within an aggregation of BDAs, and/or large blocks of contiguous forest. LCAs designated around contiguous forest were identified by means of GIS analysis, refined through aerial photograph inspection, and selected based on size. Forested areas in Crawford County were identified though a classification of 1992 National Land Cover Data (NLCD), compiled from Landsat TM (thematic mapping) satellite imagery with a resolution of 30 meters. NLCD data was downloaded from Pennsylvania Spatial Data Access (PASDA) Web site (http://pasda.psu.edu). Land coverage types used in the analysis were transitional, deciduous forest, coniferous forest, mixed forest, woody wetlands, and emergent herbaceous wetlands. Roads, active railroads, and utility rights-of-way were considered fragmenting features. Existing GIS data for roads, which included interstates, U.S. and state highways, state, county and township roads, Pennsylvania Bureau of Forestry roads, some private forest roads, and active railroads, were combined with utility right-of-way locations digitized from aerial photos. Analysis to identify contiguous blocks of forest was conducted using the map calculator function of the Spatial Analyst Extension in ArcView 3.2. The results were then compared against aerial photos and any apparent non-forested areas were removed. Forest blocks less than 250 acres were then removed, and the remaining blocks were grouped into five size classes: 250-500 acres; 500-1000 acres; greater than 1000 acres. The five largest forest blocks were selected for inclusion as LCAs to demonstrate the importance of the large, unfragmented forests. A detailed description of the GIS analysis is available upon request from Western Pennsylvania Conservancy's data manager.

Table 9. County Natural Heritage Areas Significance Ranks

Ranks	*Description*
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 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 concern or natural communities that are highly ranked, and because of their size or extent, and/or relatively undisturbed setting, 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 concern or natural communities that are of either 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	Sites that have great potential for protecting biodiversity in the county but are not, as yet, known to contain species of 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.

LANDSCAPE-SCALE CONSERVATION

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, Figure 9a (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-

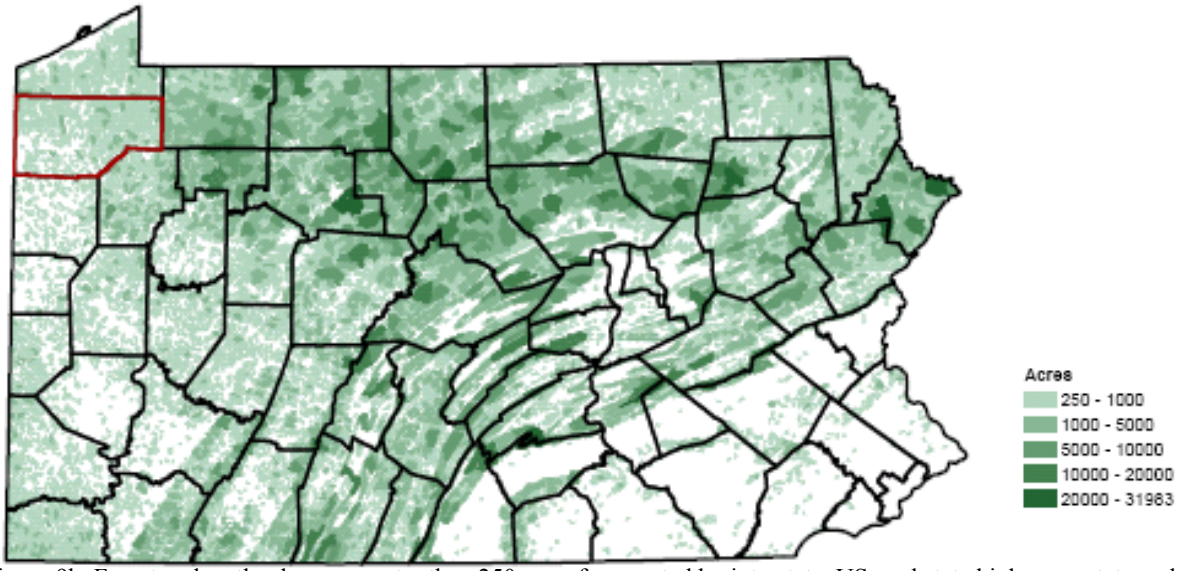


Figure 9b. Forest and wetland areas greater than 250 acre, fragmented by interstate, US, and state highways, state and local roads, public forest roads, and active railroads. The habitat blocks shown in this figure represent potential contiguous habitat for animals sensitive to all scales of fragmentation, such as interior forest birds and amphibians.

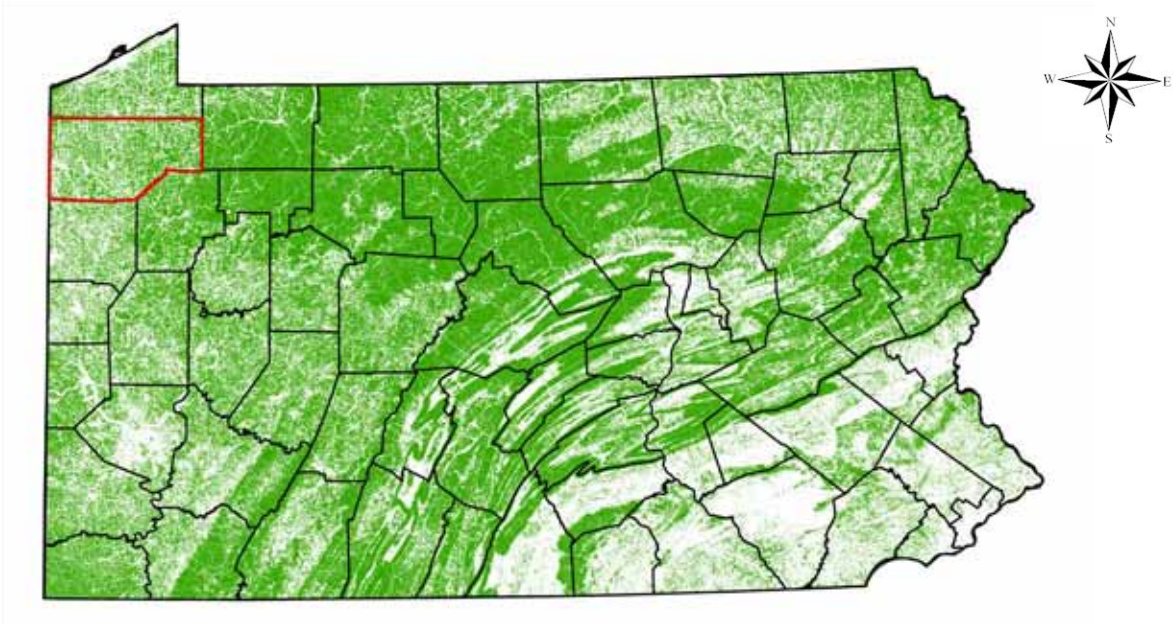


Figure 9a. Forest and wetland areas in Pennsylvania derived from the National Land Cover Data Set for Pennsylvania (USGS 2001).

ways, all-terrain vehicle and snowmobile trails, and railroads, as well as non-forest lands. Figure 9b shows forested areas greater than one acre that remain after fragmentation by interstate, US, and state highways; state and local roads; public forest roads; utility right-of ways; and active railroads. The forests blocks represent potential contiguous habitat for animals sensitive to all scales of fragmenting features, such as amphibians and interior forest birds.

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 on a single-mile stretch of road during one rainy night 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, Pennsylvania, over the last four years, white-tailed deer mortality due to road-kills was approximately four times higher than mortality due to hunting (Upper St. Clair Township Department of Deer Management). Six hundred thirty seven bobcats (*Lynx rufus*) were reported as road-kills in Pennsylvania from 1985 to 2000 (Goodrich et al. 2003). A 10-year study of road mortality in New Jersey recorded 250 raptors representing 12 species along a 90-mile section of road (Loos and Kerlinger 1993, cited in Goodrich et al. 2003).

Animals may alter their behavior in the presence of a road. One study found that small forest mammals (e.g., eastern chipmunk, eastern gray squirrel, and deer mouse) were reluctant to venture onto road surfaces where the distance between forest margins exceeded 20 m. The same study concluded that a four-lane divided highway might be as effective a barrier to the dispersal of small forest mammals as a body of fresh water twice as wide (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, 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 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, and 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, aluminum, 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 snowplowing may cause leaf injury to trees up to 120 meters from a road (Forman and Alexander 1998). Organic pollutants such as dioxins and polychlorinated biphenyls (PCBs) are present in higher concentrations along roads, and hydrocarbons may accumulate in aquatic ecosystems near roads (Trombulak and Frissell 2000). Storm runoff from roads, particularly where roads abut or cross water bodies, results in the transport of nutrients and sediments into aquatic ecosystems (Trombulak and Frissell 2000). Drifting or misapplied herbicides applied to roadsides and utility right-of-ways to control woody plant growth may damage forest edge and interior plant species (Williams 1995).

Humans are an integral part of natural history, where we function as ecosystem engineers, altering the landscape around us to suit our needs. Some species benefit from human-induced changes, such as birds that inhabit the early successional and edge habitats provided by utility corridors or disturbance-adapted plants that colonize roadsides. But as is more often the case, species with specific habitat requirements tend to suffer declining numbers when faced with human encroachment. Given the pervasiveness of human influence throughout the northeastern United States, the ecological importance of large areas of relatively pristine habitat cannot be overestimated. Not only are they potential habitat for a number of area-sensitive species, but 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.

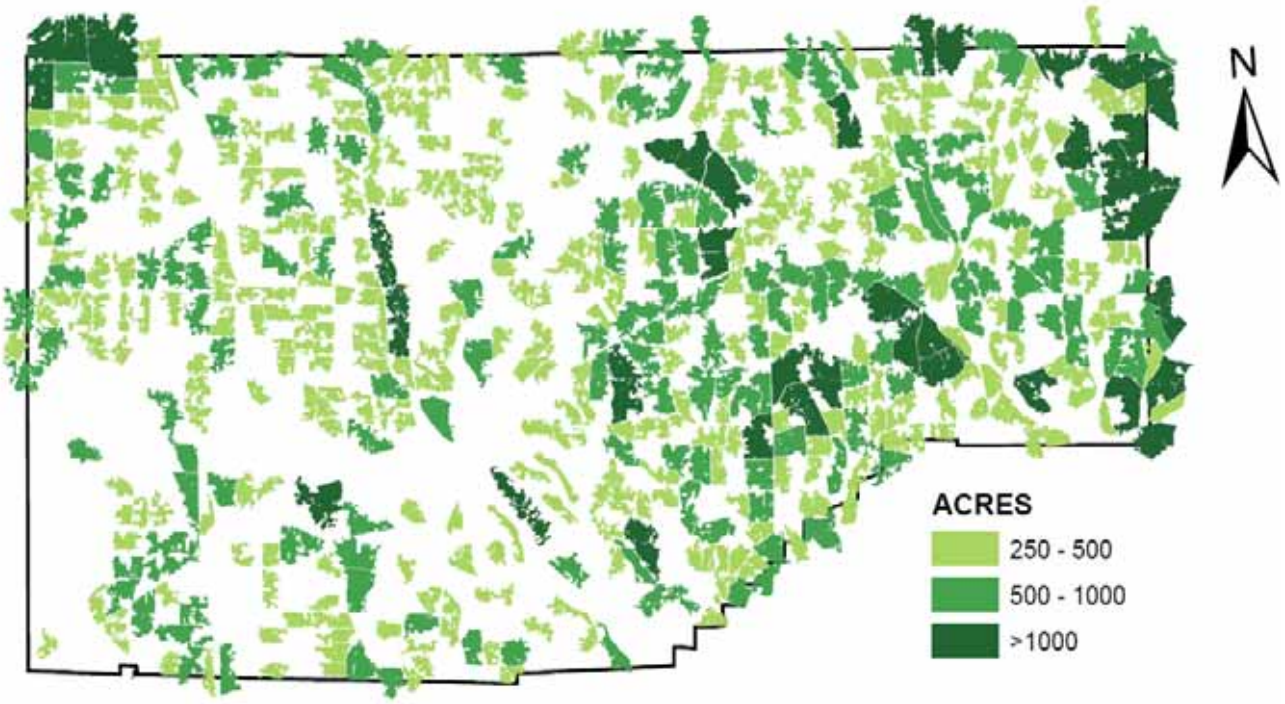


Figure 10. Contiguous forested areas in Crawford County greater than 250 acres.

NATURAL HERITAGE AREAS & CONSERVATION PLANNING CATEGORIES

To provide the information necessary to plan for conservation of biodiversity at the species, community, and ecosystem levels, two types of Natural Heritage Areas, as well as designations from two other sources, are included in the report.

Biological Diversity Area (BDA)

BDAs are areas containing plants or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity. BDAs include both the immediate habitat and surrounding lands important in the support of these special elements and are mapped according to their sensitivity to human activities. "Core" areas delineate essential habitat that cannot absorb significant levels of activity without substantial impact to the elements of concern. "Supporting Natural Landscape" areas maintain vital ecological processes or secondary habitat that may be able to accommodate some types of low-impact activities.

Landscape Conservation Area (LCA)

LCAs are large contiguous areas that are important because of their size, open space, habitats, and/or inclusion of one or more BDAs. Although an LCA includes a variety of land uses, it typically has not been heavily disturbed and thus retains much of its natural character. These large regions can be viewed as regional assets. They improve quality of life by providing a landscape imbued with a sense of beauty and wilderness, they provide a sustainable economic base, and their high ecological integrity offers unique capacity to support biodiversity and human health. Planning and stewardship efforts can preserve these landscape functions by limiting the overall amount of land converted to other uses, thereby minimizing fragmentation of these areas.

Important Bird Area (IBA)

The Pennsylvania Audubon Society administers the state's IBA Program and defines an IBA as "a site that is part of a global network of places recognized for their outstanding value to bird conservation." An IBA must meet one of several criteria developed by the Ornithological Technical Committee of the Pennsylvania Biological Survey (http://pa.audubon.org/Ibamain.htm). Planning for these areas should consider how best to maintain their value as bird habitat. The value of some large-scale IBAs may be due to the forest interior habitat contained within them. Natural communities that have a particular habitat value for birds (e.g., wetland) are typically the basis for smaller-scale IBAs, therefore, a high degree of protection should be given to these sites. Conservation plans are in the process of being completed for all IBAs in the state.

Important Mammal Area (IMA)

The Important Mammal Areas Project (IMAP) is being carried out by a broad based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Areas nominated must fulfill at least one of five criteria developed by the Mammal Technical Committee of the Pennsylvania Biological Survey (http://www.pawildlife.org/imap.htm). Planning for these areas should consider how best to maintain their value as mammal habitat. The value of these sites may be associated with high mammalian diversity, high-density populations, occurrence of species of concern, or educational potential. Stewardship plans are in the process of being completed for all IMAs in the state.

Results

As outlined above, Crawford County is highly diverse in terms of the habitats available to mammal, bird, reptiles, and amphibians. In many portions of the state, most habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix of inhospitable habitat. 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 animal species to localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction." If enough of these populations disappear from the landscape, these species' existence in Pennsylvania may be in jeopardy. Crawford County is a popular destination for residents of Pennsylvania and tourists during the summer season, and retains a large amount of publicly owned land that is managed and protected by various state and federal agencies. Extensive wooded wetlands and vegetated stream corridors serve as avenues of dispersal to the diverse list of wildlife occurring in the county. Continued management as well as responsible land use and development will ensure that this list will not be shortened and may grow in the future.

To conserve the native biological diversity of Crawford County we recommend the use of a two-tiered approach to selecting areas for their contribution to the entire ecological environment. The "fine-filter/coarse-filter" approach focuses attention on both the immediate habitat of the at-risk species, as well as the larger landscape scale processes that help to keep common species common.

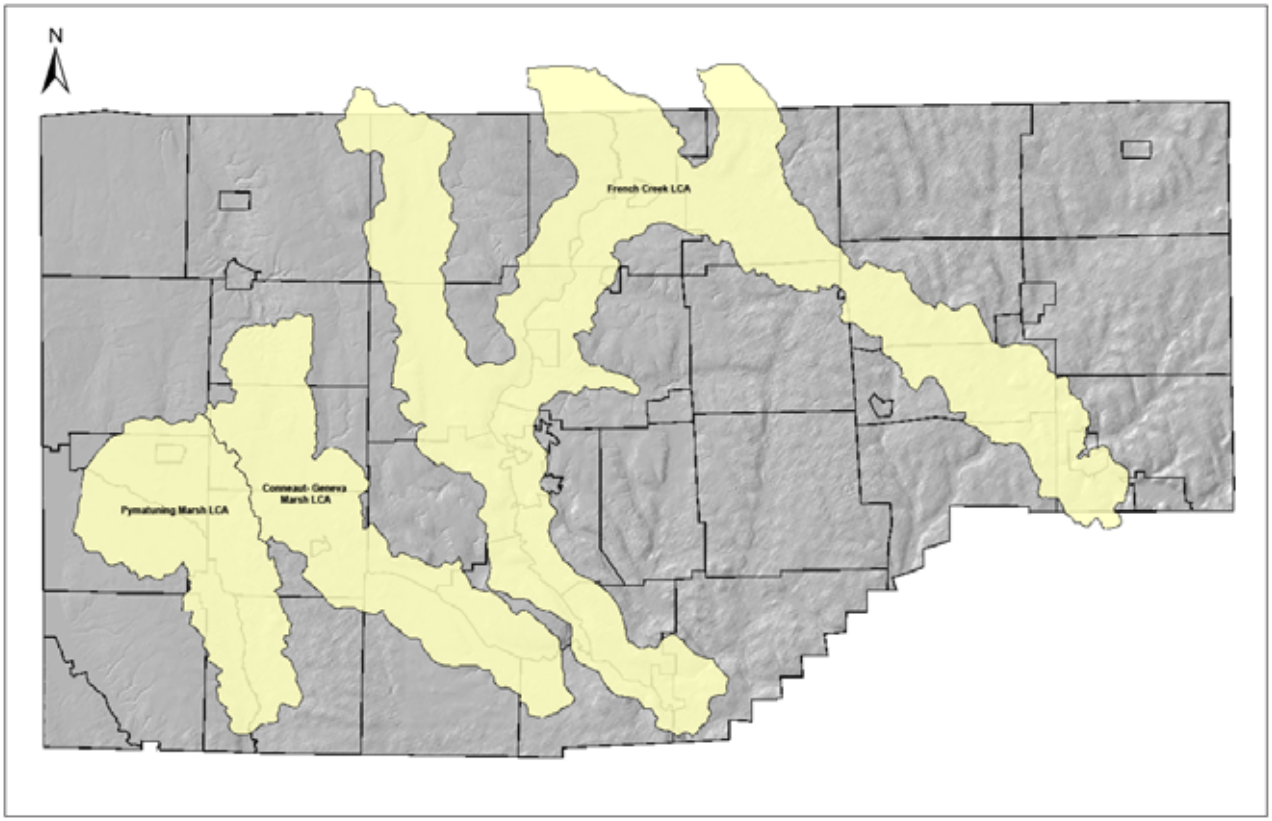
- The fine-filter approach targets protection for uncommon species that generally occur in specialized and discrete habitats. Focusing conservation efforts on these smaller habitats will help defend these species from local or global extinction. This fine-filter approach has been the focus of our field surveys – to find the locations of these unique species and their habitats, and to draw attention to the potential for their inadvertent destruction. These at-risk species and their habitats are described in the Biological Diversity Areas (BDAs).
- The coarse-filter approach suggests that whole suites of species as well as general ecological and environmental processes can be offered protection by focusing conservation efforts on large expanses of quality habitats of all types. We address the coarse filter approach by highlighting the largest unfragmented forest/natural habitats and creek, stream and river riparian corridors. The highest priority landscape scale habitats in the county are referred to as Landscape Conservation Areas (LCAs).

Besides these highest priority landscapes, all of the habitats of the county will benefit from conservation of large forested blocks and forested riparian corridors. The fine filter approach is characterized on one side of the township maps by highlighting the species of concern core and supporting habitats. On the reverse side of the maps is the coarse filter approach, with large forest blocks and all riparian corridors highlighted for the township. Through a combined effort of these two approaches, we can help to assure that uncommon species avoid local or global extinction and that common species stay common in Crawford County.

Landscape Conservation Areas (LCAs)

According to the National Land Cover Data Set for Pennsylvania (USGS 1999), forest covers roughly 310,000 acres (47%) of Crawford County. Hardwood forest accounts for 94 percent of Crawford County's forest. The remainder consists of coniferous forest (4%), and mixed conifer-hardwood forest (2%). The vast majority of contiguous forest occurs in blocks of less than 1,000 acres (Figure 10). Less than one percent (0.4%) of the identified forest blocks are larger than 1,000 acres.

Landscape Conservation Areas (LCAs) represent large areas of the landscape that are of higher ecological quality than other areas of similar size in the county. They may include large blocks of contiguous forest, extensive wetland complexes, relatively undisturbed, intact portions of the landscape, and/or areas linking rare element occurrences such as those recognized for Biological Diversity Areas. Because of the size of the LCAs, ownership is typically divided among many entities: individual, corporate, and public. Three LCAs designated around hydrologic features have been identified due to their exceptional quality as Natural Heritage Areas and wildlife habitat.



Landscape Conservation Areas (LCAs) of Crawford County

Table 10. Ownership of lands within Landscape Conservation Areas (LCAs).

LCA	Total Area (Acres)	Private Ownership (%)	Public Ownership (%)			
			State Game Lands	State Parks	National Wildlife Refuge	County and Local Parks
Conneaut-Geneva Marsh	42596	87	13	0	0	0
French Creek	133573	92	5	0	2	1
Pymatuning Marsh	36258	62	15	23	0	0

- **Conneaut-Geneva Marsh LCA**

This area is designated around the extensive emergent marsh surrounding Conneaut Lake and Conneaut Outlet, the outlet to Conneaut Lake, and the supporting watershed. Conneaut Marsh is the largest emergent marsh in the state, and is protected and managed as SGL #213 by the Pa Game Commission. Due to the size, intactness, and amount of birds that use this marsh, it has been chosen as an Important Bird Area by the PA Audubon Society. This type of habitat is increasingly important to preserve as wetland-dependent birds face range-wide habitat loss.

Threats and Stresses

The numerous tributaries flowing into Conneaut Marsh and Conneaut Outlet drain an extensive landscape matrix of agricultural and forested land. The impacts of agriculture, as discussed in the Biological Diversity Area descriptions for this site, can have severe impacts on the hydrology and quality of downstream wetlands. Issues such as chemical (pesticide) runoff, nutrient loading, and the establishment of invasive species are all threats to the species and communities present within the marsh. Many of the tributaries flow through wooded ravines, and some relatively larger forested blocks persist in some of the uplands, however, there are some streams lacking any sort of vegetated riparian border and thus, protection against the negative effects of agriculture. Road building and any other landscape modifying development will affect the current state of this wetland.

Recommendations

More than half of this LCA is protected and managed by the PA Game Commission, whose management goal is aimed to enhance habitat for wildlife. The Game Commission officers should take into consideration the importance and uniqueness of this marsh during management decision-making.

Sustainable forestry or best management practices should be applied to the surrounding agricultural lands to reduce any negative impacts that might affect the marsh. Maintaining forested riparian buffers and planting native trees along stream lacking vegetation is an important step to preserving good water quality. Furthermore, any changes to the landscape that would alter the hydrology of this marsh should be minimized.

- **French Creek LCA**

This LCA is designated around the main channel of French Creek and its major tributaries, Cussewago Creek, Conneauttee Creek, and Muddy Creek, extending almost entirely throughout the county, and the immediate supporting watershed of the creeks. French Creek, flowing from Chautauqua County, NY to the Allegheny River in Venango County, has been identified as one of the most ecologically important streams in the eastern U.S., boasting more fish and mussel species than any other comparably sized stream in the state (Western Pa Conservancy ----). This stream flows through a rural landscape with several relatively small towns along the way. The character of the landscape through which this river flows has contributed to high water quality. However, human development and landscape changes have had significant impacts on the creek in the past.

Threats and Stresses

Overall, aquatic species are declining nationwide due to human-influenced habitat degradation such as water pollution, nutrient loading, dredging, and stream channelization. The diversity of French Creek's aquatic organisms is great, but land use practices within the supporting landscape could be potentially harmful. Many of these activities are associated with the economic viability of the region such as logging, agriculture, mineral extraction, development, and some forms of recreation. The major threats to French Creek resulting from these actions include chemical pollution, nutrient loading, increased water temperatures, erosion and sedimentation, as well as the establishment of invasive species, which threaten native plant and animal species.

Recommendations

Maintaining the water quality of the French Creek watershed is key to sustaining viable populations of aquatic species. Finding a way for current economic activities of this region to coexist with the conservation of French Creek's ecological resources is essential for the watershed. The Western Pennsylvania Conservancy (WPC), in collaboration with the French Creek Project, has developed a Watershed Conservation Plan with the mission of sustaining a healthy French Creek with development and land use activities that occur in such a fashion as to protect environmental features and enhance the quality of life of its residents. The full report with detailed recommendations is available online at http://www.paconserve.org.

- **Pymatuning Marsh LCA**

This LCA is designated around the marsh and its supporting watershed that remains from the damming of the Shenango River to form Pymatuning Lake and Reservoir. This marsh, following the Shenango River outlet from the Lake and Crooked Creek to the south, lies mostly within SGL #214 and Pymatuning State Park. This LCA contains a variety of habitats such as open water, emergent marsh, shrub wetland, and bottomland forests, which supports a diversity of wildlife. This area has been designated both an Important Mammal Area (IMA) and an Important Bird Area (IBA). The supporting watershed, which is drained by the tributaries to the Shenango River, contains a mix of agricultural and urban development, including the borough of Linesville to the north of the lake.

Threats and Stresses

The core area of this LCA, part of Pymatuning Lake and the central marsh, is protected and managed by Bureau of State Parks (PA DCNR) and the PA Game Commission and is therefore largely protected from inappropriate development. The threats and stresses relative to these sections are discussed under the Biological Diversity Area descriptions for these sites. Maintaining water quality is key to sustaining the exceptional communities and species present at this site. Threats to the water quality of Pymatuning include pollution and nutrient inputs from surrounding agricultural and urban development. Additionally, any changes to the supporting landscape that would alter the hydrology of this site would greatly affect the ecological features of this LCA.

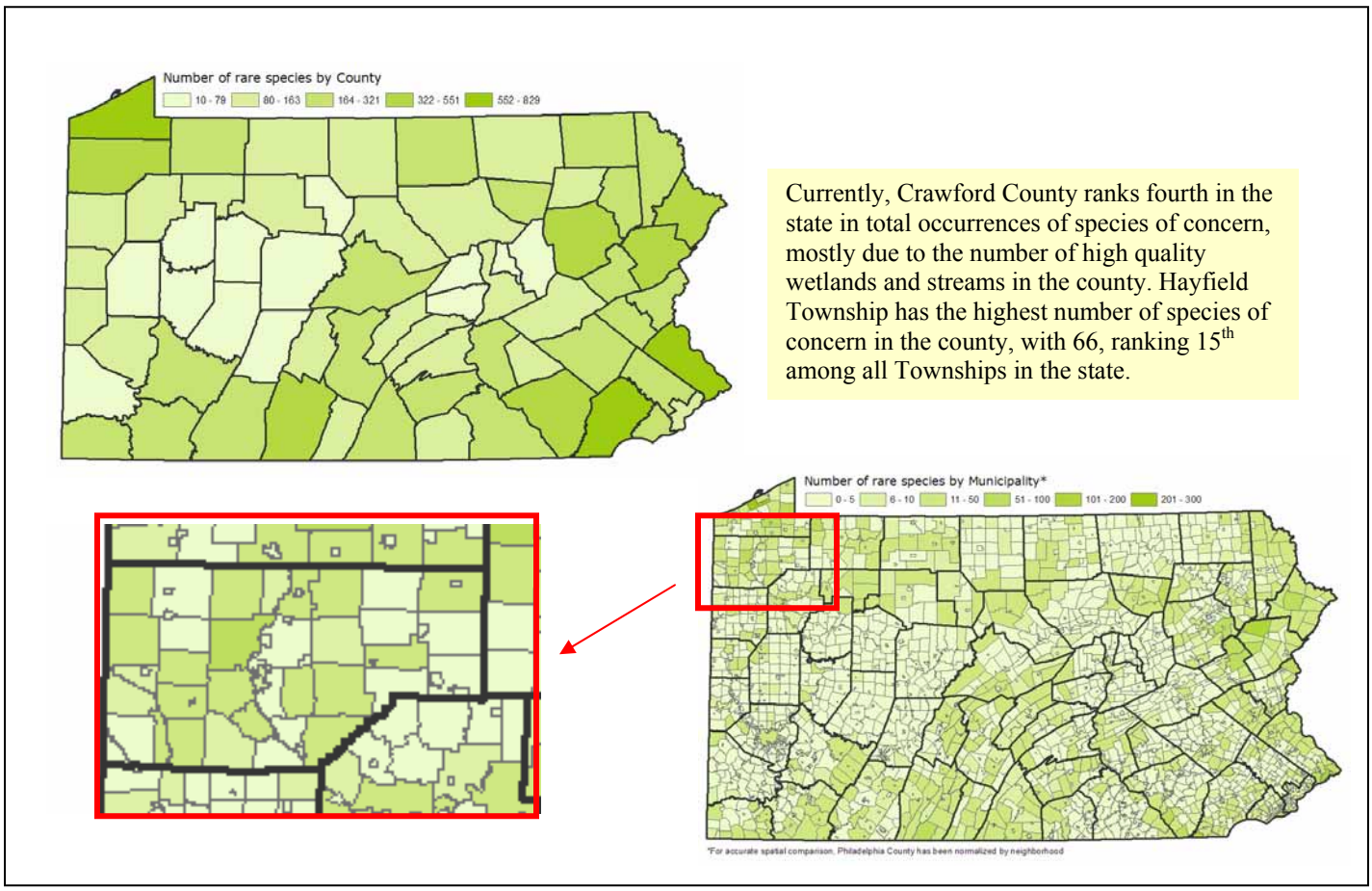
Recommendations

Any proposed development projects within this LCA should be carefully reviewed for potential impacts to the wetlands and its hydrology, as well as the rare species and natural communities linked to Pymatuning Lake and the downstream marsh valley. Maintain forested riparian buffers throughout upland farms and the surrounding wetlands. Implement best management practices and/or sustainable agriculture practices to surrounding farmland.

Biological Diversity Areas (Listed by Municipality)

Detailed maps and descriptions of Crawford County's Natural Heritage Areas follow, organized by township. For each township, a map, summary table, and full report are provided. Biological Diversity Areas, Landscape Conservation Areas, and Public Lands are indicated on the municipality maps. Public Lands are properties established and managed to a large extent for natural resources and/or those that have the potential to manage such resources in order to maintain or enhance important ecological assets in the county. Examples include state game lands, state forests, and state parks. Townships are arranged alphabetically. Boroughs are included with the appropriate township due to their small size.

- A categorical designation of a site's relative significance is listed after the site name. Table 1 (pg. xiv) has a summary of sites by significance category. Definitions of the significance categories are outlined in Appendix I (pg. 275).
- Listed under each site name are any state-significant natural communities and species of concern that have been documented within the area.
    - See Appendix IV (pg. 278) for a list of Natural Communities recognized in Pennsylvania.
    - Some species perceived to be highly vulnerable to intentional disturbance are referred to as "Species of concern" rather than by their species name, at the request of the jurisdictional agency.
    - The PNHP (Pennsylvania Natural Heritage Program) rarity ranks and current legal status (detailed in Appendix V, pg. 282) are listed for each community and species.
- The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for protection.



Athens Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
East Branch Oil Creek BDA			*Exceptional Significance*		
see Sparta Township					
Koochogey Wetlands BDA			*Exceptional Significance*		
see Steuben Township					
Muddy Creek BDA			*High Significance*		
Longhead darter (*Percina macrocephala*) – Fish	G3	S2S3	PT	2005	E
Creek heelsplitter (*Lasmigona compressa*) – Mussel	G5	S2S3	-	1995	E
Sensitive species of concern***	-	-	-	1995	E
Muddy Creek Wetlands BDA			*Exceptional Significance*		
see Rockdale Township					
Puckerbush Lake Tributary BDA			*High Significance*		
Downy willow-herb (*Epilobium strictum*) – Plant	G5	S3	PE	1999	E
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area Conservation Region.

Crawford County
Natural Heritage Inventory
Athens Township

Biological Diversity Area:

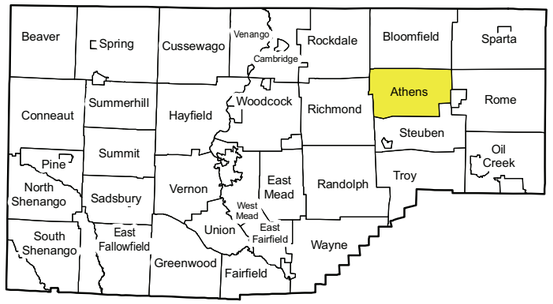
Muddy Creek
East Branch Oil Creek
Koochogey Wetland
Puckerbush Lake Tributary

Landscape Conservation Area:

French Creek LCA

Public Land:

State Game Land 122
State Game Land 199



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

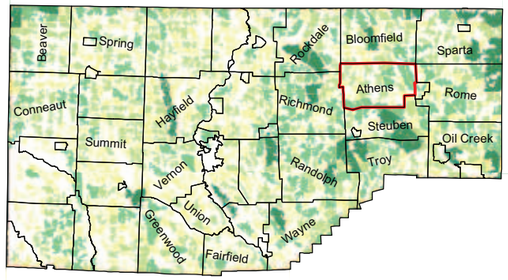
Crawford County
Natural Heritage Inventory

Athens Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

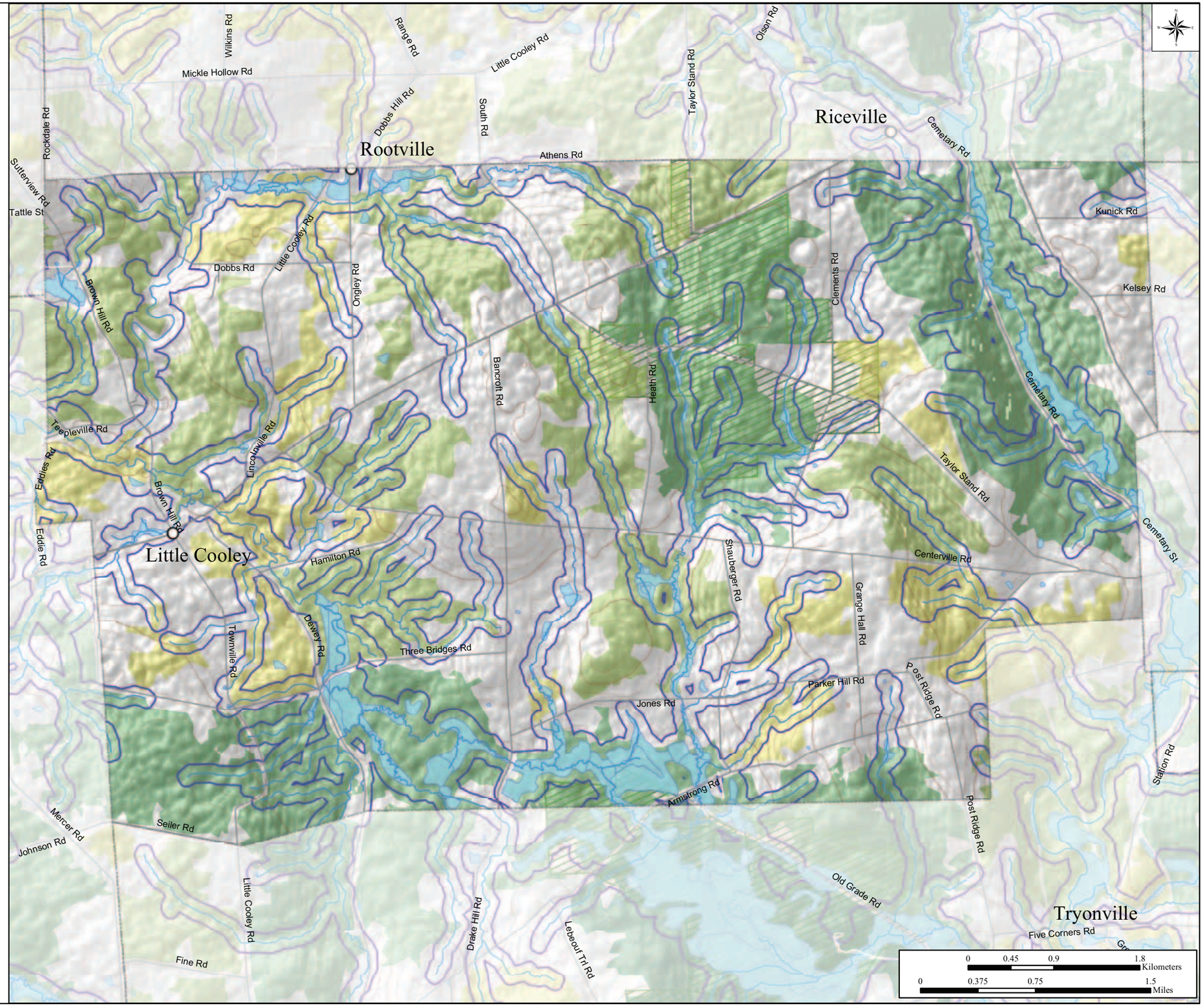
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Athens Township is located in the northeastern section of Crawford County. The landscape is characterized by rich valleys and rolling topography, which have resulted from the last glaciation. Several ecologically important watersheds lie within the township, including Muddy Creek, Navy Run, and Little Federal Run, which support the Oil Creek watershed, home to a number of exceptional value (EV) and high quality (HQ) streams. Approximately half of the township is forested with the other half being used for agriculture, mainly row crops. State Game Land #199 lies in the north central portion of the township. There are no Important Mammal Areas (IMAs) in this township however, the northeastern portion of Athens lies within the Erie National Wildlife Refuge (ENWR) Important Bird Area Conservation region.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

East Branch Oil Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Sparta Township.

Koochogey Wetlands BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Steuben Township.

Muddy Creek BDA – *High Significance*

This BDA focuses on the central portion of Muddy Creek. At this point, the creek has gained sufficient size and structure from its numerous wetlands and tributary inflows to support habitat for several important groups of aquatic organisms. Three aquatic species of concern were identified at this site, including, the **creek heelsplitter** (*Lasmigona compressa*), a mussel species of concern, and the **longhead darter** (*Percina macrocephala*), a fish species of concern. The stream is characterized by shallow riffles and runs mixed with deep holes, with substrate that varies from gravel and sand to cobble and coarser sediment. Other mussels in this portion of the stream include the ladyfinger (*Elliptio dilatata*), fat mucket (*Lampsilis siliquoidea*), plain pocketbook (*L. cardium*), and the creeper (*Strophitus undulatus*).

Threats and Stresses

A vegetated riparian zone borders much of the stream; however, some areas are lacking sufficient buffers, particularly those sections bordering agricultural fields. Numerous road and utility right-of-ways cross the creek and therefore sedimentation, loss of shading, and introduction of non-point source chemical and sediment pollutants are all concerns.

Recommendations

High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat for the mussels using this section of the creek. Establishing at least 100 m (328 ft) buffer of woody vegetation

along all segments of the stream would help protect the water quality of the creek by reducing erosion, sedimentation, and pollution, as well as aid in maintaining an even water temperature throughout the stream. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain high water quality in the creek.

Muddy Creek Wetlands BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Rockdale Township.

The wetlands surrounding Puckerbush Lake support a population of downy willow-herb, a plant species of concern.
photo source: Kenneth J. Sytsma

Puckerbush Lake Tributary BDA – *High Significance*

This BDA features the small headwaters area of a conifer-lined tributary and valley leading to Puckerbush Lake that is comprised of several wetland community types that support a population of **downy willow-herb** (*Epilobium strictum*), a plant species of concern in Pennsylvania.

The core wetland area is a small, open, herb-dominated wetland dominated by wool grass (*Scirpus cyperinus*), broom sedge (*Carex scoparia*) and wrinkled-leave goldenrod (*Solidago rugosa*). A shrub wetland community dominated by silky willow (*Salix sericea*) and quaking aspen (*Populus tremuloides*) surrounds the core area. Although the numerous communities within this wetland can be classified as several natural community types, none are recognized here as exceptional examples at a state level. However, a plant population of special concern, downy willow-herb, occupies this wetland and therefore the wetland as a whole is recognized as highly important for this plant species.

Most of the core area and approximately the eastern half of the supporting landscape area lie within State Game Lands #199. Most of the supporting landscape is forested except where a road bisects the small headwaters stream of this watershed. A few reverting agricultural fields and a small portion of one active field are within the supporting landscape of this wetland.

Threats and Stresses

Most of this area is under the management of the Pennsylvania Game Commission and is secure from development or other large land use changes. Succession of this open wetland to shrub or forest conditions may render this area less appropriate as habitat for downy willow herb and some of the other plant and animal associates of this wetland. Invasive exotic species like purple loosestrife (*Lythrum salicaria*) and exotic honeysuckles (*Lonicera* spp.) that typically establish in wetlands may pose a threat to this community but no records from surveys of this site have noted their presence. Target pioneer populations of invasive plants for immediate and continued removal, particularly purple loosestrife. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.

Disturbance to areas within the watershed that result in sediment release and hydrologic modification are primary threats to this wetland that may result from surrounding land use practices. Increased access to the wetland by invasive species that have colonized disturbed areas such as roadsides and abandoned fields may also threaten the native plant diversity of this wetland.

Recommendations

Further consideration of the hydrology and vegetation structure of this wetland would aid in the development or modification of a management plan to address succession within this site. Monitoring the downy willow-herb population is desirable. The Pennsylvania Game Commission may choose to incorporate sections of the supporting landscape area into game lands management plans with the goals of establishing vegetated buffers at least 100 meters wide around the wetland. Implementing best management practices on the remainder of the landscape would be a good step in ensuring the integrity of this wetland. Working with other involved landowners to encourage similar goals and approaches is also desirable.

Beaver Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
East Branch Conneaut Creek Headwaters Wetland BDA			*High Significance*		
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2003	E
Mud Run Wetland BDA			*High Significance*		
Pumpkin ash (*Fraxinus profunda*) – Plant	G4	S1	-	2003	E
West Branch Conneaut Creek BDA			*Exceptional Significance*		
False hop sedge (*Carex lupuliformis*) – Plant	G4	S1	TU	1998	E
Pumpkin ash (*Fraxinus profunda*) – Plant	G4	S1	-	2003	E
Shumard's oak (*Quercus shumardii*) – Plant	G5	S1	PE	2006	E
Red currant (*Ribes triste*) – Plant	G5	S2	PT	1989	E
Pineland pimpernel (*Samolus parviflorus*) – Plant	G5T5	S2	TU	2003	E
Central mudminnow (*Umbra limi*) – Fish	G5	S3	PC	2003	C
Sensitive species of concern***	-	-	-	2003	C

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: State Game Lands #101

West Branch Conneaut Creek
photo source: PHNP

Crawford County
Natural Heritage Inventory

Beaver Township

Biological Diversity Area:

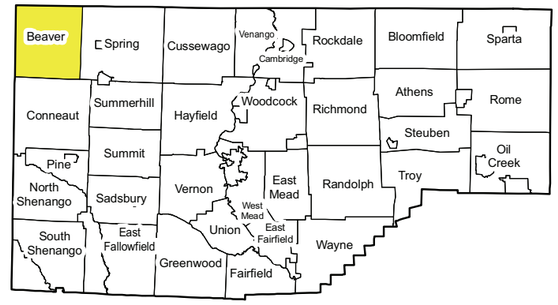
East Branch Conneaut Creek
Headwaters Wetland
Mud Run Wetland
West Branch Conneaut Creek

Landscape Conservation Area:

None

Public Land:

State Game Land 101



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

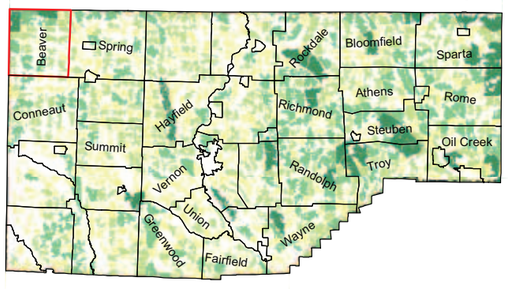
Crawford County Natural Heritage Inventory

Beaver Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



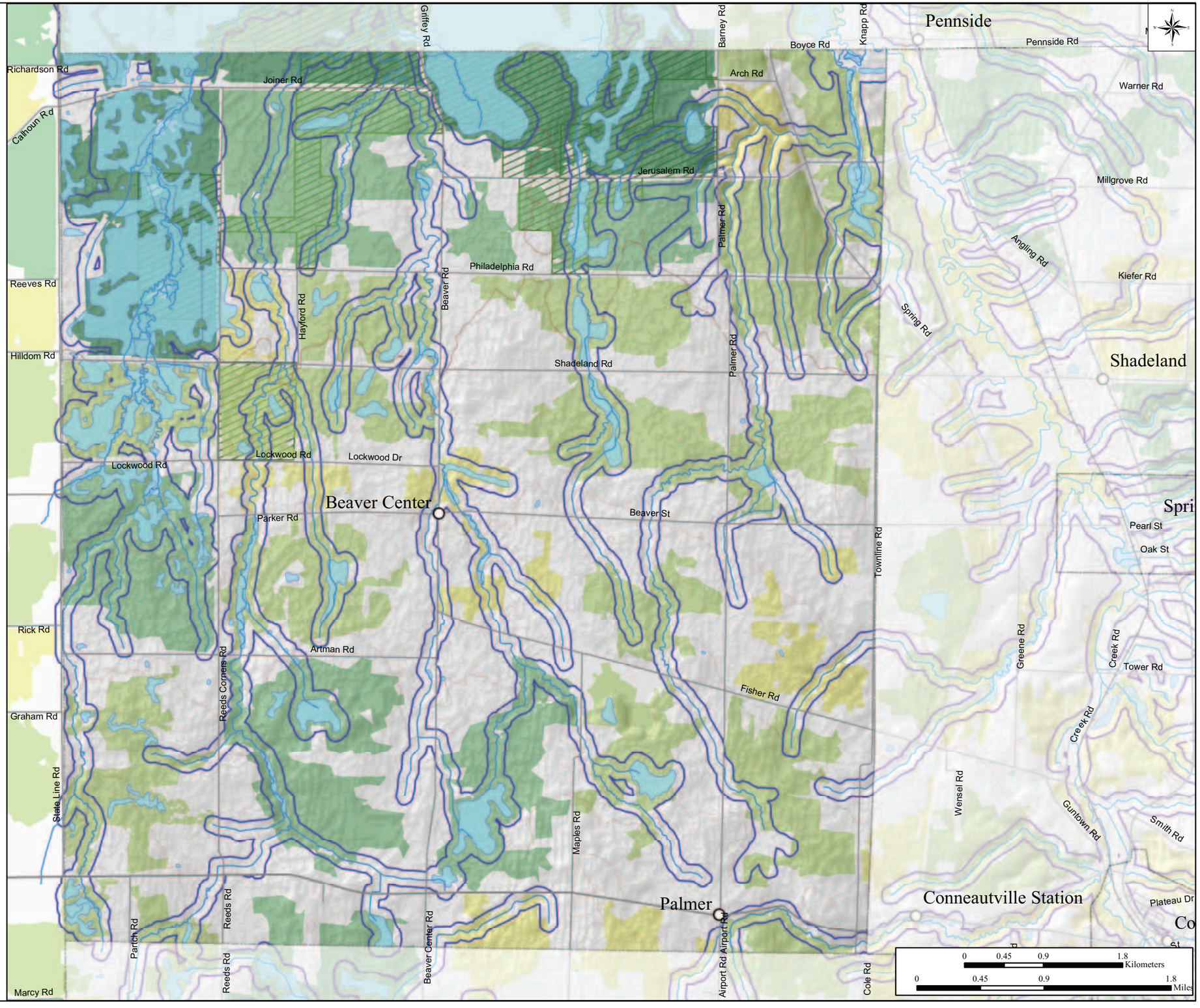
Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Beaver Township is located in the northwestern corner of Crawford County, bordered by Erie County to the north and Ohio to the west. Forests cover almost half of the township, but most of the forested blocks have been fragmented by roads and agriculture into small areas less than 500 acres. In the past, lumbering was an important source of income for residents. The largest contiguous forest blocks are located in State Game Lands #101, situated along the northern border of Crawford County. Draining the township are five small tributaries of Conneaut Creek, which flow north in somewhat parallel channels, into Erie County. Many of these streams flow through low, flat agricultural areas, most of which are dairy or stock-raising farms.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

East Branch Conneaut Creek Headwaters Wetland BDA – *High Significance*

This BDA consists of a small forested headwaters wetland and its immediate watershed. The wetland lies within the East Branch of Conneaut Creek watershed, bordering the Stone Run and Mud Run watersheds. The core of this BDA, delineated around the wetland, is comprised of forest dotted with numerous vernal pools supporting an oak-hardwood palustrine forest, which is primarily dominated by red maple (*Acer rubrum*) and swamp white oak (*Quercus bicolor*). Other associates include cottonwood (*Populus tremuloides*) and shingle oak (*Quercus imbricaria*). The understory is composed of smaller members of the canopy plus more typical understory species, such as musclewood (*Carpinus caroliniana*), witch hazel (*Hamamelis virginiana*), spicebush (*Lindera benzoin*), and winterberry (*Ilex verticillata*). Common herbaceous species include bigleaf aster (*Eurybia macrophyllum*), royal fern (*Osmunda regalis*), intermediate wood fern (*Dryopteris intermedia*), white wood aster (*Aster divaricata*), Christmas fern (*Polystichum acrostichoides)* and a plant species of concern, **Clinton's wood fern** (*Dryopteris clintoniana*). This fern species is typically associated with circumneutral swamps, and in the northwest portion of the state, often those of the hemlock-northern hardwoods type.

The wetland features within this watershed combine to form the small, unnamed tributary that feeds into the main branch of the East Branch of Conneaut Creek. The bulk of the supporting landscape is forested with a section of agricultural field in the southwestern and northeastern portion of the watershed.

Threats and Stresses

Although the wetland featured in this BDA and the plants of concern supported by it are relatively intact, the watershed of the wetland is constricted within a matrix of agricultural fields. Much of the water feeding the wetland travels as surface water or groundwater through a forested landscape except for the sections of the watershed being used for agriculture. Therefore, forestry and agricultural practices within the watershed may affect the water quality of the wetland.

Recommendations

The wetland forest section constitutes the bulk of the core habitat. Most of this BDA is nearly contiguous forest. Maintaining both the canopy and contiguity of the forest would help maintain the hydrology and microhabitats that are important for the population of Clinton's wood fern. Timber management would best be reserved for areas outside the core wetland.

Avoid activities that would fragment this habitat or create more edge areas, such as road building, which encourage the introduction of invasive plants or edge-adapted species.

Mud Run Wetland BDA – *High Significance*

This BDA focuses on a wetland within the shallow Mud Run valley, which supports an occurrence of **pumpkin ash** (*Fraxinus profunda*), a tree species of concern in Pennsylvania. Pumpkin ash grows in shallow, swampy forests in Pennsylvania, and is native only to the northwestern portion of the state. Pumpkin ash gets its name from the large swollen base that develops in older trees.

The core area contains two occurrences of pumpkin ash, one occurring within a forested wetland on State Game Lands #101, and another occurrence on a private inholding upstream from the large wetland. The area is a successional woodland and shrubland dominated by red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), and black ash (*Salix nigra*). Other species present include white ash (*Fraxinus americana*), downy serviceberry (*Amelanchier arborea*), musclewood (*Carpinus caroliniana*), and American hop hornbeam (*Ostrya virginiana*). The more open areas are herbaceous-graminoid dominated with northern bugleweed (*Lycopus uniflorus*), scorpion grass (*Myosotis verna*), reed canary-grass (*Phalaris arundinacea*), devil's beggartick (*Bidens frondosa*) and greater bladder sedge (*Carex intumescens*). This survey found a limited population of pumpkin ash and therefore the extent of the core area is limited to the wetland and the upstream occurrence buffered by a hundred meters.

The main section of wetland extends along the Muddy Creek drainage and includes sections of standing water and dense shrubland dominated by meadowsweet (*Spiraea alba*), silky dogwood (*Cornus amomum*), and buttonbush (*Cephalanthus occidentalis*). The watershed of the wetland is important for maintaining hydrology and supporting both the wetland and the pumpkin ash that in turn depends upon the wetland. The immediate watershed of the wetland is considered supporting landscape for this BDA.

Threats and Stresses

Much of this area is within State Game Lands and is therefore afforded protection from many kinds of development, however, the area has received numerous disturbances including ditching and maintenance of areas adjacent to the wetland as game food plots. Timbering and use, in part, for pasturing were likely past activities within this area. Multiflora rose (*Rosa multiflora*) is one of several exotic invasive species present in the wetland and along with past and current maintenance of open conditions, will likely prove to be a significant problem for maintaining native diversity on the site.

Emerald ash borer (*Agrilus planipennis*) is a direct threat to the species of concern, pumpkin ash, at this site. Emerald ash borer larvae feed on the inner bark of the tree, causing mortality. This invasive insect pest was discovered in Michigan in 2002, and is now found in several nearby counties in Pennsylvania.

Recommendations

Correcting altered hydrology, controlling invasive species, and working to establish canopy conditions in areas surrounding the shrub and herbaceous portions of the wetland would be important management considerations for improving the overall condition of this wetland. Further survey for rare species, including new locations for pumpkin ash, would be important for updating any management plan for the area. Making land managers aware of the presence of pumpkin ash and engaging them in surveys would be a good first step in the conservation of this particular species.

Maintaining forest cover with the goals of increasing connectivity and a greater portion of forest interior to provide better habitat for edge sensitive species would also help to ensure good riparian and wetland buffers and ensure high water quality inputs into the wetland.

Best Management Practices should be adopted to control the spread of Emerald Ash Borer, and monitoring should be done to determine if this species has increased its range into Crawford County. To prevent the spread of Emerald Ash Borer, fire wood and other ash products should not be moved, especially from areas known to be infested.

Red Currant
Photo source: Kitty Kohout

West Branch Conneaut Creek BDA – *Exceptional Significance*

Beginning in Crawford County and flowing northwestwardly into Erie County, Conneaut Creek is Pennsylvania's largest tributary to Lake Erie. Despite impacts from agricultural runoff, Conneaut Creek harbors a great diversity of plant and animal life. This creek has a diverse fishery including bass and walleye, and is stocked with steelhead trout by the Pennsylvania Fish and Boat Commission. The West Branch of Conneaut Creek, flowing through northwestern Crawford County supports a number of species of concern. Due to the size and the complexity among the areas highlighted in the BDA, the descriptions and recommendations are split into different sections.

West Branch of Conneaut Creek Wetlands

A stretch of Conneaut Creek flowing through the eastern portion of State Game Lands #101 is embedded within an extensive wetland, which supports several plant species of concern. This wetland complex contains a variety of continuously forested and shrub wetland types. The southern portion of this core consists of a red maple-yellow birch-black ash palustrine forest that supports a population of **red currant** (*Ribes triste*), a plant species of concern. The adjacent forest is dominated by black cherry (*Prunus serotina*), basswood (*Tilia americana*), American beech (*Fagus grandifolia*), cucumber magnolia (*Magnolia acuminata*), and tulip poplar (*Liriodendron tulipifera*). Moving upstream, palustrine forests give way to hardwood-dominated swampy areas. The eastern bank contains scattered **pumpkin ash** (*Fraxinus profunda*) throughout wet vernal pond flat s and **Shumard's oak** (*Quercus shumardii*). **False hop sedge** (*Carex lupuliformis*), another plant species of concern, grows on the western bank of the creek. The open muddy banks and floodplain of the creek contain scattered occurrences of **pineland pimpernel** (*Samolus parviflorus*), a wetland plant of conservation concern. Several small areas within this wetland complex are currently impounded or open post-impoundment wetlands.

False Hop Sedge
Photo source:Robert Read

<u>Threats and Stresses</u>

Much of this wetland falls within State Game Land boundaries and is largely protected from disturbance. The eastern migration of the emerald ash borer (*Agrilus planipennis*), an exotic Asian beetle, is a potential threat to all ash trees (*Fraxinus* sp.). The beetle has currently been documented in Ontario, Michigan, Illinois, Indiana Ohio, Maryland, Virginia, and most recently in Pennsylvania. Currently the entire states of Indiana and Illinois and 22 Ohio counties are being quarantined to prevent the spread of the emerald ash borer (Ohio Department of Agriculture 2006). A four county area in Pennsylvania has also been quarantined. Movement of firewood by campers from infected areas to non-infected areas has unfortunately created a fast and effective travel route for this pest species.

Recommendations

The PA Game Commission should maintain the wetland in a forested condition and avoid building roads through or adjacent to this wetland in order to protect water quality and habitat continuity. Additional surveys for animals and plants that utilize this wetland, as well as periodic monitoring for the presence of the emerald ash borer, are desirable.

Conneaut Creek

The core area of this BDA contains sections of the east, middle, and west branches of Conneaut Creek in the northwest section of Crawford County, extending into Erie County. This portion of the stream serves as important aquatic habitat for **central mudminnows** (*Umbra limi*), a fish species of concern and another **sensitive species of concern**. There are a variety of natural communities in the floodplain of Conneaut Creek. Most forested communities are medium age eastern hemlock (*Tsuga canadensis*)-mixed hardwood forests with some interspersed mature stands. A population of **pineland pimpernel** (*Samolus parviflorus*) is located along the banks of this creek.

The population of central mudminnows was found in the West Branch of Conneaut Creek approximately one kilometer upstream from the aforementioned wetlands. This fish prefers slow-moving streams and wetlands with abundant aquatic vegetation and substrates with high organic debris, peat or muck accumulation (Ohio Department of Natural Resources 2002). In the spring when water temperatures and stream levels rise, spawning occurs along stream margins (Tomelleri and Eberle 1990). Central mudminnows are fairly uncommon throughout much of their range, which extends through the Midwestern states, northeastern U.S. and Canada. The central mudminnow is in need of protection or conservation along the periphery of its range.

Similarly, the species of concern typically inhabit pools and moderate to low gradient streams with gravel substrates and light aquatic vegetation. This species has a reproductive association with sunfish (*Lepomis* spp.), and they typically spawn in the nesting territories of sunfish (NatureServe 2006). Most of the year, this species can tolerate mild turbidity but they require clear water for spawning. They inhabit small streams from Ontario south through most of the Midwestern U.S. (2006).

Threats and Stresses

This stretch of stream, including the majority of this BDA, lies within State Game Lands #101 and is largely protected from inappropriate development. However, timbering or road development by the PA Game Commission in this area may be detrimental to the quality of this habitat. Both of these species of fish are somewhat tolerant to harsh habitat conditions, however, they are vulnerable to habitat destruction and alteration such as dredging, channelization, and ditching projects.

Recommendations

The PA Game Commission land managers should avoid road building around this portion of the stream and best management practices should be consulted for any timbering plans. Dredging, ditching, and channelization of the stream should be avoided to promote healthy in-stream habitat for these fish.

East Branch Conneaut Creek Swamp

A small portion of floodplain forest along the East Branch of Conneaut Creek contains a wooded swamp harboring a population of **pumpkin ash** (*Fraxinus profunda*) a species of concern. Pumpkin ash is typically found in areas where surface water stands well into the growing season, such as swamps, sloughs, and poorly drained flats of major river floodplains (Burns and Honkala 1990). In Pennsylvania it is limited to Erie, Crawford, and Warren counties (Rhoads and Klein 1993; NatureServe 2006). Common associates of this tree include red and sugar maple (*Acer rubrum*, *A. saccharum*), black willow (*Salix nigra*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and poison-sumac *(Toxicodendron vernix*).

Threats and Stresses

This forested swamp lies in the State Game Lands and is largely protected from inappropriate development. The eastern migration of the emerald ash borer (*Agrilus planipennis*), an exotic Asian beetle is a potential threat to all ash trees (*Fraxinus* sp.). The larvae of this beetle feed on the inner bark of ash trees, which disrupts the natural transport of nutrients and water throughout the tree leading to the eventual death of the tree. An ash tree that is infected by the emerald ash borer will often experience canopy dieback, or thinning of the canopy, splitting bark, serpentine galleries which show the feeding route of the larvae, and epicormic shoots (new growth from the base of the tree) (Wilson and Rebek 2005). The beetle has currently been documented in Ontario, Michigan, Illinois, Indiana Ohio, Maryland, Virginia, and most recently in Pennsylvania. More information regarding the emerald ash borer can be found on the PA DCNR website or at http://www.emeraldashborer.info.

Recommendations

Periodic monitoring of ash trees for invasion by emerald ash borers is advised. Since this BDA lies within a large block of interior forest, timbering should be limited, or if harvesting is to occur, sustainable timber management should be practiced. Interior forests are important landscape features, and they provide habitat to many wildlife species including a number of interior forest dwelling birds. These species require a certain amount of continuous forest just to breed. Retaining as much interior forest as possible at this site is desirable.

Bloomfield Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Lake Canadohta BDA	*Exceptional Significance*				
Tadpole madtom (*Noturus gyrinus*) – Fish	G5	S1	PE	1980	E
Vasey's pondweed (*Potamogeton vaseyi*) – Plant	G4	S1	PE	2004	A
Glacial lake – Natural Community	G?	S1	-	2004	E
Little Federal Run Headwaters Wetland BDA	*High Significance*				
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2004	E
Pied-billed grebe (*Podilymbus podiceps*) – Bird	G5	S3BS4N	-	1984	E
Hemlock palustrine forest – Natural Community	GNR	S3	-	2004	E
Puckerbush Lake Tributary BDA	High Significance				
see Athens Township					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

Other Conservation Areas: None

Crawford County
Natural Heritage Inventory
Bloomfield Township

Biological Diversity Area:

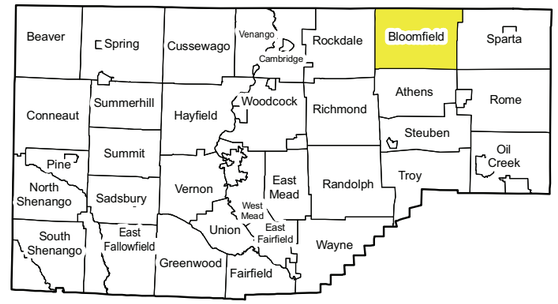
Lake Canadohta
Little Federal Run Headwaters Wetland

Landscape Conservation Area:

None

Public Land:

State Game Land 202



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

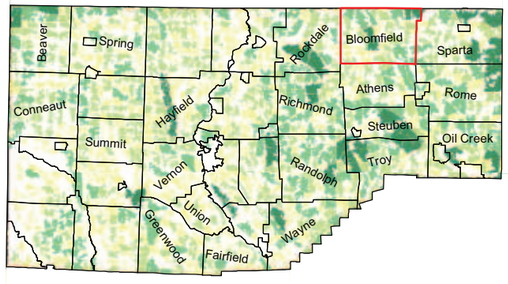
Crawford County
Natural Heritage Inventory

Bloomfield Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

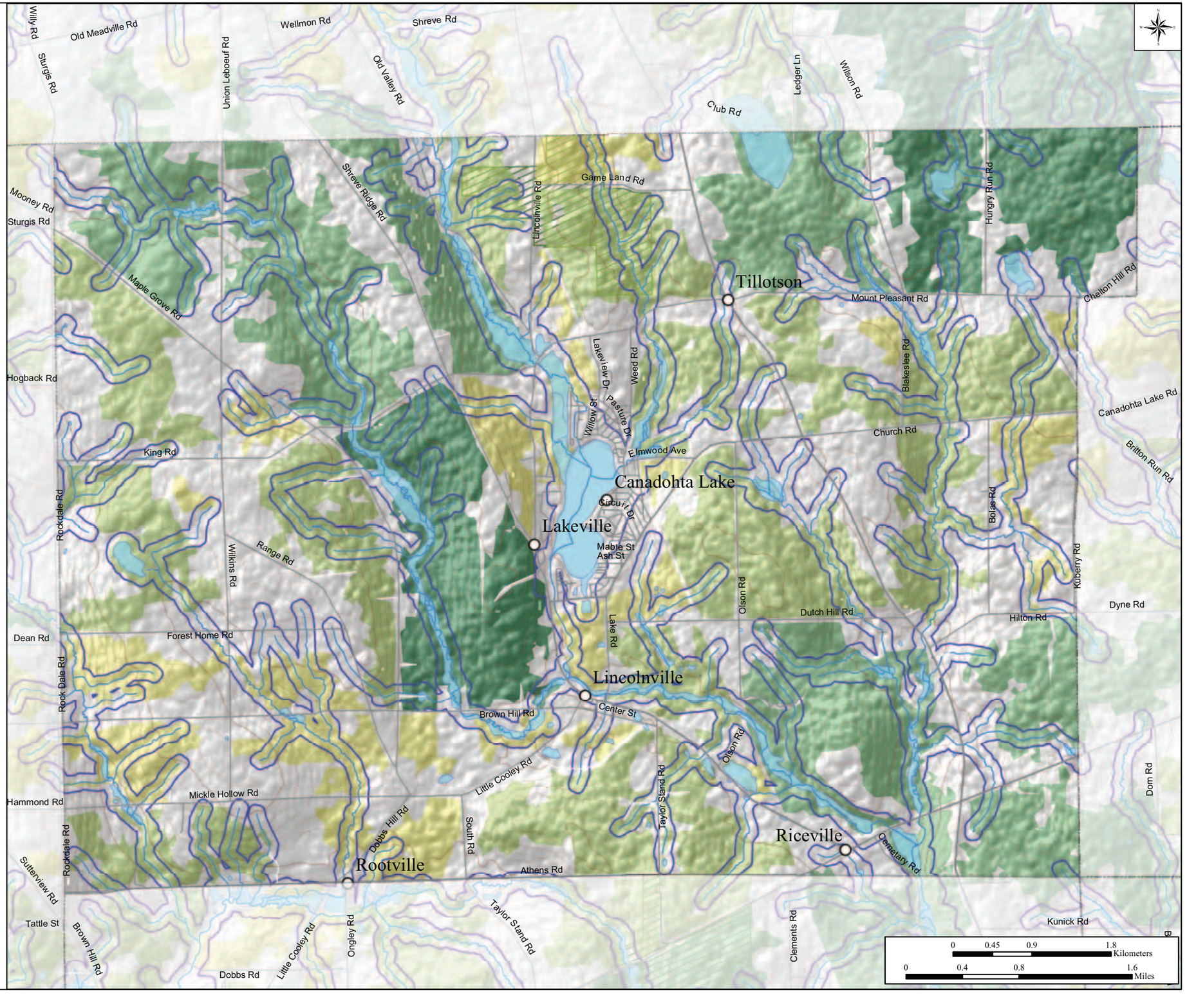
PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Bloomfield Township is located in northeastern Crawford County. It is bordered by Rockdale Township and Sparta Township to the west and Erie County to the north. The main branch of Oil Creek has created a deep valley, which bisects the township in southeastwardly fashion. The numerous valleys of small tributaries to Oil Creek create an overall rolling topography. Lake Canadohta is the source of West Branch Oil Creek. This glacially formed lake is situated between Shreve Ridge, the eastern wall of the Oil Creek Valley, and Dutch Hill in the center of the township. State Game Lands #202 is located to the north. Over half of this township is forested with beech, maple, hemlocks, and basswoods in the eastern lowlands and chestnut and white pine ridges prevailing in the west.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Lake Canadohta BDA – *Exceptional Significance*

Lake Canadohta was formed, as were the other **glacial lakes** in Pennsylvania, from the weight of ice lying in place as the glaciers retreated north. Despite the bi-lobed outline of this lake, it was apparently created from a single ice block, as there is no depression in the southern end of the lake. There is a dam at the outlet, which raises the level of the lake about two meters except for drawdown in the winter when it is about one meter. The lake is fed by East Shreve Run, West Shreve Run and an unnamed tributary. West Shreve Run has been widened, dredged, and split into two channels near the mouth to provide boat access to about thirty residences. The outlet is dammed and leaves as Oil Creek, which subsequently drains into the Allegheny River at Oil City. The flora of this lake has been extensively documented in the Glacial Lakes Report (Grund and Bissell 2006), a project of the Western Pennsylvania Conservancy. Details of the distribution of both native and invasive plants are known throughout the lake. A total of 174 plant species have been documented at the lake.

The shoreline and adjacent areas have been extensively developed for seasonal and permanent residences. According to local residents, extensive wetlands at the north end of the lake were filled to create more land for development in the 1930's (Grund and Bissell 2006). Accounts of houses shaking as trucks pass suggest that some of these houses are sitting on saturated peat. A local legend states that a house that was built south of the mouth of East Shreve Run has sunken into the wetland, and even the roof is no longer visible. The high population density has led to septic problems in the lake that have been ameliorated by the installation of a municipal sewage system.

The lake itself represents the core habitat of this BDA. The glacial lake community and **Vasey's pondweed** (*Potamogeton vaseyi*), a plant species of concern, are the conservation focus of this site. The lake hosts the largest population of *Potamogeton vaseyi* in Pennsylvania. This plant was common during surveys in 2004, though not nearly as abundant as in the late 1980's when the lake was in the early stages of recovery from high nutrient inputs before a sewage treatment plant was installed for residents around the lake. Wetlands that were apparently once extensive around the lake are now restricted to small, disturbed remnants to the northwest side of the lake.

The immediate area surrounding the lake is heavily developed as residential areas and numerous roads provide access to the lake. Outside the ring of intensive development, the landscape contains a mixture of farm fields and woodlots.

Threats and Stresses:

One of the big concerns within the lake itself is competition of invasive plant species with the population of Vasey's pondweed and other native flora of the lake. Eurasian water milfoil (*Myriophyllum spicatum*) is a very aggressive introduced plant species common and locally abundant throughout the lake. Spot treatment with diquat, an herbicide, has been moderately effective in controlling its population. Near the Pennsylvania Fish and Boat Commission access area, a thick bed of brittle waternymph (*Najas minor*), an introduced Eurasian species, is cause for concern. Both motorized and non-motorized boats that have not been properly cleaned can spread plants into the lake, as well as other bodies of water.

The major threat imposed by the surrounding landscape is commercial and residential development along the shoreline. Past issues regarding septic problems in the lake have resulted due to the concentration of residences along the perimeter. Although these have been fixed, for the most part continued development may lead to further complications.

The immediate watershed draining into the lake includes some forested areas and agricultural fields. Logging of wooded areas, specifically along riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers and other sources can accumulate in the lake leading to algal blooms and the consequent death of aquatic organisms (Vellidis et al 2003). The amount of impervious surfaces around the lake can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the lake.

Recommendations:

Continued monitoring of lake flora, fauna, and chemistry will be important in understanding the success of programs designed to improve water quality and health of the lake ecosystem. The health of people using the lake for recreation is also at stake as the community looks to keep the lake healthy.

Development along the shoreline, as well as on wetlands should be eliminated. Limiting and converting impervious surfaces, planting vegetative buffers along drainages, including the lake shore, and regulating total nutrient input from the watershed will all be important in maintaining and improving the health of the lake. Sewage and wastewater management should be closely monitored in addition to implementing best management practices (BMP) for stormwater management. Implementing BMPs on surrounding farmland to control runoff and pollution into the lake is recommended. Invasive species control along riparian corridors is also advisable. Watercrafts using the lake need to be cleaned to control the spread of invasive species within and between lakes.

Little Federal Run Headwaters Wetland BDA – *High Significance*

The wetland forming the headwaters of Little Federal Run is considered a **hemlock palustrine forest**, a natural community of concern in Pennsylvania. This swamp also supports a plant species of concern, **Clinton's wood fern** (*Dryopteris clintoniana*) and a bird species of concern, **pied-billed grebe** (*Podilymbus podiceps*. The core area of this BDA is delineated around the outer extent of this community and includes surrounding habitat that might be utilized by species occupying this habitat.

The wetland itself forms the core of this BDA and is a modest size forested wetland of its type and in good condition. The wetland is dominated by eastern hemlock (*Tsuga canadensis*), with black gum (*Nyssa sylvatica*) and yellow birch (*Betula allegheniensis*) as major associates. Crested wood fern (*Dryopteris cristata*) and marginal wood fern (*Dryopteris marginalis*) also grow in this community and can hybridize with Clinton's

wood fern. Clinton's wood fern, as well as the wetland community, depend upon the continued structure of the forest and the maintenance of the hydrology of the site.

The sections of the watershed to the east and south of the core area are wooded but several fields cross into the supporting landscape on the west and north ends of the wetland. Otherwise, few other features or detrimental land uses are involved at this site.

Threats and Stresses

The context of this BDA suggests the possibility of a few issues regarding the health of this wetland. Timbering within the core area would open the canopy, allowing more sunlight to penetrate to the forest floor, thereby detrimentally changing microhabitat conditions for existing plants and animals. This may also serve as an avenue for the establishment of invasive species. Adjacent agricultural fields can also serve as places where non-native invasive species may establish. Such plants are a threat to the native plant diversity at this site. Likewise, excessive nutrients entering the system via runoff and loss of soil, which commonly occurs when vegetation is removed, could negatively affect the plant and community of special concern of this BDA. Furthermore, the westward migration of the hemlock wooly adelgid (*Adelges tsugae*), currently documented in 42 counties in the eastern two-thirds of Pennsylvania (PA Bureau of Forestry 2006), poses a potential threat to the hemlock trees in the region. The hemlock woolly adelgid, native to Asia, is a sap feeding insect that attacks native hemlocks, causing defoliation and eventual death of the tree which results in the removal of forest canopy and the illumination of the forest floor by full sunlight.

Recommendations

Any changes to the landscape that may alter the hydrology of this wetland should be avoided and action should be taken to limit the negative impacts of such activities. Increase forested buffers along field borders, limit timbering within the core habitat area and limit nutrient inputs in adjacent areas to help maintain the health of this wetland. Landowners are encouraged to employ best management practices to agricultural lands within the supporting landscape of this BDA in order to reduce the negative impacts farming may have on this natural community. Periodic monitoring for the establishment of exotic, invasive plant species and the presence of the hemlock wooly adelgid is recommended.

Puckerbush Lake Tributary BDA – *High Significance*

This Natural Heritage Area is discussed under Athens Township.

Cambridge Township and Cambridge Springs Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Cambridge Springs BDA			*Local Significance*		
French Creek BDA			*Exceptional Significance*		
see Woodcock Township					
French Creek Floodplain Forest BDA			*High Significance*		
see Venango Township					
Little Conneauttee Floodplain BDA			*Exceptional Significance*		
Harbinger-of-spring (*Erigenia bulbosa*) – Plant	G5	S2	PT	2004	E
Sensitive species of concern***	-	-	-	2004	E
State Game Lands # 277 BDA			*High Significance*		
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2003	E
Blue-tipped dancer (*Argia tibialis*) – Odonate	G5	S1	-	2005	E
Lilypad clubtail (*Arigomphus furcifer*) – Odonate	G5	S2	-	2005	E
Midland clubtail (*Gomphus fraternus*) – Odonate	G5	S2S3	-	2005	E
Rapids clubtail (*Gomphus quadricolor*) – Odonate	G3G4	S1S2	-	2005	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1998	E
Sora (*Porzana carolina*) – Bird	G5	S3B	-	2005	E
Sensitive species of concern***	-	-	-	1989	E
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area Conservation Region

The western border of Cambridge Township is formed by Conneaut Creek entering from Erie County and flowing into French Creek at Cambridge Springs. The northern portion between these two creeks is low and marshy, and the remainder of the township is a fairly flat to gently rolling floodplain. Numerous tributaries to French Creek drain the southeast section of the township, which is largely agricultural land. About half the township is agricultural with three quarters of that being row crops. The Borough of Cambridge Springs, a largely urban town, is located along French Creek just upstream from the confluence with Conneauttee Creek.

Crawford County
Natural Heritage Inventory
Cambridge Township
&
Cambridge Springs

Biological Diversity Area:

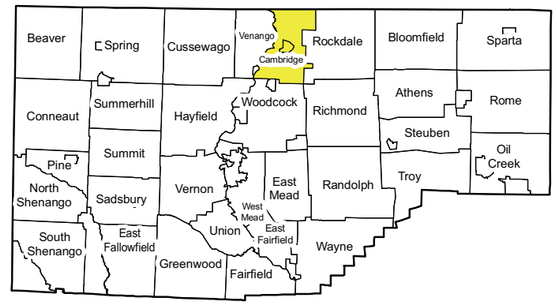
French Creek
Little Conneauttee Floodplain
Cambridge Springs Swamp
State Game Lands #277

Landscape Conservation Area:

French Creek

Public Land:

State Game Land 277



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

Florek Rd
Armenian Rd
Timber Dr
Mount Pleasant Rd
Lake Dr
Yucha Rd
Miller Hill Rd
Capp Rd
Jericho Rd
Blystone Rd
Kreitz Rd
Zilhaver Rd
Beckman Rd
Irish Rd
Drakes Mills
Plank Rd
Kacop Rd
Drakes Mills Rd
Hecker Rd
Little Conneauttee Floodplain BDA
Cambridge Springs Swamp BDA
State Game Lands #277 BDA
State Game Land 277
Skeltontown
Skeltontown Rd
Mcclellan St
Millers Station
Miller Station Rd
French Creek BDA
Tobin Rd
Cambridge Springs
Williams Dr
Sherred Rd
Center Rd
Zimmerman Rd
Thomas Rd
Blink Dr
Lura Rd
Johnstown Rd
Andersons Corner
Fox Rd
Kightlinger Rd
Electric Dr
Ridge Rd
Bear Rd
Cemetery Rd
Center St
Birchard Rd
Yankee Hill Rd
French Creek LCA
Venango
Sherred Hill Rd
Ellis Rd
Henry Rd
Gospel Hill Rd
Walters Rd
Hurnes Hill Rd
Greytown Hills Rd
Merritt Rd
Bechtold Rd
Allen Rd
Griffith Rd
Russell Rd
Jouver Rd
Greer Rd
Ball Rd
Gravel Run Rd
Bockman Hollow Rd
Hill Rd
Woodcock

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

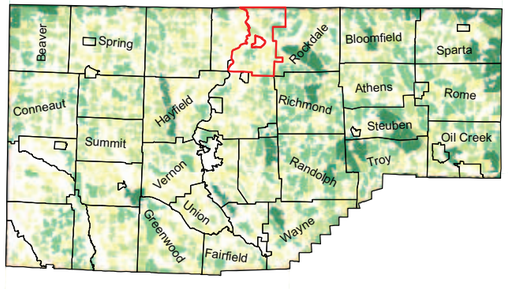
Crawford County Natural Heritage Inventory

Cambridge Township & Cambridge Springs Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

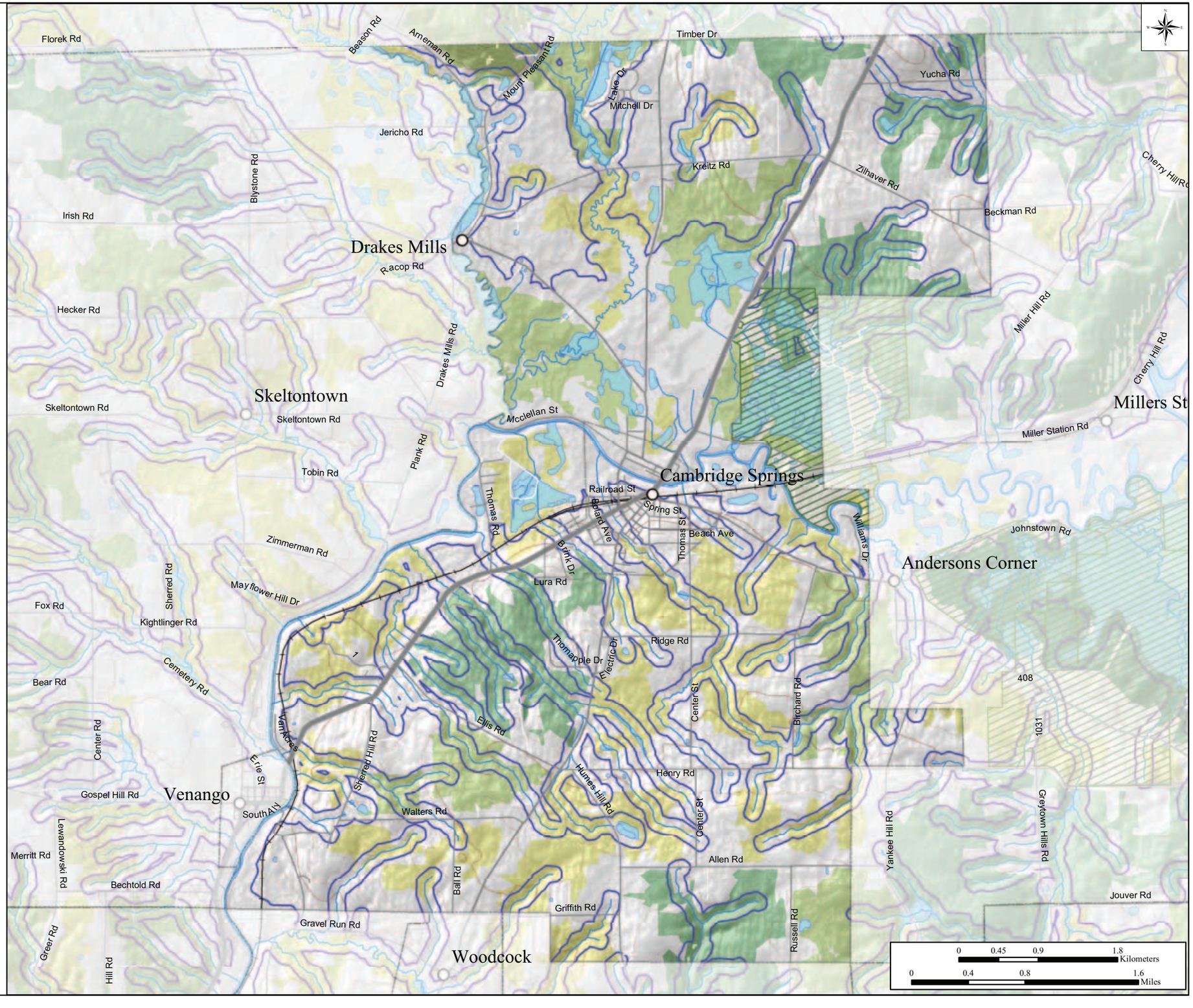
PNHP Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



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Cambridge Springs Swamp BDA – *Local Significance*

The headwaters of an unnamed tributary to French Creek contain a wetland supporting a breeding **sensitive species of concern**. This wetland occupies a large area north of Riverside Golf course, to the northeast of Cambridge Springs. The swamp and adjacent farmland are included in the BDA. The sub-watershed of this wetland is considered the supporting landscape.

This species breeds across the western and central U. S. and north through Canada and Alaska, spending winters in the southwest and Gulf states. They are rare migrants in Pennsylvania, however, a few pairs have recently bred in Crawford, Lawrence, and Mercer Counties (McWilliams and Brauning 2000). This species utilizes a variety of habitats, commonly nesting in open freshwater wetlands including bogs, sedge meadows, and fens. They can also be found in open grasslands, cultivated lands, and pine savannas (NatureServe 2006). This occurrence was observed feeding in agricultural fields adjacent to swampy woods.

Threats and Stresses

This wetland is currently protected by a forested buffer and is too wet in some parts for major development. The sensitive species could be nesting on the marsh or in the upland vegetation. Early mowing of the fields could disturb the nest. Common threats to this species include loss and degradation of habitats, and because they feed on grains, seeds, and insects in agricultural fields, chemicals applied to farmlands could poison them.

Recommendations

Landowners should be made aware of this occurrence and should be encouraged to postpone mowing until after July to avoid disturbance during the breeding season. Allow taller brush to remain as a transitional zone between agricultural fields and forested edges.

French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Woodcock Township.

French Creek Floodplain Forest BDA – *High Significance*

This Natural Heritage Area is discussed under Venango Township.

Little Conneauttee Floodplain BDA – *Exceptional Significance*

This BDA focuses on the Little Conneauttee Creek floodplain just before the confluence of the creek with Conneauttee Creek. In this area, numerous channel scars, vernal and perennial wetlands, and mature hardwood forest create a diverse habitat for many plant and animal species. This BDA contains two species of concern, including **harbinger-of-spring** (*Erigenia bulbosa*), a plant species of concern, and a **sensitive species of concern.**

The core habitat for this area consists of mostly floodplain terrace with a deeply cut, complex series of meander channels. Little Conneauttee Creek meanders through this valley creating long peninsulas of land containing pockets of mature bottomland forest dominated by bitternut hickory (*Carya cordiformis*) and shagbark hickory

(*C. ovata*) with eastern sycamore (*Platanus occidentalis*). Dominant associates within the core area include sugar maple (*Acer saccharum*) and American basswood (*Tilia americana*). The shrub layer of this forest is rather sparse, likely due to deer browse pressure, but the herbaceous layer is quite rich with spring beauty (*Claytonia virginica*), trout lily (*Erythronium americana*), wild leek (*Allium tricoccum*), golden ragwort (*Senecio aureus*), and **harbinger-of-spring** (*Erigenia bulbosa*). Harbinger-of-spring, the plant species of concern, tends to grow in patches scattered throughout the area. The harbinger-of-spring and the forest community in general receive occasional flooding and exist on the moist, rich alluvium of the creek. Surface water and ground water inputs as well as the microhabitat within this mature community are likely important to the *Erigenia* populations as well as numerous other plants and animals associated with these areas.

The supporting landscape consists of the immediate watershed of the core area combined with an area of recommended non-disturbance for the species of concern. The bulk of this area is forested with some areas of open wetland to the west and a small amount of agricultural fields to the south. Little Conneauttee Creek, portions of Conneauttee Creek, and many prominent creek meander remnants and oxbows are included.

Threats and Stresses

Degradation and disturbance of the mature bottomland forest within this BDA is of greatest concern to both the natural forest community and the plants and animals which it supports. Timbering or clearing of vegetation and riparian buffers for maintenance of marginal agricultural fields, if not considered carefully, could compromise this already limited expanse of bottomland forest.

Agricultural practices that would decrease the width of riparian areas along any streams or drainages with the BDA could negatively affect this area. Additionally, further clearing and increased light levels can encourage invasive species, such as multiflora rose (*Rosa multiflora*), to penetrate deeper into the forested areas. Noise from machinery and equipment as well as the presence of the operators may negatively affect the behavior and reproductive success of this species within the BDA.

Recommendations

Conservation of the maturing bottomland forest is very important to the species of concern on the site as well as to the multitude of other species that utilize mature forest. Sustainable forestry practices and protection of critical resources recognized here would be of great benefit. Monitoring of the species of concern and the forest community as a whole will allow more detailed management recommendations and plans to be developed.

Limit disturbance in the supporting landscape area between January and late June to help ensure breeding success for the species of concern. Clearing as little land as necessary to accomplish agricultural goals would help to buffer the core habitat area from the effects of edge interaction, improve water quality and discourage activities that would serve as disturbances.

State Game Lands # 277 BDA – *High Significance*

This BDA is designated around a series of wetland areas that lie adjacent to French Creek upstream from the confluence with Little Conneauttee Creek. This portion of the game lands is comprised of shrub swamps, wet meadows, beaver ponds, and man made ponds with forested upland areas. The open shrub swamp supports a population of alder-leaved buckthorn (*Rhamnus alnifolia*), and the forested uplands contain several occurrences of **Clinton's wood fern** (*Dryopteris clintoniana*), which is a plant species of conservation concern. This BDA also provides habitat for three other species of concern, including the two bird species of concern **marsh wren** (*Cistothorus palustris*), and **sora** (*Porzana carolina*) and an additional **sensitive species of concern.**

The wetlands and man-made ponds provide habitat for four dragonfly species of concern, **blue-tipped dancer** (*Argia tibialis*), **lilypad clubtail** (*Arigomphus furcifer*), **midland clubtail** (*Gomphus fraternus*), and **rapids clubtail** (*Gomphus quadricolor*).

The core area of this BDA is designated around the three populations of plants and extended to include appropriate habitat. Alder-leaved buckthorn, a northern wetland species, is found throughout the extensive shrub swamp of this area. Dominant shrubs within the swamp include gray dogwood (*Cornus racemosa*), meadowsweet (*Spiraea alba*), highbush blueberry (*Vaccinium corymbosum*), and arrowwood (*Viburnum dentatum*) with rough-

stemmed goldenrod (*Solidago rugosa*), harvestlice (*Agrimonia parviflora*), and swamp dewberry (*Rubus hispidus*) as the main components of the herbaceous layer.

State Game Land #277

photo source: PNHP

The peripheral forest consists of two community types. The lower, wetter areas are dominated by hemlock (*Tsuga canadensis*) gradually becoming a more typical mixed hardwood forest on higher, drier ground. Primary canopy species include yellow birch (*Betula allegheniensis*), American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*), black cherry (*Prunus serotina*), and black ash (*Fraxinus nigra*). The understory is similar for both communities although the hemlock forest in some place lacks an understory due to heavy deer browse. Understory species include American hornbeam (*Carpinus caroliniana*), sugar maple (*Acer saccharum*), cucumber magnolia (*Magnolia acuminata*), and black ash (*Fraxinus nigra*). Herbs in these communities include brome-like sedge (*Carex bromides*), spinulose woodfern (*Dryopteris carthusiana*), jumpseed (*Polygonum virginianum*), wood sorrel (*Oxalis montana*), partridge berry (*Mitchella repens*), threeleaf goldthread (*Coptis trifolia*), and lowbush blueberry (*Vaccinium pallidum*). **Clinton's woodfern**, a plant species of concern, is common throughout this site.

The hydrology of a wetland is a major determinant of the plant community present at a site. Therefore, the immediate watershed supporting a habitat with threatened, endangered, or rare plants is of conservation interest. For this BDA, the immediate upstream watershed is considered the supporting landscape for these occurrences, most of which is forested.

Threats and Stresses

Most of the core area of this BDA falls within State Game Lands #277 and is largely protected from inappropriate development. However, there are several small threats that could affect these plant populations. Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to both the *Dryopteris* populations and the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources (Curtis and Sullivan 2001). Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

A recent clearcut to the north of the State Game Lands has created some undesirable edge effects on the adjacent forest. Unnatural edges created by human disturbance create a discontinuity of habitats, significantly altering environmental conditions. The edge created here could provide a path for the introduction of exotic species, which in turn threatens native plant diversity.

The proximity of this wetland to a major road could create several problems. The spread of invasive species, which usually colonize disturbed areas such as roadsides, and runoff into the wetland from impervious surfaces.

Recommendations

The Game Commission should consider erecting deer exclosure fences around areas supporting rare plant species. Continual monitoring of these populations, to assess deer damage, is highly recommended. Further bird, amphibian, and invertebrate sampling, as well as continual monitoring for the establishment of invasive species, is also recommended.

Conneaut Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Blackjack Swamp BDA			*Exceptional Significance*		
Short-awn foxtail (*Alopecurus aequalis*) – Plant	G5	S3	-	2001	E
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1988	B
Bebb's sedge (*Carex bebbii*) – Plant	G5	S1	PE	2003	E
Lesser panicled sedge (*Carex diandra*) – Plant	G5	S2	PT	2001	AB
Cyperus-like sedge (*Carex pseudocyperus*) – Plant	G5	S1	PE	2001	E
Downy willow-herb (*Epilobium strictum*) – Plant	G5	S3	PE	2001	E
Pumpkin ash (*Fraxinus profunda*) – Plant	G4	S1	-	2006	E
Bog bluegrass (*Poa paludigena*) – Plant	G3	S1	PT	1988	E
A swamp smartweed (*Polygonum setaceum var. interjectum*) – Plant	G5T4	S2	PE	2006	E
Shumard's oak (*Quercus shumardii*) – Plant	G5	S1	PE	2006	E
Red currant (*Ribes triste*) – Plant	G5	S2	PT	1991	BC
Autumn willow (*Salix serissima*) – Plant	G4	S2	PT	2001	B
Highbush cranberry (*Viburnum trilobum*) – Plant	G5T5	S3S4	TU	2006	E
Sensitive species of concern***	-	-	-	2005	B
Linesville Creek Headwaters Wetland BDA			*High Significance*		
Hemlock palustrine forest – Natural Community	GNR	S3	-	2004	E
Pymatuning Marsh LCA					

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Pymatuning-Hartstown Important Bird Area

Crawford County
Natural Heritage Inventory

Conneaut Township

Biological Diversity Area:

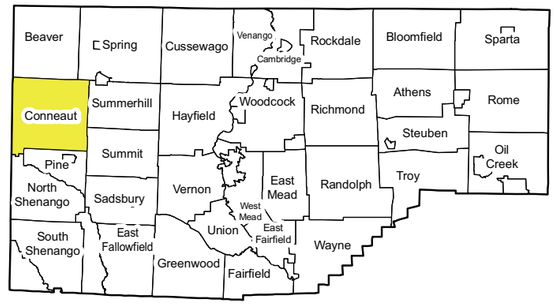
Blackjack Swamp
Linesville Creek Headwaters Wetland

Landscape Conservation Area:

Conneaut Marsh Complex
Pymatuning Wetland Complex

Public Land:

Blackjack Swamp Natural Area
Clark Island Natural Area
Pymatuning State Park



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

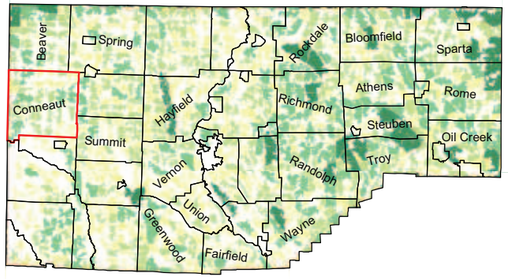
Crawford County
Natural Heritage Inventory

Conneaut Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Middle Rd
Marcy Rd
Parish Rd
Reeds Rd
Penn Line Rd
Turner Rd
Lester Rd
Steamburg
Carpenter Rd
Airport Rd
Cole Rd
Vendel Rd
Conneautville Rd
Mulberry
Turkey Track Rd
State Line Rd
Steamburg Rd
Beaver Center Rd
Maples Rd
Fish Rd
Creek Rd
Waring Rd
Pennline
Center Road
Center Rd
Conneaut Center
Dicksonburg Rd
Dantown
B And B Dr
Tighe Rd
Linesville Rd
Townline Rd
Hall Rd
Bertram Rd
Phelps Rd
Footsville Rd
Footville Richmond Rd
Waring
Shore Dr
Wheeler Rd
Agnew Rd
Sherretts Rd
Ruheville Rd
Shermansville Rd
West Rd
Wallace Ave
Swiden
Swiden Rd
Wilson Rd
Conaway Rd
Lee Rd
Debow Rd
Township Rd
Gilliland Rd
Woodard Rd
Maple Dr
Primrose Dr
Cemetary
Linesville
Madigan Rd
Spur Rd
Harmonsburg Rd
Beagle Rd
Erie St
Lewis Ave
Access Rd
Stewart Ln
Franklin St
Pine St
Leon Rd
Padanaram Rd

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

Conneaut Township lies along the Ohio Border in the northwestern portion of the county. It is bordered by Beaver Township to the north and Pine and North Shenango Townships to the south. The Shenango River originates in the northeast with Paden Creek, Linesville Creek, and Crooked Creek as major tributaries. These streams drain a majority of the township. The Conneaut Creek watershed drains the northwestern corner of the township. The Shenango River is dammed in the south to form Pymatuning Lake and Reservoir, which extends into Pike, North, South and West Shenango Townships, as well as Ohio. In addition to the rich alluvial soils, the fairly level to gently rolling topography supports an agricultural community dominated by dairying and stock raising. The Pymatuning, Hartstown Complex Important Bird Area (IBA) is located in the southwestern corner of the township, providing extensive habitat for waterfowl, shorebirds, and many other rare avian species.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Blackjack Swamp BDA – *Exceptional Significance*

Blackjack Swamp is a large palustrine scrub-shrub area with emergent wetlands surrounding the Shenango and Ashtabula Rivers, inlets to Pymatuning Lake. Approximately 800 acres of the swamp, which is contained within Pymatuning State Park, is managed as a Natural Area by the Pennsylvania Department of Conservation and Natural Resources (DCNR). The core area of this BDA includes the entire Natural Area and is expanded to include the entire extent of the wetland, continuing north into portions of Ohio.

The plant community of this swamp includes an overstory comprised of Big-tooth aspen (*Populus grandidentata*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and American elm (*Ulmus americana*). The understory is populated with willow (*Salix* sp.), hawthorn (*Crataegus* sp.), red osier dogwood (*Cornus sericea),* and spiraea (*Spiraea* sp.). The plants of special concern located within this habitat are **autumn willow** (*Salix serissima),* **red currant** (*Ribes triste*), **Bebb's sedge** (*Carex bebbii*), **cyperus-like sedge** (*Carex pseudocyperus*), **lesser-panicled sedge** (*Carex diandra*), **highbush cranberry** (*Viburnum trilobum*), **Shumard's oak** (*Quercus shumardii*), pumpkin ash (*Fraxinus profunda*), **bog bluegrass** (*Poa paludigena*), and **a swamp smartweed** (*Polygonum setaceum var interjectum*). This area also hosts a **sensitive species of concern**.

Bebb's Sedge
Photo source: Gary Fewless

The immediate watershed feeding the wetland complex supports the core area of Blackjack Swamp. The landscape is a matrix of forests and agricultural fields with most of the fields in production as row crops located adjacent to the wetland perimeter.

Cyperus-like Sedge
Photo source: Gary Fewless

Threats and Stresses

Most of Blackjack Swamp is currently under management by the Pennsylvania Department of Conservation and Natural Resources (DCNR) and faces no eminent threat. Those areas not included within the state park appear too saturated for development, but draining or filling for agricultural lands, or permanent flooding would eliminate this exceptional habitat. Stresses that may influence the wetland as a result of the surrounding landscape include water pollution and nutrient loading from agricultural lands and possible invasion by exotic plants such as purple loosestrife (*Lythrum salicaria*) and honeysuckles (*Lonicera* sp.).

Recommendations

The portion of Blackjack Swamp extending north outside of the state park boundary is protected by a forested riparian buffer and appears intact. The wetlands contain heavily saturated soils and are inappropriate for development of any kind. Maintaining a forested riparian buffer of at least 300 feet and implementing best management practices on surrounding lands is recommended. Pennsylvania DCNR may consider working with landowners to include this portion of swamp in management plans. Periodic monitoring of endangered plants and invasion by exotics is recommended. Additionally, human traffic within the Natural Area should be limited from January to June, so as not to disturb nesting sensitive species of concern.

Linesville Creek Headwaters Wetland BDA – *High Significance*

This BDA is designated around a **hemlock palustrine forest**, a natural community of conservation concern. The perimeter of the wetland is buffered slightly to capture potential habitat for any bird or amphibian species that this wetland may support. This wetland forms the headwaters of Linesville Creek, located along the watershed boundary with Fish Creek, which drains into Conneaut Creek and Linesville Creek, a Shenango River tributary. The forested drainage supporting this wetland is considered the supporting landscape of this BDA.

Hemlock palustrine forests are characterized by a pit and mound microtopography, with pools of standing groundwater. Eastern hemlock (*Tsuga canadensis*) is the dominant canopy cover, with white pine (*Pinus strobus*), red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), ash (*Fraxinus* sp.), red oak (*Quercus rubra*), white oak (*Q. alba*), and American beech (*Fagus grandifolia*) present in smaller components (Fike 1999). A dense understory is formed by rhododendron (Rhododendron maxima), with occasional highbush blueberry (*Vaccinium corymbosum*) and winterberry (*Ilex verticillata*). The herbaceous layer, which grows from a well-developed layer of sphagnum moss (sp.), is sparse but includes several fern species (*Onoclea sensibilis, Osmunda cinnamomea, and O. claytonia*), violets (*Viola* sp.), Canada mayflower (*Maianthemum canadense*), and Indian cucumber-root (*Medeola virginiana*).

Threats and Stresses

Any change in the current hydrology of this forest would impact the structure of this unique community. The westward migration of the hemlock wooly adelgid (*Adelges tsugae*) poses a serious potential threat to hemlock trees, which is a dominant species in this wetland. The hemlock wooly adelgid is an invasive pest that defoliates hemlock trees, ultimately causing death. It is currently documented in 42 counties in the

eastern two-thirds of the Commonwealth (PA Bureau of Forestry 2006). The loss of hemlock trees can create substantial changes in eastern forests such as climate and forest cover.

Recommendations

Any land management plans that would disrupt the natural hydrology of the supporting watershed should take into consideration potential impacts to this hemlock palustrine forest. Additional surveys to document birds, amphibians, and insects utilizing the wetland as well as periodic monitoring for the hemlock wooly adelgid would be advantageous.

Cussewago Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Carr Run BDA			*High Significance*		
Creek heelsplitter (*Lasmigona compressa*) – Mussel	G5	S2S3	-	1993	E
Cussewago Creek Central Riparian Corridor BDA			*Exceptional Significance*		
Sweetflag (*Acorus americanus*) – Plant	G5	S1	PE	2005	E
Harbinger-of-spring (*Erigenia bulbosa*) – Plant	G3	S2	PT	2004	E
White trout lily (*Erythronium albidum*) – Plant	G5	S3	-	2001	E
Racemed milkwort (*Polygala polygama*) – Plant	G5	S1S2	TU	2006	E
Shumard's oak (*Quercus shumardii*) – Plant	G5	S1	PE	2006	E
Pineland pimpernel (*Samolus parviflorus*) – Plant	G5T4	S2	TU	2002	E
Sensitive species of concern***	-	-	-	1991	E
Cussewago Creek at Crossingville BDA			*High Significance*		
Sensitive species of concern***	-	-	-	198-	E
Pont Road Wetlands BDA			*High Significance*		
see Spring Township					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Cussewago Bottom Important Bird Area and Erie National Wildlife Refuge Important Bird Area Conservation Region

Crawford County
Natural Heritage Inventory

Cussawago Township

Biological Diversity Area:

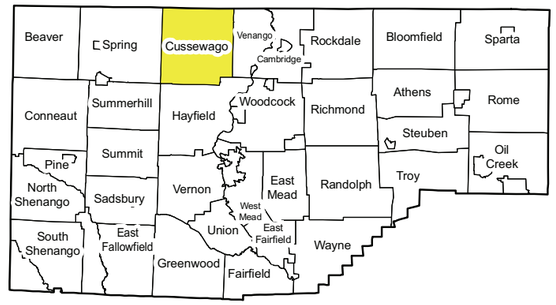
Carr Run
Cussawago Creek Central Riparian
Cussawago Creek at Crossingville
Pont Road Wetland

Landscape Conservation Area:

French Creek

Public Land:

State Game Land 152
State Game Land 269



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

Crawford County
Natural Heritage Inventory

Cussewago Township

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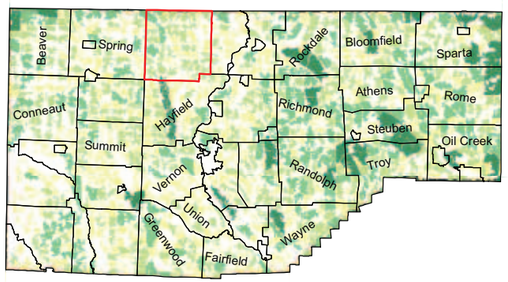
Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Cussewago Township is located in north central Crawford County on the Erie County border. Cussewago Creek flows through the western portion of this township, with numerous tributaries that drain the majority of the landscape. Cussewago Creek flows through a fairly forested valley including larger forest blocks in the northern part of the township, which helps to buffer the stream and keep water quality high. The managed lands within Cussewago Township include State Game Lands (SGL) #152 in the north, containing a fairly large forest block, and SGL #269, along Cussewago Creek in the central part of the township. Cussewago Bottom has been designated an Important Bird Area (IBA). This site was chosen because it is a high-quality wetlands, bottomlands and hardwood forests. A large number of neotropical migrant birds are seen here every year. The topography is generally flat to rolling with about half the land in agricultural production.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Carr Run BDA - *High Significance*

Carr Run is a fairly sizeable tributary to Cussewago Creek, draining a large portion of Spring Township before flowing into Cussewago Township and the main stem of the creek. Cussewago Creek is a main drainage of the French Creek watershed. Due to the size and appropriate habitat conditions of Carr Run, the lower section supports a mussel species of concern. The core for this BDA focuses on Carr Run from the confluence with Cussewago Creek, upstream to include where Rundelltown Creek enters and an additional 500 meters upstream from that point. A 100-meter buffer is included on both sides of the stream. The mussel of interest here, **creek heelsplitter** (*Lasmigona compressa*), rely on the in-stream habitat that consists of appropriate substrate and good water quality.

The immediate watershed of Carr Run and portions of Cussewago Creek support this core stretch of stream. Due to the locality of this BDA and the quality of the larger watershed, the supporting landscape is absorbed into the supporting watershed of the Cussewago Creek. The land surrounding Carr Run contains mostly forest riparian corridors that meander through agricultural lands. The floodplain terrace is a mixed hardwood forest containing bitternut hickory (*Carya cordiformis*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pensylvanicum*), black cherry (*Prunus serotina*), and American hornbeam (*Carpinus americana*). Numerous shrublands and wetlands are present along Cussewago Creek as it cuts through a forested and agricultural landscape.

Carr Run is a small, slow moving stream with a sandy to muddy stream bottom. Such habitat characteristics are important in supporting the mussel species of concern. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to good water quality and mussel habitat.

Threats and Stresses

This core habitat contains a high amount of natural cover, including wetlands, within the riparian zone. Where Route 98 crosses Carr Run represents the most extensive break in riparian vegetation and significant possible disruptions to in-stream habitat. Roads and bridges, storm water drainage, and chemical runoff associated with the road and right-of-way maintenance pose the greatest potential impact to the stream quality.

A large portion of the supporting landscape is in agricultural use with much of that land in row crops. Potential influx of nutrients, sediments, and agricultural chemicals is a concern for Carr Run throughout the watershed, specifically in the lower part of the stream. Forested stream corridors contribute positively to stream conditions, such as cover and lower temperatures. Thus, logging or clearing streamside vegetation significantly degrades habitat conditions within the stream.

Recommendations

Maintenance of the natural cover within this core is important in providing a buffer against nutrient and sediment loading. Vegetation corridors can intercept unwanted inputs before they enter the stream. Additionally, preserving forested stream banks is vital to maintain water quality and mussel habitat. For many places within the Cussewago Creek Valley, timber management and production may be compatible with maintaining high-quality conditions for the numerous important species living here. However, sustainable forest management plans that consider these important areas are essential for the long-term health of these forest communities. Road development and other construction should be kept away from the stream if at all possible. Work with farmers and landowners of adjacent parcels to maintain as much of the area in forest as possible to help to buffer the core areas from edge effects.

Cussewago Creek

photo source: PNHP

Within the entire watershed, maintain vegetated riparian buffers for any small perennial or ephemeral drainages that flow through this predominately agricultural landscape will be beneficial to water quality within Carr Run and Cussewago Creek. Limit stream crossing by domesticated animals and generally limit contact of animals with streams as part of the best management practices recommended for the areas within the immediate watershed of the stream. Best management practices should be applied to adjacent farmland to minimize nutrient and chemical inputs. Further evaluation of the in-stream habitat and surveys for animals of special concern is also desirable.

Cussewago Creek Central Riparian Corridor BDA – *Exceptional Significance*

Starting in Erie County, Cussewago Creek dips into Spring Township and snakes through Cussewago and Hayfield townships, eventually meeting with French Creek at Meadville. It is a low gradient stream that flows south-southeast through a long, narrow glacial outwash valley (Tautin 2004). The natural processes associated

with stream flow have created a variety of habitats used by a rich diversity of wildlife including several species of concern. Backwaters, cutoffs, oxbows, and scattered wetlands lie along the course of the creek. Additionally, forested uplands, abandoned fields, and agricultural fields further enhance this unique landscape. This mosaic of habitats provide important bird habitat and has been named an Important Bird Area by the Pennsylvania Audubon Society, which includes the adjacent lake and wetlands of State Game Lands #269.

The core of this BDA follows Cussewago Creek from the central portion of Cussewago Township south nearly to the Hayfield Township border. The stream contains a 100-meter buffer to include adjacent wetland and riparian habitats harboring species of concern. The riparian corridor contained within this BDA is largely forested except for the areas near Crosley Road. The supporting watershed extends north and south to include Pont Road Wetlands (Spring Township) and Cussewago Creek in Coons Valley (Hayfield Township) respectively. The land use is mostly rural residential and agriculture with primarily dairy and row crop, small forest blocks, and early successional oldfields are interspersed throughout the landscape. Route 98 runs nearly parallel to Cussewago Creek throughout the watershed. Due to the size of this BDA, this site has been broken into sections to facilitate thorough discussion of the natural features present: Townhall Oxbows, State Game Lands #269, Carr Run Confluence, and Crosely Road.

The supporting landscape of this BDA is considered the watershed draining into Cussewago Creek. There are numerous integral tributaries and wetlands that contribute to the Cussewago system. The land within this BDA is mostly used for agriculture and contains small blocks of forest throughout.

Threats and Stresses

Overall, there are few imminent threats to the Cussewago Valley, however, long term cumulative effects of siltation and pollution from agriculture, gas development, gravel mining, and logging would be harmful to the variety of wildlife and habitats present. Establishment of exotic species, specifically common reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*) in wetlands and Japanese knotweed (*Polygonum cuspidatum*) along riparian corridors would negatively affect native plant populations and diversity. Most threats to species of concern are localized and discussed above.

Racemed Milkwort
Photo source: Thomas Barned

Recommendations

Best management practices should be applied to agricultural lands and forestry practiced within this BDA. Maintain a forested riparian buffer of at least 100 meters along the stream. Not only does this create additional habitat and travel corridors for wildlife species, it protects the water quality and aquatic habitat of the system. Road development and construction projects should be kept at a distance of 300 feet from the stream so as to limit chemical pollution and sedimentation into the stream.

Town Hall Oxbows

This BDA is designated around a section of floodplain forest in the northern portion of State Game Lands # 269. Three plant species of concern, **Shumard's oak** (*Quercus shumardii*), **racemed milkwort** (*Polygala polygama*), and **pineland pimpernel** (*Samolus parviflorus*), are contained within the floodplain forest. At this site, the forest has a large swamp white oak (*Quercus bicolor*) overstory component. Other canopy species include black ash (*Fraxinus nigra*), red maple (*Acer*

rubrum), sugar maple (*Acer saccharum*), and red oak (*Quercus rubra*). The main understory plants are spicebush (*Lindera benzoin*) and American hornbeam (*Carpinus caroliniana*), with the herbaceous layer being comprised of nodding beggarticks (*Bidens cernua*), golden ragwort (*Senecio aureus*), Christmas fern (*Polystichum acrostichoides*), sneezeweed (*Helenium autumnale*), maidenhair fern (*Adiantum pedatum*), and royal fern (*Osmunda regalis*).

Threat and Stresses

This part of the BDA is bordered by State Game Lands on the western bank and is protected from development. The eastern bank, bordering a private residence, lacks a forested buffer. The farmlands to the east are directly upslope from Cussewago Creek, and without a forested riparian zone, nutrients can readily enter the stream. A driveway or small road runs parallel to the stream in this area and could cause sedimentation and erosion problems in the stream. Furthermore, any potential grazing by livestock could eliminate this population of pineland pimpernel.

Recommendations

Landowners should be made aware of the occurrence and encouraged to allow regeneration of a forested buffer along the stream. Livestock, if any, should be restricted from grazing in this area as well as accessing the stream to prevent trampling. Periodic monitoring for erosion problems associated with the driveway or small road is desirable.

State Game Lands #269

Moving downstream along the creek across from the lower portion of State Game Lands (SGL) #269, a stretch of rich bottomland oak-hardwood forest contains several occurrences of a plant species of concern and several **vernal pools**. The forest is dominated by red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and eastern hemlock (*Tsuga canadensis*) with a dense herbaceous layer of wild leek (*Allium tricoccum*), yellow trout lily (*Erythronium americanum*), false mermaid (*Floerkea proserpinacoides*), and golden ragwort (*Senecio aureus*). Spicebush and American hornbeam are the dominant shrubs. **Harbinger-of-spring** (*Erigenia bulbosa*), a plant species of concern, is present on the southern part of the site, where it is scattered but not particularly dense. It appears early in the season and therefore many individuals may not be in flower. Overall, this is a nice example of a rich, maturing floodplain forest with much potential for amphibian breeding, birds requiring moderately large riparian corridors, and numerous plants of special concern. The surrounding reverting pastureland has become a hawthorn (*Crataegus* sp.) and red osier dogwood (*Cornus sericea*) shrubland with dense graminoid cover.

Threats and Stresses

The eastern portion of the creek falls within State Game Lands and is largely protected as the wetlands and upland areas are managed for wildlife by the Pennsylvania Game Commission. The western bank, which is privately owned, retains a fair amount of floodplain forest. Runoff from agricultural fields and grazing by livestock could affect this habitat.

Recommendations

Allow regeneration of forested buffers of at least 100 meters and retain forested riparian zones.

Carr Run Confluence

The confluence of Cussewago Creek and Carr Run is an exceptionally rich area. Several mussel species of concern occur in Carr Run, and the floodplain forest along Cussewago Creek hosts several plant species of concern. There are numerous wetlands and a small tributary that substantially increase the volume of Carr Run before it crosses Route 98, creating instream habitat for a few aquatic species of interest. The floodplain core area includes a large section of forested floodplain terrace dominated by bitternut hickory (*Carya cordiformis*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pensylvanicum*), black cherry (*Prunus serotina*), and American hornbeam (*Carpinus caroliniana*). Two plants of special concern, **white trout lily** (*Erythronium albidum*) and **harbinger-of-spring** (*Erigenia bulbosa*), grow within this area. Both plants are spring ephemerals, meaning that they emerge and flower early in the spring before the tree canopy has leafed-out, and are indicative of maturing forests with rich soils and minimal ground-layer disturbance.

White Trout Lily
photo source: P. Weigman

Threats and Stresses

The forest and the plant populations supported within this forest are the essential features of this core area. Timber removal and extension of fields or field edges would have negative impacts on the plants and forest community in this section of Cussewago Creek. Timbering seems to be one of the major concerns in the Cussewago Creek valley, especially heavy, unsustainable cuts. Such forestry practices eliminate the type of rich habitats that support the plant species of concern that are found here. Erosion and sedimentation from Route 98 could be detrimental to water quality and aquatic life.

Recommendations

Landowners interested in timbering should consult *Best Management Practices (BMPs) for Pennsylvania's Forests*, a pamphlet available online from Penn State University (http://pubs.cas.psu.edu/FreePubs/pdfs/uh102.pdf). Otherwise, BMP's should be applied to surrounding agricultural land. Pesticides application along Route 98 should be eliminated around the stream, and ideally, enact a hundred meter no spray zone on either side of the creek. Future road construction should not be within 300 feet of the creek, and continued monitoring of erosion and siltation due to Rt. 98 is recommended.

sweetflag
Dennis W. Woodland, University of Wisconsin

Crosley Road

Further downstream near Crosley Road the natural flow of Cussewago Creek has created a series of bends and wetlands, which support unique communities harboring species of conservation concern. Here, the scoured banks of the stream contain sparse vegetation. The area is an open shrubland with extensive seepage marshes surrounded by a floodplain forest to the south of Crosley Road. North of Crosley Road, the seepage marshes

along Cussewago Creek support **sweetflag** (*Acorus americana*) a Pennsylvania critically imperiled wetland plant. The preferred habitat of sweetflag is the edges of swamps, streams, marshes, and ponds.

Lying along the east valley wall of the creek, seepage marshes dominate this fairly saturated area. Dominant plants include joepye weed (*Eupatorium maculatum*), lake sedge (*Carex lacustris*), and broadfruit bur-reed (*Sparganium eurycarpum*). Sparsely vegetated, steep embankments populated by dwarf St. Johnswort (*Hypericum mutilum*), joepye weed (*Eupatorium* sp.), and dotted smartweed (*Polygonum punctatum*) harbor a population of **pineland pimpernel** (*Samolus parviflorus*). The canopy closes up to the south of Crosley road and features a terraced floodplain comprised of a maturing shellbark hickory (*Carya laciniosa*) forest containing a population of **harbinger-of-spring** (*Erigenia bulbosa*).

Threats and Stresses

The oxbow-like creek and wetlands area north of Crosley Road appear to have been cleared to create an open swamp. In these areas, lacking forested riparian buffers could contribute to water pollution, erosion, and altered hydrological regimes within the creek. A large arm of the stream to the north of the road lies adjacent to Crosley Road, and the intersection of the stream and road could create potential problems related to pollution, erosion, and sedimentation. As always, the establishment of invasive species could greatly affect native plant populations in this complex.

Recommendations

The original forest surrounding the wetland and seepage area should be allowed to regenerate to protect the integrity of this system. Minimally, a hundred meter forested buffer surrounding the wetland is advised. This will afford the stream protection from pollution and erosion associated with Crosley Road. The intersection of the road and stream should be periodically monitored to track erosion issues and stream impact.

Cussewago Creek at Crossingville BDA – *High Significance*

This BDA focuses on the section of Cussewago Creek near Crossingville where Route 98 crosses the creek. A **sensitive species of concern** occupies this section of stream. The core area of this BDA is designated around the Cussewago Creek and an unnamed tributary with an additional hundred meters buffer on both sides to include the riparian corridor contributing to the instream conditions preferred by this species. Specifically, this species prefers pools and moderate to low gradient streams with gravel substrates and light aquatic vegetation. The southern portion of this core retains a highly forested riparian corridor, however, clearing has occurred upstream from this occurrence on both streams.

Cussewago Creek
photo source: PNHP

The area being drained by this section of Cussewago Creek and its unnamed tributary is considered the supporting landscape for this BDA, due to the proximity of other areas embedded within the larger Cussewago Creek supporting landscape. A substantial portion of this area is forested, although sections are dedicated to agriculture. Several roads and utility right-of-ways cross through the area and Cussewago Creek.

Threats and Stresses

Several sections of the creeks within this BDA, especially in the northern section near and including road crossings, are lacking vegetation in the riparian zone. In other sections, the land cover is agriculture, young forest, or shrubland. A lack of vegetated riparian buffers can expose streams to inputs of nutrients, sediments, and numerous chemicals that wash off fields, roads, and lawns. Road crossings can present issues related to erosion and sedimentation. Sedimentation, runoff, and changes in stream hydrology are all threats to the water quality of a stream and maintenance of water quality is key to the persistence of this species.

Recommendations

Allow the regeneration of forested riparian zones to protect the water quality of the stream. Landowners should apply best management practices to forestry practices and agricultural lands. Road crossings should be monitored for maintenance and to evaluate the impact of these crossings on stream conditions. Future road construction should be kept a minimum of 300 feet away from the portion of the stream which the species of concern occupies.

Pont Road Wetlands BDA – *High Significance*
This Natural Heritage Area is discussed under Spring Township

East Fairfield Township and Cochranton Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Little Sugar Creek at Pettis Corners BDA			*High Significance*		
Wavy-rayed lampmussel (*Lampsilis fasciola*) – Mussel	G5	S4	-	1993	E
Creek heelsplitter mussel (*Lasmigona compressa*) – Mussel	G5	S2S3	-	1993	E
Lower French Creek BDA			*Exceptional Significance*		
see Fairfield Township					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh- Geneva Marsh Important Bird Area Conservation Region

Crawford County Natural Heritage Inventory

East Fairfield Township & Cochranton Borough

Biological Diversity Area:

Conneaut Creek - French Creek Confluence

Little Sugar Creek at Pettis Corners

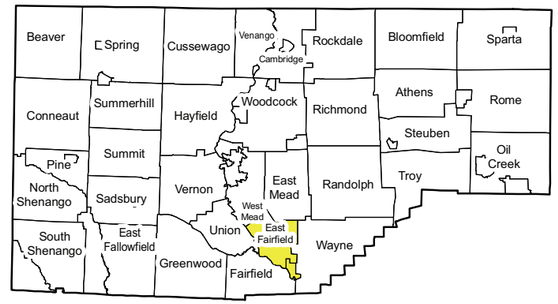
Lower French Creek

Landscape Conservation Area:

French Creek

Public Land:

None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

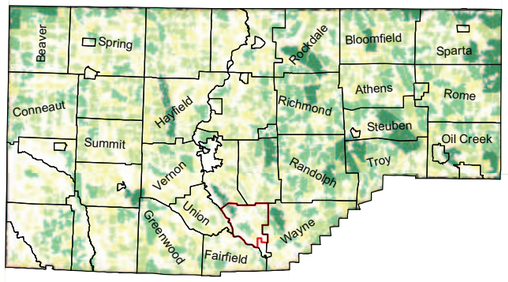
Crawford County Natural Heritage Inventory

East Fairfield Township & Cochranton Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



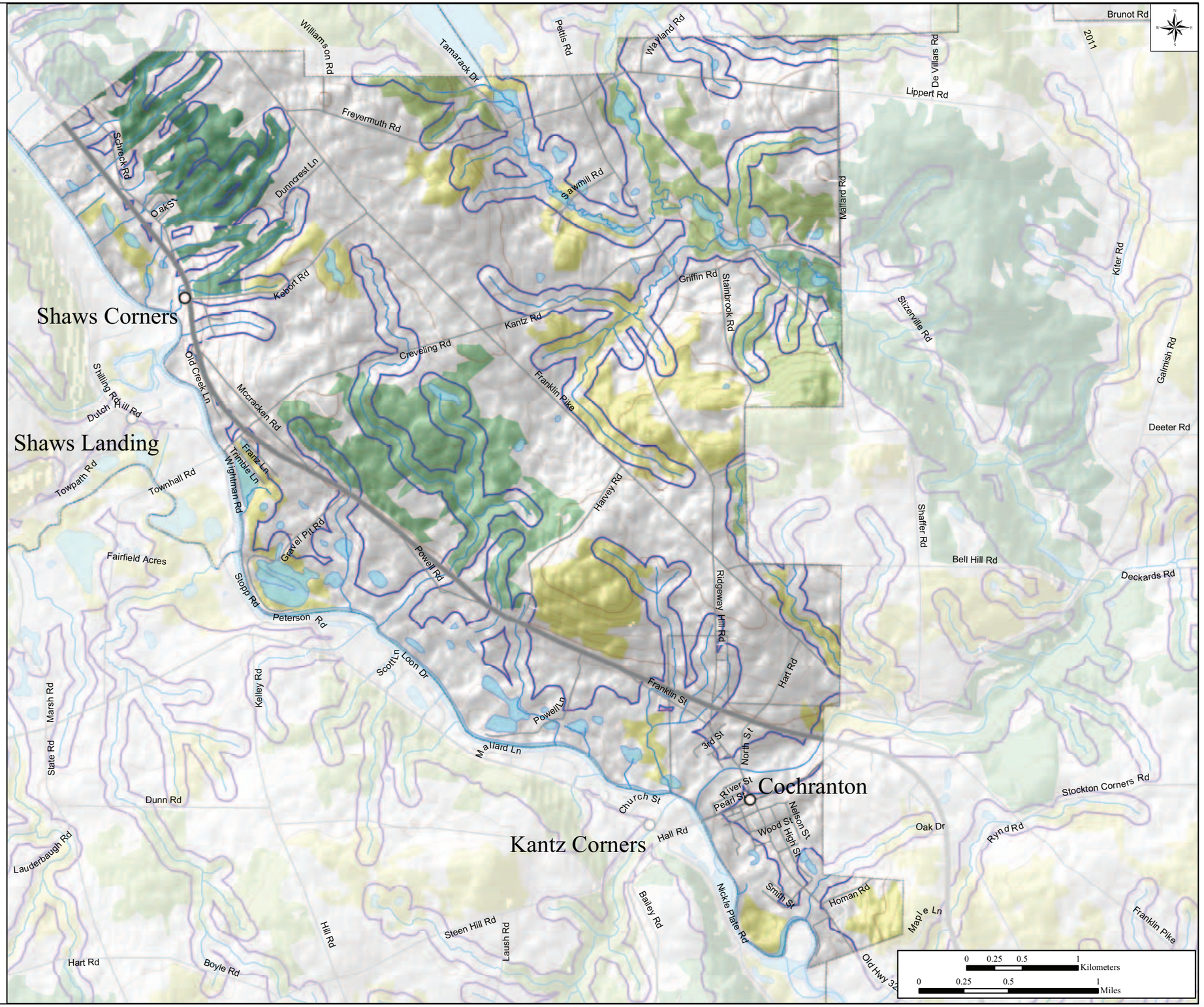
Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



The western border of East Fairfield Township is formed by French Creek, which determines the topography for much of the township. Wide, flat floodplains and steep valley walls characterize this section of the French Creek valley. A large portion of the floodplain south of Shaw's Landing, extending to Cochranton, has been extensively mined for gravel. Much of East Fairfield Township is agricultural, with a few good-sized forested hillsides in areas that are too steep to farm. A series of hills that intersect the township in a southeastern fashion creates the watershed divide between Little Sugar Creek and French Creek. The east bank of Mud Run, which flows into Little Sugar Creek, has steep valley walls like those in the west. The Borough of Cochranton is located at the confluence of French Creek and Little Sugar Creek. It contains a mix of urban and agricultural development with a small amount of forest.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Little Sugar Creek at Pettis Corners BDA – *High Significance*

In the stretch of Little Sugar Creek immediately upstream from the confluence with Mud Run, there is an occurrence of two aquatic species of concern, **wavy-rayed lampmussel** (*Lampsilis fasciola*) and **creek heelsplitter** (*Lasmigona compressa*). These freshwater mussels are found in fine gravel or sand substrate in the creeks and headwaters of small to medium rivers (Cummings and Mayer 1992). Although globally secure throughout its range, the creek heelsplitter is currently considered imperiled in Pennsylvania. The wavy-rayed lampmussel is considered apparently secure in Pennsylvania. Like most mussel species, these species are highly susceptible to major changes in hydrology and water quality such as damming, dredging, sedimentation, nutrient loading, and acid precipitation.

Threats and Stresses

A vegetated riparian corridor protects most of this stream, however, some areas are lacking sufficient buffers especially where bordered by agricultural lands. Most of the surrounding agricultural fields are inactive or in pasture, however the potential for water pollution and nutrient loading into the creek from agricultural practices still exists. At one point, a large road crosses the stream which could contribute to sedimentation, loss of shading, and the introduction of non-point source chemical pollutants.

Recommendations

Maintaining water quality and natural stream structure are both requirements to sustaining aquatic diversity. Mussel species are particularly sensitive to the substrate, structure, and turbidity levels of streams. To increase water quality and potential in-stream habitat, establish forested riparian buffers of approximately 328 feet (100 meters). Wooded riparian buffers aid in moderating water temperatures and reducing sedimentation, pollution, and erosion. Landowners should be made aware of the threatened aquatic species occupying the stream habitat and should employ best management practices that focus on limiting nutrient and soil loss into surface and ground water to maintain water quality in the creek.

Lower French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Fairfield Township.

East Fallowfield Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
McMillen Hollow BDA			*High Significance*		
Central mudminnow (*Umbra limi*) – Fish	G5	S3	PC	2003	C
Pymatuning Wetland Complex-Central BDA			*Exceptional Significance*		
see West Fallowfield Township					
Pymatuning Wetland Complex-South BDA			*Exceptional Significance*		
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1997	E
Lesser panicled sedge (*Carex diandra*) – Plant	G5	S2	PT	1988	E
Soft leaved sedge (*Carex disperma*) – Plant	G5	S3	PR	1988	E
Prairie sedge (*Carex prairea*) – Plant	G5	S2	PT	1988	E
Marsh bedstraw (*Galium trifidum*) – Plant	G5	S2	-	1988	E
Swamp fly honeysuckle (*Lonicera oblongifolia*) Plant	G4	S1	PE	1988	E
Swamp lousewort (*Pedicularis lanceolata*) – Plant	G5	S1S2	-	1997	E
Bog bluegrass (*Poa paludigena*) - Plant	G3	S3	PT	1988	B
Flat-stem pondweed (*Potamogeton zosteriformis*) – Plant	G5	S2S3	PR	1988	E
Autumn willow (*Salix serissima*) – Plant	G4	S2	PT	1981	D
Bog-mat (*Wolffiella gladiata*) – Plant	G5	S2	PR	1986	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Prothonotary warbler (*Protonotaria citrea*) – Bird	G5	S2S3B	-	1982	E
Sensitive species of concern***	-	-	-	1983	E
Sensitive species of concern***	-	-	-	2003	E
Conneaut Marsh-Geneva Marsh LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh- Geneva Marsh Important Bird Area and Pymatuning-Hartstown Complex Conservation Regions .Maurice K. Goddard State Park Important Mammal Area (IMA) Pymatuning Wildlife Management Area and State Game Lands #214 IMA

Crawford County
Natural Heritage Inventory
East Fallowfield Township

Biological Diversity Area:

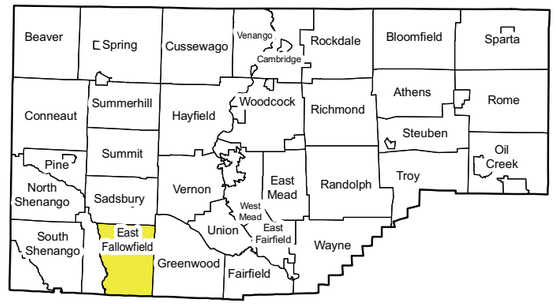
- Mud Lake
- McMillen Hollow
- Pymatuning Wetland Complex - Central
- Pymatuning Wetland Complex - North
- Pymatuning Wetland Complex - South

Landscape Conservation Area:

- Conneaut Marsh Complex
- Pymatuning Wetland Complex

Public Land:

- State Game Land 213
- State Game Land 214



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

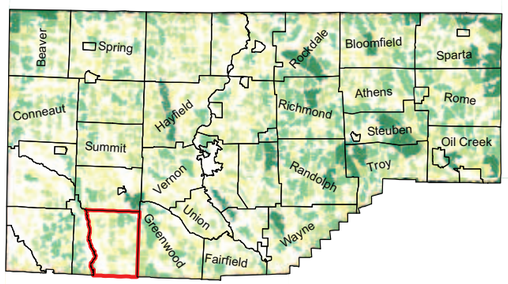
Crawford County Natural Heritage Inventory

East Fallowfield Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Stony Point
Townline Rd
Harding Dr
Andrews Ln
Booth Rd
Mcmichael Rd
Carmon Rd
Canal Rd
Deboit Rd
Helbig Rd
Atlantic Lake Rd
Leach Rd
Sperry Rd
Scott Rd
Lake Rd
Westford Rd
Hartstown
Pine Rd
Union St
Calvin Rd
Morian Rd
Cole Rd
Home Rd
Klein Rd
Woodmans Trl
Brooks Rd
Hall Rd
Patton Rd
Kellogg Rd
Gelvin Rd
Kennard Rd
Mike Wood Blvd
Circle Dr
Adamsville Rd
Kibbler Rd
Huckleberry Rd
Laird Rd
Powder Rd
Adamsville
Baird Rd
Momaster Rd
Seeley Rd
B Rd
C Rd
D Rd
E Rd
F Rd
G Rd
H Rd
Atlantic
Atlantic Rd
Porters Corners
Rocky Glen Rd
Thomas Rd
Leach Rd
Miller Rd
Pine Rd
Minnis Corner
County Line Rd
Tower Rd
Probst Rd
Dick Rd

0 0.3 0.6 1.2 Kilometers
0 0.3 0.6 1.2 Miles

East Fallowfield Township is located in south central Crawford County along the Mercer County border. Crooked Creek, flowing out of Pymatuning Marsh, forms the western border of this township. The marsh extends halfway through the township and is contained within State Game Lands #214. The woody wetlands surrounding Crooked Creek provide contiguous habitat for birds and other wildlife species. This area has been selected as an Important Bird Area (IBA) and an Important Mammal Area (IMA) due to the wildlife habitat it provides. About half of the township is forested, most of which occurs along the creek valleys of Crooked Creek tributaries. Roads and farms have fragmented much of the forest blocks in this township, and agriculture accounts for almost half of the land use in East Fallowfield with row crops being most prevalent. The northwestern end of the Maurice K. Goddard State Park IBA and IMA is located in southeastern East Fallowfield Township. The IMA was selected because it is a stopover during the migration of many songbirds and waterfowl, as well as the numerous species that breed in this IBA. The IMA was chosen due to its diversity of habitats for mammals, including river otters and little brown bats.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

McMillen Hollow BDA – *High Significance*

The stream locally known as Crooked Creek, which flows through McMillen Hollow, supports a population of fish species of conservation concern, the **central mudminnow** (*Umbra limi*). Central mudminnows are small fishes of clear, low gradient streams or wetlands with abundant aquatic vegetation and substrates with high organic debris, peat, or muck accumulation (Ohio Department of Natural Resources 2002). They are fairly uncommon throughout much of their range, which extends through much of the Midwestern states and northeastern U.S. and Canada. This species is considered vulnerable in Pennsylvania.

Threats and Stresses

Central mudminnows are habitat specialists and are extremely susceptible to major instream alterations such as dredging, channelization, and ditching of streams. Draining and filling of wetlands also destroys their habitat (MDC 2000). The supporting watershed of this stream contains a mix of agricultural lands, primarily row crops, and forest. Nutrient loading from pesticides and herbicides into Crooked Creek would negatively affect these fish. Reduced forest cover in riparian zones and changes in hydrology are additional threats to this species.

Recommendations

Land management plans that would alter the hydrology, such as those that cause siltation, increase erosion, increase temperatures, or cause flooding should be avoided to protect this species. Restore forested riparian buffers on agricultural lands. The United States Forest Service recommends maintaining forested buffers of at least 50 meters along streams to protect water quality for aquatic organisms (1991). Best management practices to reduce water pollution should be applied to surrounding farmland.

Pymatuning Wetland Complex-Central BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under West Fallowfield Township.

Pymatuning Wetland Complex-South BDA – *Exceptional Significance*

This BDA includes the primary wetland communities that together form the lower portion of Pymatuning Swamp. The area now occupied by the swamp represents only a part of what once was one of the most extensive wetland complexes in the state. The damming of the headwaters of the Shenango River in the early 1930's resulted in the formation of Pymatuning Lake and the loss of a substantial portion of the swamp. The changes in the wetland communities are not fully known or understood, but historic records of plant species that once occupied now flooded areas indicate that sections of the swamp supported a rich flora, featuring species affiliated with calcareous conditions. The remaining swamp communities include open water, emergent, and palustrine wetland community types. The wetland as a whole extends for several miles from the lake edge upstream to where it narrows and eventually becomes discontinuous along the drainage. This BDA is delineated around the southern portion of the wetland that lies within the southern portion of State Game Lands #214.

The area along the southern and western shore of Mud Lake is comprised of an open, mixed emergent marsh with scattered seepage openings. The dominant plants of the emergent marsh area includes swamp loosestrife (*Decodon verticillatus*), giant bur-reed (*Sparganium eurycarpum*), green arrow arum (*Peltandra virginica*), and numerous sedges (*Carex* sp.). Water lily (*Nuphar* sp.) is common, floating throughout the wetland. Several species of concern are associated with this community. They include **broad-winged sedge** (*Carex alata*), **lesser-panicled sedge** (*C. disperma*), and **marsh bedstraw** (*Galium trifidum*). Seepage openings scattered throughout the swamp in the upland areas support a few plant species of concern, including **swamp lousewort** (*Pedicularis lanceolata*), **autumn willow** (*Salix serissima*), and **swamp fly honeysuckle** (*Lonicera oblongifolia*). These seepages are populated by numerous sedges (*Carex interior*, *C. stricta*), round-leaf goldenrod (*Solidago patula*), royal fern (*Osmunda regalis*), swamp thistle (*Cirsium muticum*), and Canada burnet (*Sanguisorba canadensis*).

Downstream from the emergent marsh, the swamp opens up and becomes a water lily (*Nuphar lutea* ssp. *advena*) swamp with floating peat rafts on open water. The edges of the marsh support a variety of sedges (*Cyperus* sp., *Carex* sp., *Scirpus* sp.), pondweed (*Potamogeton* sp.), rushes (*Juncus* sp.), and buttonbush (*Cephalanthus occidentalis*). This area supports several plant species of concern including **Engelmann's flatsedge** (*Cyperus engelmannii*), **bog-mat** (*Wolffiella gladiata*), and **flat-stem pondweed** (*Potamogeton zosteriformis*). The perimeter of this marsh is a low-relief forested wetland with white pine (*Pinus strobus*), tamarack (*Larix laricina*), red maple (*Acer rubrum*), and black ash (*Fraxinus nigra*) present. This area supports three plant species of concern: **bog bluegrass (***Poa paludigena*), **prairie sedge** (*Carex prairea*), and **soft-leaved sedge** (*Carex disperma*). Additionally, firm aster (*Symphyotrichum firmum*) is present throughout the wet meadows of this site. Once listed as endangered in the Commonwealth, this species has recently been delisted, but remains on the PNHP Watch List.

In addition to the diverse plant community, several bird species of concern are known to nest within the larger wetland complex: **marsh wren** (*Cistothorus palustris*), c**ommon moorhen** (*Gallinula chloropus*), and **prothonotary warbler** (*Protonotaria citrea*). The nesting requirements of these species represent the diverse communities present throughout the swamp.

The supporting landscape for Pymatuning Swamp is represented by the immediate watershed of the wetland complex and includes a large percentage of agricultural lands. Numerous small tributaries flow through these predominately agricultural areas directly into the swamp, which then drain to the Shenango River to the north and Crooked Creek to the south.

Threats and Stresses

Maintaining water quality is the key to the continued success of this wetland complex and the many species of concern it supports. Changes in hydrology of this system such as flooding, damming, draining, loss of forest cover, and increased impervious surfaces within the watershed can affect this wetland. Periodic changes from natural processes, such as beaver and seasonal flooding events, have resulted in a dynamic mix of habitats, and these natural processes will likely maintain the diversity of habitats at this site. Portions of this area are used for

light recreation which may present a problem to some nesting bird species that are extremely susceptible to human disturbance during the breeding season.

Logging should not be permitted so that the vegetation may buffer this system from any potentially harmful runoff that may enter the wetland from upland farms, roads, and municipalities. Loss of the surrounding vegetation will also cause changes in the canopy cover and temperature of this wetland. The introduction and spread of invasive exotic species, specifically common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*), is a threat to native plant and animal populations.

Recommendations

The sensitivity of the core area is high, and any activities taking place within have the possibility of affecting the wetland and some or all species of concern occurring there. A good deal of protection is in place given that the swamp is almost entirely on public land and is considered an exceptional value (EV) wetland. Periodic monitoring for the presence or establishment of invasive species is necessary. Also, incorporating policy and strategy for controlling invasive species into the management plans for the Game Commission lands will be essential in managing this threat.

All activities that have the capacity to affect water quality should be carefully reviewed and measures taken to limit such impact. Human traffic throughout the wetland should be limited during the breeding season so as not to disrupt nest success. Nutrient inputs from agriculture are of concern, and programs to help farmers best manage their livestock, pastures and crop fields will go a long way in maintaining good water quality. Forested buffers along streams are very important for absorbing surface water and the accompanying pollutants and for helping to limit the spread of invasive species that respond to high light conditions.

East Mead Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Little Sugar Creek at Blooming Valley		*Notable Significance*			
Hemlock palustrine forest - Natural Community	GNR	S3	-	2004	E
Mixed forb marsh - Natural Community	GNR	S3	-	2004	E
Northern hardwood forest - Natural Community	GNR	S4	-	2004	E
Little Sugar Creek at Pettis Corner BDA		*Exceptional Significance*			
see East Fairfield Township					
Yoset Lake Palustrine Forests BDA		*High Significance*			
Clinton's wood fern (*Dryopteris clintoniana*) - Plant	G5	S2	-	2004	E

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: None

East Mead Township lies within the Meadville metropolitan area in the center of the county. The township lies completely within the Little Sugar Creek watershed, which flows southwesterly through the township. Several small tributaries that have cut fairly deep valleys support the main branch of Little Sugar Creek. The creek has also been dammed by the Army Corps of Engineers to create Tamarack Lake. The riparian zone of Little Sugar Creek contains a fair amount of floodplain palustrine forest, and wooded wetlands are present adjacent to the stream channel. Agriculture and forest blocks are present in equal amounts in this township.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Crawford County
Natural Heritage Inventory
East Mead Township

Biological Diversity Area:

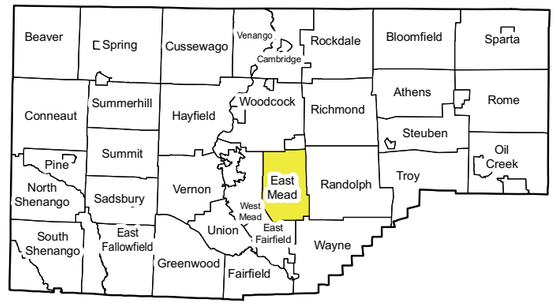
Little Sugar Creek at Blooming Valley
Little Sugar Creek at Pettis Corners
Yoset Lake Palustrine Forest

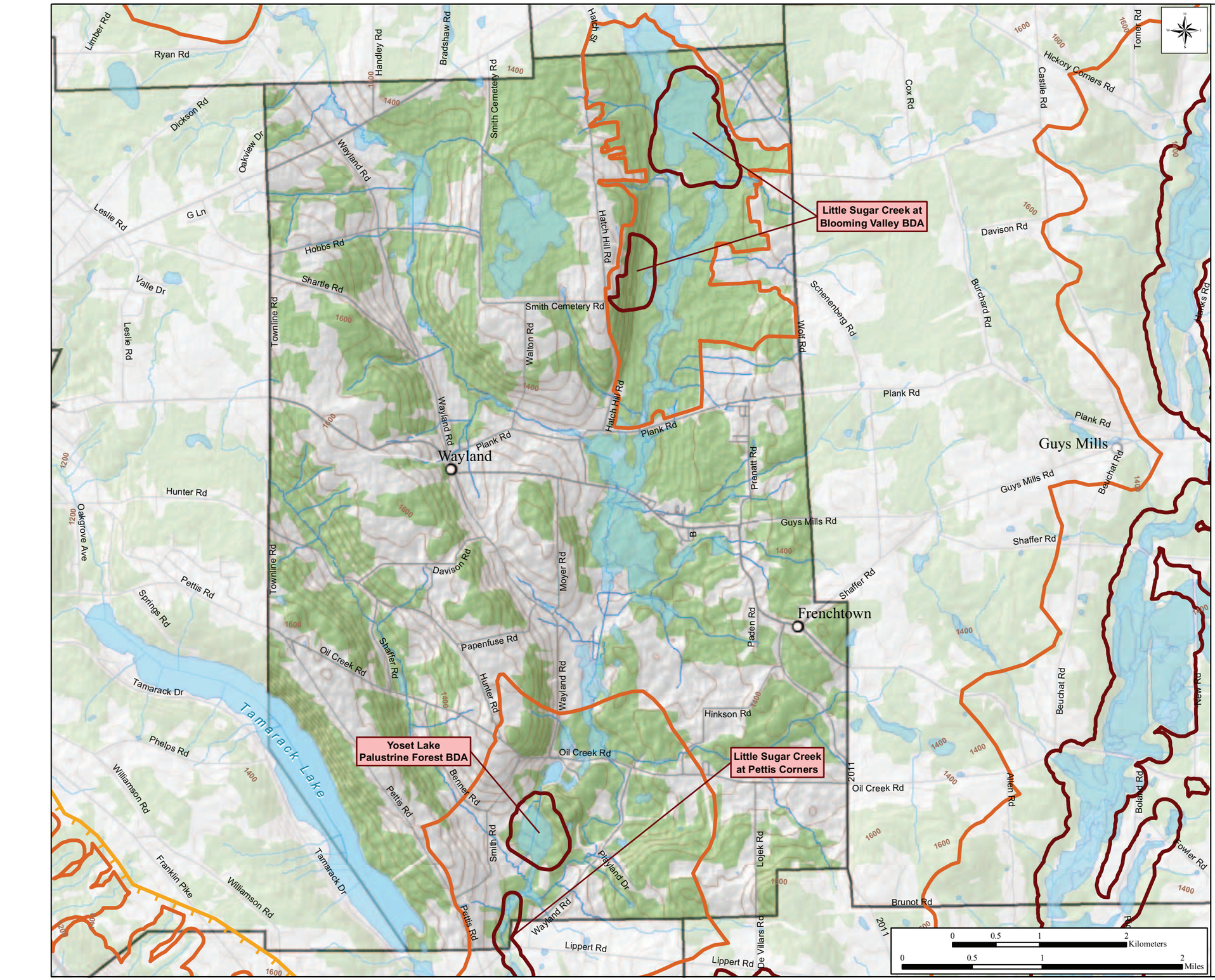
Landscape Conservation Area:

None

Public Land:

None





0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

Crawford County
Natural Heritage Inventory

East Mead Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

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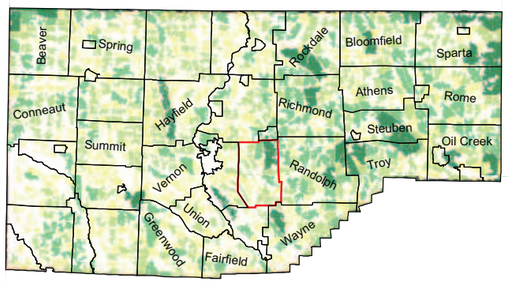
Distribution of forest blocks in Crawford County



Legend

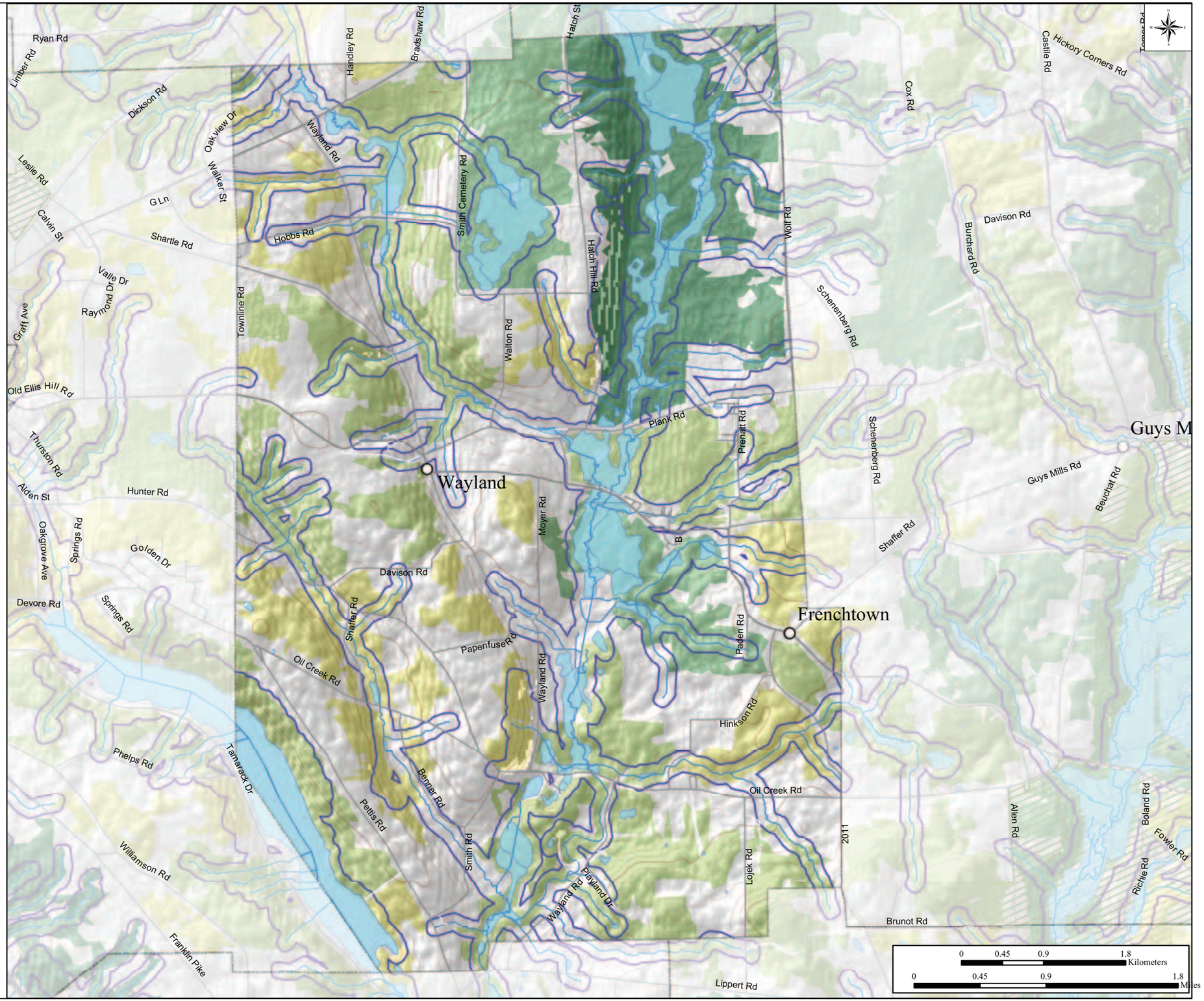
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Little Sugar Creek at Blooming Valley – *Notable Significance*

This site is one of the largest forest blocks remaining in the county and contains three natural communities of special concern, **mixed forb marsh**, **hemlock palustrine forest**, **and northern hardwood forest**. The mixed forb marsh is dominated by grasses and herbs and has more open water than the other communities. The hemlock palustrine forest is dominated by eastern hemlocks with a sphagnum ground cover. Northern hardwood forests are often dominated by American beech, red maple, sugar maple and black cherry (Fike 1999).

Threats and Stresses

Even though the forest block is intact, it is surrounded by agricultural and residential areas. Chemical and sediment inputs from roads and agriculture could degrade the quality of Little Sugar Creek, which would negatively affect the quality of the natural communities. The communities are buffered by forested areas in most places, but in others, are bordered by agricultural fields. Having a direct connection with such highly disturbed areas increases the chance that these communities may become exposed to pollutants and invasive species. Invasive species often begin to spread rapidly along edges of habitat where disturbance occurs.

Recommendations

Maintain the existing forest block, and expand wherever possible to create a larger buffer for the communities of special concern. Forested buffers should also be established along Little Sugar Creek to help maintain the quality of the communities. Monitor for invasive species and remove them as soon as they are discovered to increase the chance of successful removal.

Little Sugar Creek at Pettis Corners BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under East Fairfield Township.

Yoset Lake Palustrine Forests BDA – *High Significance*

This site has been designated a BDA around a plant species of concern, **Clinton's wood fern** (*Dryopteris clintoniana*). This species was observed in a white pine and hemlock swamp. Clinton's wood fern is found in northwestern Pennsylvania growing in moist woods. This species is known to hybridize with other members of its genus.

Threats and Stresses

This wetland is surrounded by farmland, so water pollution from herbicide or insecticide-laden runoff could be detrimental to the habitat. Draining, filling or permanently flooding would devastate the hydrology and eliminate these special communities. Furthermore, the westward migration of the hemlock wooly adelgid (*Adelges tsugae*) poses a serious potential threat to the viability of these hemlocks and the existence of this community.

An aerial view of Yoset Lake

photo source: PHNP

Recommendations

Best Management Practices (BMPs) should be applied to surrounding farmland to reduce water pollution and nutrient loading. Enrollment in the Wetland Reserve Program (WRP) through the Natural Resources Conservation Service (NRCS) is also an option for protecting these wetlands. Additional information on this program can be obtained from the NRCS website (http://www.pa.nrcs.usda.gov/programs/WRP/). Periodic monitoring for hemlock wooly adelgid is recommended along with further surveys to document animal species utilizing the wetlands.

Fairfield Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Marsh Complex South BDA			*Exceptional Significance*		
see Union Township					
French Creek- Conneaut Outlet Confluence BDA			*Exceptional Significance*		
see Union Township					
Lower French Creek BDA			*Exceptional Significance*		
Pineland pimpernel (*Samolus parviflorus*) – Plant	G5T5	S2	TU	1998	E
Elktoe (*Alasmidonta marginata*) – Mussel	G4	S4	-	2005	E
Three-ridge (*Amblema plicata*) – Mussel	G5	S2S3	-	2005	E
Round pigtoe (*Pleurobema sintoxia*) – Mussel	G4	S2	-	2005	E
Ohio lamprey (*Ichthyomyzon bdellium*) – Fish	G3G4	S2S3	PC	1999	E
Sensitive species of concern***	-	-	-	2005	E
Sensitive species of concern***	-	-	-	2005	E
Sensitive species of concern***	-	-	-	1992	B
Sensitive species of concern***	-	-	-	1992	B
Sensitive species of concern***	-	-	-	1987	E
Sensitive species of concern***	-	-	-	2005	E
Conneaut – Geneva Marsh LCA					
see page 53 for descriptions of LCAs					
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area Conservation Region

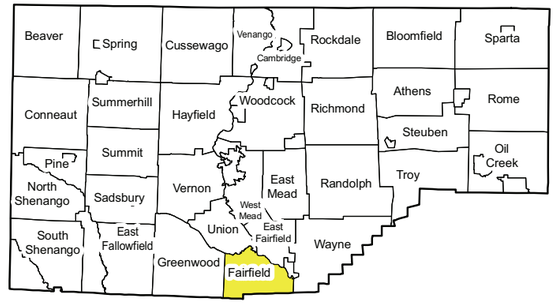
Crawford County
Natural Heritage Inventory

Fairfield Township

Biological Diversity Area:
- Conneaut Marsh Complex South
- Conneaut Creek - French Creek Confluence
- Lower French Creek

Landscape Conservation Area:
- Conneaut Marsh Complex
- French Creek

Public Land:
- French Creek



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.45 0.9 1.8 Kilometers
0 0.45 0.9 1.8 Miles

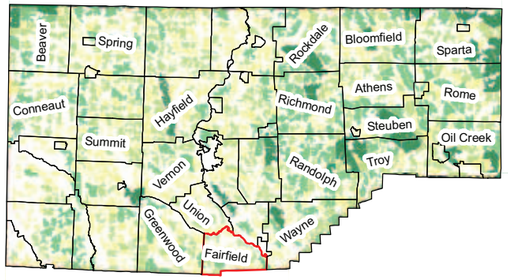
Crawford County
Natural Heritage Inventory

Fairfield Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



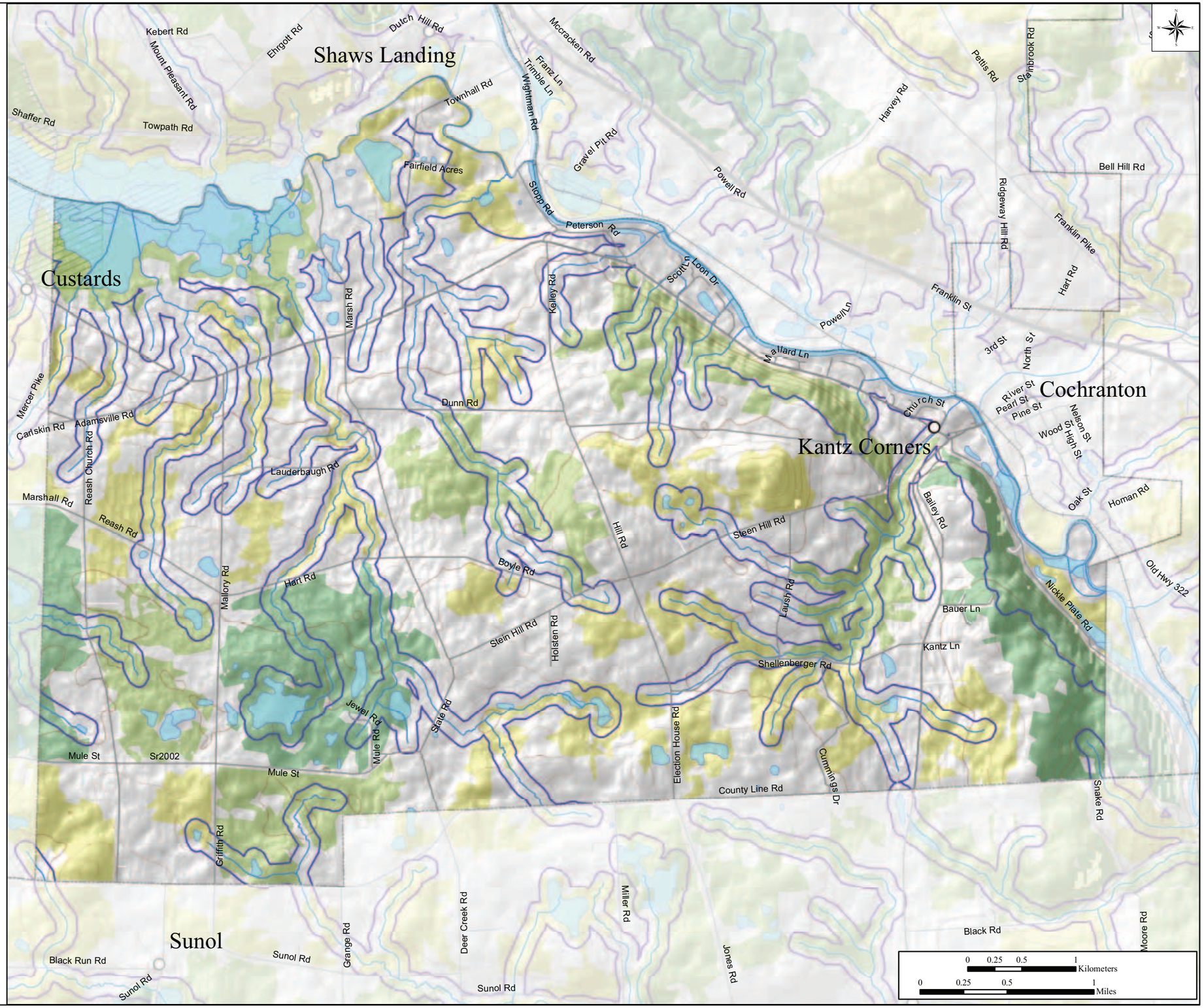
Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Fairfield Township lies in southern Crawford County with Mercer County to the south. The northern border is formed by Conneaut Outlet and French Creek, which also form the eastern border of this township. Numerous tributaries to both of these creeks flow through narrow forested channels across agricultural areas, which is the principal land use of this township. However, some streams retain little or no vegetated riparian buffers to filter out sediment, pollutants, and chemicals. Both of these creeks provide critical habitat to a number of species of concern and pollution entering the stream via runoff poses a serious threat to communities and species present. Less than half of the county is forested. Planting native trees, especially in riparian zones, is encouraged to protect the aquatic and terrestrial systems associated with Conneaut Outlet and French Creek. The southern end of the Conneaut Marsh - Geneva Marsh Important Bird Area (IBA) is located in the northwestern corner of Fairfield Township. This area has been identified as important to bird species because of the large number of different types of wetland habitats that occur here, including the largest remaining emergent marsh in the state. Some of the largest breeding populations of several wetland species occur in this IBA. The supporting landscape for this IBA covers most of the township.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Conneaut Marsh Complex South BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Union Township.

French Creek-Conneaut Outlet Confluence BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Union Township.

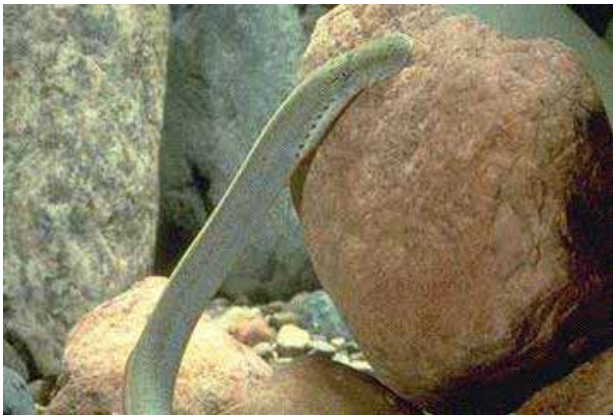
Elktoe
Photo source: Tam Smith, PNHP

Lower French Creek BDA – *Exceptional Significance*

This BDA captures the confluence of French Creek with Little Sugar Creek at Cochranton, which supports a number of aquatic species of concern. This BDA extends upstream into Little Sugar Creek to include appropriate habit for a **sensitive species of concern** and downstream into French Creek to take into account several aquatic species of concern and a plant species of concern, **pineland pimpernel** (*Samolus parviflorus*), growing on the bank of the river. The **Ohio lamprey** (*Ichthyomyzon bdellium*), a fish species of concern, and three mussel species of concern, **elktoe** (*Alasmidonta marginata*), **three-ridge** (*Amblema plicata*), and **round pigtoe** (*Pleurobema*

sintoxia) were located in the French Creek section of this site. Six other **sensitive species of concern** were also found at this site.

Ohio lampreys, a species of concern, have been found in Little Sugar Creek, just before it enters French Creek, and in French Creek itself. This species of lampreys is a locally migratory species. The young, called ammocoetes, bury themselves in the muck and organic material of small headwaters streams, once sexual maturation is reached, adults migrate to larger streams where they prey upon fish. This suggests that populations found in Little Sugar Creek may have been migrating to French Creek to find food. More extensive surveys of Little Sugar Creek are needed to confirm their presence in this stream. An upstream stretch of Little Sugar Creek is included in this BDA to account for possible lamprey habitat.



Ohio Lamprey
Photo source: Ohio DNR Native Fish Conservancy, Animal Diversity Web

The confluence of the two creeks creates riffle habitat for several aquatic species of concern. These species prefer the riffles of medium rivers with sand, rubble, and cobble bottoms. These species are also found in another riffle area further downstream. Historically, this portion of the stream also hosted a rich diversity of mussel species.

The aquatic plant species of concern, **pineland pimpernel** (*Samolus parviflorus*), grows in sandy shorelines of this portion of French Creek. This species grows submersed on marshy shores and river banks.

pineland pimpernel
photo source: PNHP

Threats and Stresses

Maintaining high water quality and suitable stream habitat is the key to sustaining healthy populations of aquatic plants and animals in French Creek. Loss of forested riparian zones would likely result in increased water temperature, erosion and sedimentation pollution in the river, and disruption of natural nutrient cycling linked to the stream. Removal of forest cover on valley walls is especially problematic due to the potential for increased runoff and erosion following storm events.

The primary source of water pollution in French Creek is most likely linked to non-point pollution sources such as agricultural runoff and point source pollution such as wastewater discharge from residential and industrial property. Agriculture can contribute to erosion and pollution problems via clearing of riparian vegetation and farming too close to streams, chemical runoff from herbicides, pesticides and fertilizers, and nutrient loading due to animal waste. Allowing livestock to cross streams may cause trampling and death of aquatic plant and animal species. Stream dredging, the removal of sand and gravel from river bottoms, destroys

mussel and fish habitat and alters stream flow. Runoff from impervious surfaces, such as roads, causes water pollution of salt, oils, and chemicals.

Recommendations

Maintain forested riparian buffers along the main stem and all tributaries to protect the water quality of French Creek. A minimum of a 100-meter buffer is recommended. Landowners within the floodplain and watershed of French Creek should consult best management practices to reduce impacts from agriculture and septic systems. Restrict livestock from entering or crossing the stream. Dredging, although not currently practiced here, should be restricted due to the amount of mussel species in the stream. Road maintenance activities should avoid excessive application of salt during the winter

Greenwood Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Marsh Complex-Central BDA		*Exceptional Significance*			
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
American coot (*Fulica americana*) – Bird	G5	S3BS3N	-	1988	E
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Pied-billed grebe (*Podilymbus podiceps*) – Bird	G5	S3BS3N	-	1996	B
Mixed forb marsh – Natural Community	GNR	S3	-	1982	B
Sensitive species of concern***	-	-	-	2005	E
Conneaut Marsh Complex-North BDA		*Exceptional Significance*			
see Vernon Township					
Conneaut Marsh Complex-South BDA		*Exceptional Significance*			
see Union Township					
Sandy Creek Wetlands BDA		*High Significance*			
Downy willow-herb (*Epilobium strictum*) - Plant	G5	S3	PE	2003	E
Red currant (*Ribes triste*) – Plant	G5	S2	PT	2004	E
Conneaut-Geneva Marsh LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh- Geneva Marsh Important Bird Area (IBA), Maurice K. Goddard State Park Important Mammal Area and IBA

Crawford County
Natural Heritage Inventory

Greenwood Township

Biological Diversity Area:

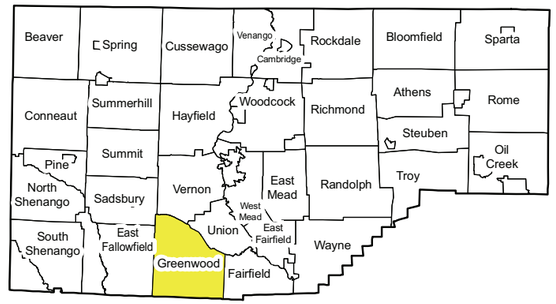
Conneaut Marsh Complex Central
Conneaut Marsh Complex North
Conneaut Marsh Complex South
Sandy Creek Wetlands

Landscape Conservation Area:

Conneaut Marsh Complex

Public Land:

State Game Land 213



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

Crawford County
Natural Heritage Inventory

Greenwood Township

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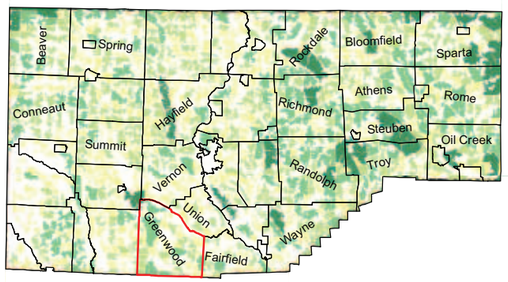
Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

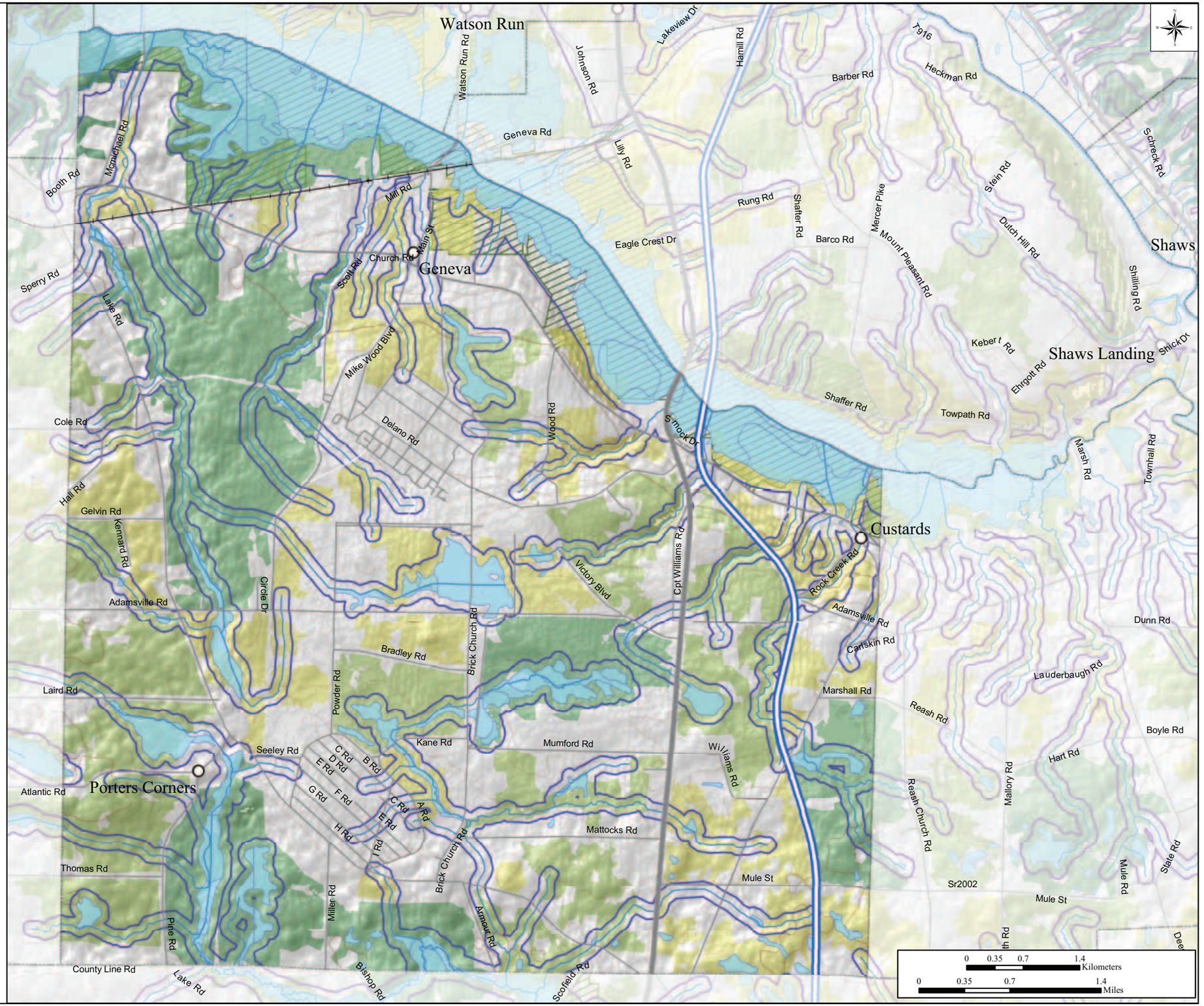
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Greenwood Township is located in southern Crawford County, along the Mercer County border. Conneaut Outlet forms the northern border of this township. Most of this township is drained by tributaries to Conneaut Outlet, which flows into French Creek to the northeast. The headwaters of Sandy Creek, which flows into Mercer County, originate in the southern part of Greenwood Township. About half of this township is forested. Some of the largest remaining forest blocks in the county are located in Greenwood Township. State Game Lands #213, comprised of the Conneaut Outlet Marsh, is fairly wooded, which should afford protection to this area. Conneaut Marsh has been designated an Important Bird Area (IBA) by the Audubon Society of Pennsylvania due to the extensive marsh habitat it provides for wetland birds. The MK Goddard State Park IBA is located along the southern border of Greenwood Township, and was selected because it is a stopover during the migration of many songbirds and waterfowl, as well as the numerous species that breed in this IBA. The Maurice K. Goddard State Park Important Mammal Area (IMA) is also located in southern Greenwood Township. This site was chosen due to its diversity of habitat for mammals, including river otters and little brown bats. This IMA also provides programs for the public on various mammal species. Only about one third of the township is agricultural.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Conneaut Marsh Complex Central BDA – *Exceptional Significance*

Conneaut Marsh, locally known as Geneva Marsh, is the largest marsh complex in Pennsylvania. Formed by glacial outwash, it extends approximately thirteen miles along Conneaut Outlet from Conneaut Lake, almost reaching French Creek. The entire marsh is owned and managed by the Pennsylvania Game Commission (PGC) as State Game Lands #213 and is recognized as an Important Bird Area (IBA) by the Pennsylvania Audubon Society. A variety of habitats, including forested wetlands, shrub-scrub wetlands, and open emergent marshes dominate the central wetland complex, while a few old fields, reverting forests, and mixed hardwood forests populate the remainder of the area. The entire marsh has been designated as a BDA, however, due to the size of the area it has been broken into three smaller sections. This BDA extends downstream a little from the Watson Run confluence to slightly upstream from where Williams Run meets Conneaut Outlet. This area supports a number of bird and plant species of concern.

Conneaut Marsh is an extremely important habitat for many migrating and resident bird species. Approximately 10,000 waterfowl use the marsh during spring and fall migration, and a number of Pennsylvania bird species of concern are known to occur within the marsh (Tautin 2004). This portion of the marsh contains a considerable amount of emergent aquatic vegetation such as spatterdock (*Nuphar* sp.), smartweed (*Polygonum* sp.), and cattails (*Typha* sp.). Prairie cordgrass (*Spartina pectinata*) and bur-reed (*Sparganium* sp.) can also be found here. These plants provide nesting habitat for several threatened or endangered species of marsh birds as listed below. Five species of concern and a natural community of concern were documented at this site. Parallel to Conneaut outlet, mud flats provide refuge for migrating shorebirds

Pennsylvania's largest population of **marsh wrens** (*Cistothorus palustris*), once much more widespread, occurs at Conneaut Marsh. Marsh wrens are small songbirds with highly specific habitat requirements. Marsh Wrens breed across southern Canada, locally across the interior United States and coasts. They prefer freshwater or brackish marshes with a dominant cattail component (NatureServe 2006). In Pennsylvania, this species is most often found

in the glaciated northwest, the Lake Erie shore, and coastal plain (McWilliams and Brauning 2000). Marsh wrens have experienced population declines due to the significant loss of appropriate wetland habitat.

Pied-billed grebes (*Podilymbus podiceps*) are small, secretive wetland birds that are regular migrants and winter residents in Pennsylvania. The are known to breed in the large marshes of the glaciated northwest, as well as other areas of the state, and prefer bodies of water with thick vegetation such as rushes, reeds, or cattails which they use for cover and anchorage for floating nests. This species is extremely susceptible to human disturbance and alteration of hydrological regimes. However, Ickes (In Brauning 1992) suggests that this danger may be offset by the grebe's willingness to nest in artificial ponds. Recreational activities such as boating and fishing may also disturb the birds.

The **American coot** (*Fulica americana*) is a less secretive wetland bird that frequently migrates through Pennsylvania. Local breeding populations are restricted to the glaciated northwest and regular winter residents can be found in areas of open water. This species usually nests in emergent vegetation of large marshes, often on floating mats of vegetation. Regular breeding populations have most notably been recorded at Conneaut Marsh.

Another less secretive wetland bird, the **common moorhen** (*Gallinula chloropus*), is a local breeder on the coastal plain and glaciated northwest regions of the state. These birds prefer marshes and the edges of open water with sufficient emergent vegetation with which they build floating platform nests.

The immediate area drained by Conneaut Outlet and Conneaut Marsh is considered the supporting landscape for this BDA. Much of this landscape is forested or contains agricultural fields, most of which is pasture or reverting fields.

Threats and Stresses

Conneaut/Geneva Marsh lies completely within State Game Lands #213 and is largely protected. As with other wetlands in the area however, invasive species establishment is a problem in the marsh. Narrow-leaf cattail (*Typha angustifolia*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and multiflora rose (*Rosa multiflora*) are all present throughout the marsh. Lack of management for these invasives could lead to the formation of dense stands and encroachment into open water. Currently, the PGC is using a mechanical vegetation cutter to remove stands and maintain areas of open water in the marsh.

Human disturbance to nesting birds is a potential threat at this site due to the amount of birdwatchers, hikers, and hunters who frequent the gamelands. However, other activities, such as canoeing, could unintentionally disrupt other nesting marsh birds, which are currently not granted the same protection.

Watershed-scale impacts are potentially the most imminent threats to this ecosystem. Conneaut Lake, with its heavily developed shore, forms the headwaters of Conneaut Outlet, the main channel of the marsh. Runoff from impervious surfaces, pollution, and nutrient loading into the stream would drastically alter the habitat conditions of this marsh. Parts of the lake are eutrophic, and it is currently being treated with chemicals to reduce invasive aquatic plant species. Ultimately, these chemicals may enter the marsh and food chain of this ecosystem. Furthermore, the area surrounding the marsh is rich in glacial deposits, therefore, gravel mining within the watershed is a potential habitat disturbance to be avoided.

Recommendations

The Pennsylvania Game Commission has developed a management plan for SGL #213, which includes habitat management, invasive species management, and seasonal protection for breeding birds. Limiting open water access during the breeding season might also prove beneficial to the success of other marsh-dependent birds. A more active invasive species management plan is highly recommended and an opportunity for a volunteer-based hand removal program may be an option given the large amount of visitors who enjoy the marsh for recreation. The Game Commission should consider working with local groups to help reduce the impacts of watershed-scale activities.

Conneaut Marsh Complex North BDA – *Exceptional Significance*
This Natural Heritage Area is discussed under Vernon Township.

Conneaut Marsh Complex South BDA – *Exceptional Significance*
This Natural Heritage Area is discussed under Union Township.

Sandy Creek Wetlands BDA – *High Significance*

The wetlands along Sandy Creek, south of Porters Corners, in the upper portion of the watershed harbor two plant species of concern. Both species, **red currant** (*Ribes triste*) and **downy willow herb** (*Epilobium strictum*), are indicative of wet woods or swamps. The area representing the core wetland contains a range of wetland types, which cover the valley bottoms. The open shrub wetland becomes a hardwood palustrine forest in the lower portion of the core. Select patches of the wetlands suggest calcareous habitats, although the overall system is circumneutral.

The northern portion of the wetland, which lies adjacent to Sandy Creek, contains a sedge meadow, which succeeds to a shrub swamp. This area is dominated by grass-like plants, such as common lake sedge (*Carex lacustris*) and slender manna grass (*Glyceria melicaria*), with intermittent shrubs such as alder-leaved buckthorn (*Rhamnus alnifolia*), meadowsweet (*Spiraea alba*), and ninebark (*Physocarpus opulifolius*). This area supports an occurrence of downy willow-herb. The wetland contains several channels and patches of wetland, however, the overall community is not contiguous. Shrubs give way to a palustrine forest with occasional calcareous seeps to the southeast. Overstory dominants include eastern hemlock (*Tsuga canadensis*), yellow birch (*Betula allegheniensis*), red maple (*Acer rubrum*), and white pine (*Pinus strobus*). Understory species include musclewood (*Carpinus caroliniana*) and spicebush (*Lindera benzoin*). The herbaceous layer supports skunk cabbage (*Symplocarpus foetidus*), ferns (*Onoclea sensibilis* and *Osmunda cinnamomea*), sedges (*Carex bromoides*, *C. scabrata*), marsh marigold (*Caltha palustris*), and small-flowered forget-me-not (*Myosotis laxa*).

Threats and Stresses

Although most of the core area is forested wetland, it appears that some of the marsh complexes once served as pastures or were timbered, even though they are extremely wet and unsuitable for general agriculture. Clearing for timbering, pasture, and agriculture are threats to both of these plant species of concern and the general habitat. The occurrence of these plants is linked to hydrology of this wetland complex, so any activity that would distinctly alter the hydrologic regime would be detrimental to these populations. Specifically, flooding or draining of the northern sedge swamp would disturb downy willow-herb populations.

The supporting landscape contains a few roads and agricultural lands. Non-point source pollution entering the system via runoff from these areas is a threat to the overall hydrology of the wetland complex. Establishment of invasive species, which may be dispersed by roads or other disturbances, could threaten healthy populations of native plants.

Recommendations

Restrict grazing, timbering, and road construction within the core area to maintain desirable habitat conditions. Land managers should be made aware of these communities and plants of conservation concern and should aim to reduce impacts to the hydrology by implementing best management practices on surrounding farmlands. Periodic monitoring of these species and communities, as well as for invasion by exotic species is recommended.

Hayfield Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Cussewago Creek at Onspaugh Corners BDA			*High Significance*		
see Vernon Township					
Cussewago Creek-Coons Valley BDA			*Exceptional Significance*		
Brown sedge (*Carex buxbaumii*) – Plant	G5	S3	TU	2004	E
False hop sedge (*Carex lupuliformis*) – Plant	G4	S1	TU	2006	E
Cattail sedge (*Carex typhina*) – Plant	G5	S2	PE	2004	E
Harbinger-of-spring (*Erigenia bulbosa*) – Plant	G5	S2	PT	2000	E
Virginia blue flag (*Iris virginica*) – Plant	G5	S2	-	2000	E
Shumard's oak (*Quercus shumardii*) – Plant	G5	S1	PE	2006	E
Pineland pimpernel (*Samolus parviflorus*) – Plant	G5T5	S2	TU	2003	E
Veiny-lined aster (*Symphyotrichum praealtum*) – Plant	G5	S3	-	1997	E
Sensitive species of concern***	-	-	-	2006	E
Sensitive species of concern***	-	-	-	2003	E
French Creek BDA			*Exceptional Significance*		
see Woodcock Township					
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh- Geneva Marsh Important Bird Area (IBA), Cussewago Bottom IBA, and Erie National Wildlife Refuge IBA

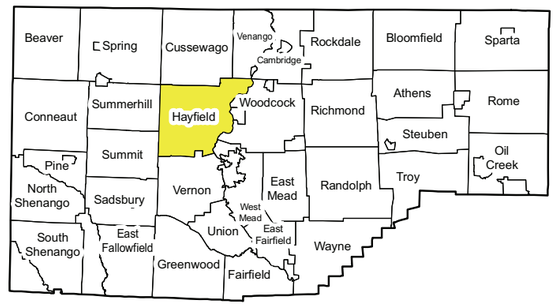
Crawford County
Natural Heritage Inventory

Hayfield Township

Biological Diversity Area:
Cussewago Creek - Coons Valley
Cussewago Creek at Denny's Corners
French Creek

Landscape Conservation Area:
French Creek LCA

Public Land:
None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

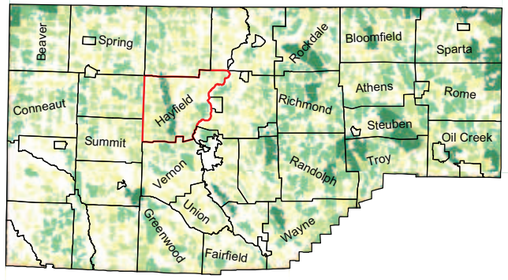
Crawford County
Natural Heritage Inventory

Hayfield Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

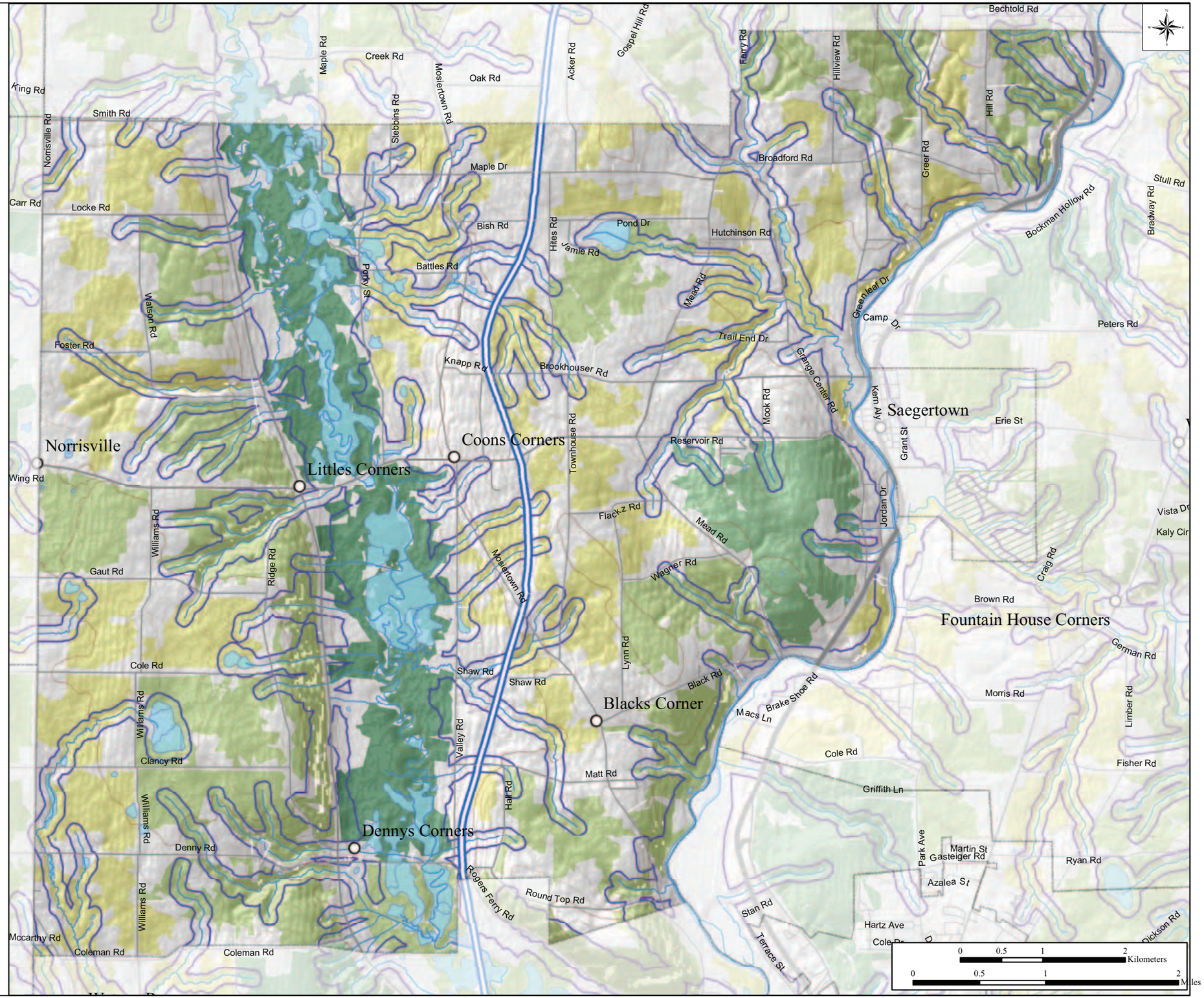
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Hayfield Township is located in central Crawford County. It is bordered by Cussewago Township to the north and Vernon Township to the south, and French Creek creates the eastern border of this township. Cussewago Creek flows through the center of this township with its numerous tributaries draining nearly all of Hayfield Township. The Cussewago Creek valley is fairly steep and forested with numerous wetlands and bottomland forests along the stream. This area provides habitat to a diversity of wildlife species and has been named an Important Bird Area (IBA) by the Pennsylvania Audubon Society. Almost half of this township is forested, and about 40% of the land is farmland, in the form of row crops. Interstate 79, running north to south, cuts through the eastern side of Hayfield Township, with French Creek located to the east. French Creek is one of the most ecologically intact streams in the eastern United States. The stream and the watershed support a great diversity of flora and fauna. Any activity that takes place within the watershed ultimately impacts the quality of this river and the life of the species it supports.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Cussewago Creek at Dennys Corners BDA – *Notable Significance*

Cussewago Creek meanders south into Hayfield Township. This stream has retained its forested buffer throughout much of its length, which provides protection for the stream and the species living there. Many oxbows have also been created along Cussewago Creek as it changes its course and moves through the landscape. These areas can provide habitat for many species. One plant species of concern, **pineland pimpernel** (*Samolus parviflorus*), was located along the stream. Pineland pimpernel grows in moist soils along lakes and streams. This plant is currently listed as endangered in Pennsylvania.

Threats and Stresses

Much of Cussawgo Creek is forested, but there are some agricultural areas along the stream and its tributaries. The immediate habitat of the pineland pimpernel at this site has remained intact, but activities upstream also have an effect on the survival of this species. Removing trees and other vegetation allows agricultural runoff to go directly into the stream. Sediment and chemicals can degrade the water quality for species that live downstream.

Recommendations

Retain the forested buffer that exists around the species of concern and expand it wherever possible. In agricultural areas, a forested buffer of 300 feet should be established along the stream edge and all tributaries to filter sediments and chemicals. Avoid the use of pesticides and herbicides to prevent them from entering the stream.

Cussewago Creek at Onspaugh Corners BDA – *High Significance*

This Natural Heritage Area is discussed under Vernon Township.

Cussewago Creek- Coons Valley BDA – *Exceptional Significance*

Cussewago Creek flows southeastwardly from Cussewago Township into Hayfield Township before entering French Creek at Meadville. This BDA encompasses a large section of the Cussewago Creek flowing through

Coons Valley and includes a variety of habitats and natural communities set within a context of an extensive floodplain forest surrounded by agricultural land. The core area of this BDA is designated around the riparian corridor of Cussewago Creek, and expanded in some areas to include meander channels and scars, associated emergent and shrub wetlands, and floodplain forests of importance.

The northern portion of this BDA contains an extensive system of wetlands and forested communities that are fed by several small, unnamed tributaries. The central wetland, on the western bank of the creek is fairly open with shrub-dominated parts that succeed to a forest along the stream channel. This extensive system of emergent marshes and wet meadows harbor a diversity of plant species and several species of concern. These graminoid dominated emergent marshes support two important wetland species, **veiny-lined aster** (*Symphyotrichum praealtum*) and **Virginia blue flag** (*Iris virginica*). Associates include sedges (*Carex* sp.), bur-reed (*Sparganium eurycarpum*), tall manna grass (*Glyceria septentrionalis*), tussock sedge (*Carex stricta*), and smooth goldenrod (*Solidago gigantea*). The adjacent wet meadows, some of which were used for agriculture in the past, are often dominated by Emory's sedge (*Carex emoryi*) and support **varied sedge** (*Carex buxbaumii*), a plant species of concern.

The outer edge of the wetland gives way to shrub wetland and eventually a mixed hardwood floodplain forest. The dominant tree species here are sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), and shellbark hickory (*Carya laciniosa*). The floodplain terraces adjacent to the creek support four plant species of concern, **Shumard's oak** (*Quercus shumardii*), **harbinger-of-spring** (*Erigenia bulbosa*), **brown sedge** (*Carex buxbaumii*), **false hop sedge** (*Carex lupuliformis*), and **cattail sedge** (*Carex typhina*). Within the forested riparian areas, populations of **pineland pimpernel**, a plant species of conservation concern is present throughout this site. This area also hosts two additional **sensitive species of concern**.

The central portion of this BDA contains a rich mesic floodplain forest. Some dominant tree species here include tulip poplar (*Liriodendron tulipifera),* sugar maple, American beech (*Fagus grandifolia*), basswood (*Tilia americana*), black cherry (*Prunus serotina*), and red oak (*Quercus rubra*). The shrub and herbaceous layer are quite diverse in these types of communities and include a number of spring wildflowers such as trilliums (*Trillium* spp.), spring beauty (*Claytonia virginica*), toothworts (*Cardamine* spp.), Dutchman's breeches (*Dicentra cucullaria*), pineland pimpernel and wild geranium (*Geranium maculatum*). Additionally, these floodplain forests surrounding Cussewago Creek support a breeding species of concern.

The southern portion of this BDA contains a series of stream meanders, wetland areas, and floodplain habitat supporting several plant species of concern. Sugar maple (*Acer saccharum*) and shagbark hickory (*Carya ovata*) dominate these forests with shellbark hickory (*Carya laciniosa*) often co-dominant. The forest is structurally open with scattered American hornbeam (*Carpinus caroliniana*) and spicebush (*Lindera benzoin*) as the dominant shrubs. Many pools and muddy patches cover the forest floor and wetland plants such as sensitive fern (*Onoclea sensibilis*), regal fern (*Osmunda regalis*), monkey flower (*Mimulus ringens*), and numerous sedges (*Carex* spp.) live within these palustrine wetland areas. One of the sedges known as **cattail sedge** (*Carex typhina*) is a Pennsylvania endangered plant species that is found in this type of wet, forested community. It is known from several locations within this core area and a further survey may indicate it is more widely distributed within this site than is currently known.

The supporting landscape of this BDA is very large and encompasses the immediate watershed of the creek. Due to the proximity to other BDAs mentioned in this report, it shares the supporting landscape with other core areas along Cussewago Creek. This section of the supporting landscape is a little less than 50% forested with about a third of the land being used for agriculture. The remainder represents wetland complexes mentioned as part of the core habitat. One major tributary and several small drainages discharge into the creek at this BDA, many seepages, depressions, and channel scars within the floodplain create a series of wetland features. This section of Cussewago Creek Valley contains a large amount of interior forest within the riparian zone.

Threats and Stresses

The creek, surrounding wetlands, and floodplain communities are directly influenced by the hydrology of this watershed. Therefore, maintaining good water quality is necessary to sustaining the ecological features within this valley. In the northern section, direct disturbance of the core area, although unlikely in this situation, could result in damage to plant populations of concern as well as the habitat that they require for survival. In some areas, expansion of fields or re-establishment of previous fields, as well as ditching and culverting of water are direct disturbances to the area's hydrology. Furthermore, degradation or disturbance to the mature bottomland forest communities or the in-stream habitat of the southern section is of concern to both the forest and aquatic communities and the plants and animals they support. Non-sustainable forest practices, loss of forest buffer between agricultural fields, and activities or practices that would lead to sedimentation of wetlands and drainages are of primary concern for features within this BDA. Human disturbance to some nesting species, including light recreation in adjacent areas, during the breeding season may affect nestling survival.

Numerous tributaries of Cussewago Creek drain the agricultural uplands of the supporting landscape of this BDA. Agricultural inputs of nutrients, sediments, and chemicals are of concern for the natural communities and aquatic organisms of the valley. As for many sections along Cussewago Creek, wooded areas that lie adjacent to the core areas can serve important roles as buffers from surrounding land uses, and their loss may compromise the larger blocks of interior forest along the creek. Also, I-79 passes through the watershed that forms the supporting landscape for this area and crosses numerous small drainages that feed directly into Cussewago Creek. Compounds and chemicals associated with highway use, including road salt, can damage and contaminate aquatic habitats.

Recommendations

Limit disturbance within the core and allow this area to continue to mature. Although not documented from surveys of this site, invasive species are always of concern, particularly those that, in this case, are common in wetland habitats. Common reed (*Phragmites australis*) is present in patches throughout the valley and would be one to target for control. Reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*) are two other plant species that should be considered as targets for control. Target pioneer populations of invasive plants for immediate and continued removal. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.

Maintain high quality, maturing forest conditions within this area to ensure good habitat for the plants of concern and those other plants and animals supported within the forest. For many places within the Cussewago Creek Valley, timber management and production may be compatible with maintaining high-quality conditions for the numerous important species living here. However, sustainable forest management plans that consider these important areas are essential for the long-term health of these forest communities. Also, work with adjacent farmers and landowners to maintain as much forested area as possible to help buffer the core areas from edge effects.

Maintain substantial riparian buffers along all drainages to help limit the influx of nutrients and sediments into core wetland areas. This would also prevent or limit the introduction and establishment of exotic plant species into both wetland and forest areas of the core. Minimize and optimally time fertilizer and chemical inputs on agricultural fields, and limit stream crossings by livestock and machinery to help maintain good water quality inflows to Cussewago Creek. Stormwater runoff from roads can carry with it an array of chemicals. The quality of stormwater originating from roads, particularly I-79, can be improved through retention and passage through vegetated buffers.

French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Woodcock Township.

North Shenango Township

	PNHP Rank* Global	PNHP Rank* State	State Status	Last Seen	Quality**
NATURAL HERITAGE AREAS:					
Pymatuning Shoreline-Bottomland Forests BDA			*High Significance*		
Prothonotary warbler (*Protonotaria citrea*) – Bird	G5	S2S3	-	1985	E
Pymatuning Wetland Complex-North BDA			*Exceptional Significance*		
see Sadsbury Township					
Pymatuning Marsh LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Pymatuning-Hartstown Complex Important Bird Area and Pymatuning Wildlife Management Area/ State Game Lands #214 Important Mammal Area

Prothonotary Warbler
photo source: Ron Austing

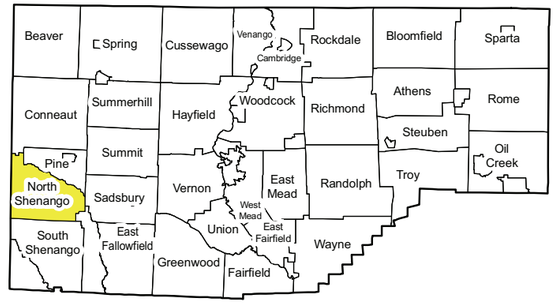
Crawford County Natural Heritage Inventory

North Shenango Township

Biological Diversity Area:
Pymatuning Resevoir
Pymatuning Shoreline - Bottomland Forests
Pymatuning Wetland Complex - North

Landscape Conservation Area:
Pymatuning Wetland Complex

Public Land:
Pymatuning State Park
State Game Land 214



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)
State Land
Federal Land
National Wetland Inventory
Streams
40 Ft. Contour Line

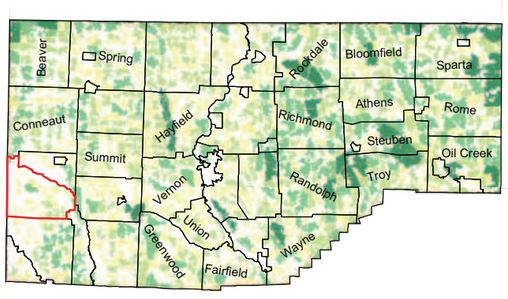
Crawford County Natural Heritage Inventory

North Shenango Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

North Shenango Township is located on the western Crawford County border with Ohio. This township is comprised of a mix of agriculture, forests, wetlands, and residential areas. The township is dominated by Pymatuning Reservoir and the associated wetlands. Numerous small forest blocks located around Pymatuning comprise the majority of the forest in the township. Pymatuning State Park, which encompasses all of the reservoir and lake on the Pennsylvania side, and State Game Lands #214 are publicly managed lands that largely afford protection to this area. This region has also been designated an Important Bird Area (IBA) and an Important Mammal Area (IMA) based on the extensive wildlife habitat provided by the reservoir and wetlands. Bennett Run, which drains the central portion of the township, flows into the reservoir near the spillway. The predominant land use of this township is agriculture and residential. North Shenango has the highest residential land use of any other township in the county.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Pymatuning Shoreline-Bottomland Forests BDA – *High Significance*

Pymatuning Reservoir was formed in the early 1930's by the damming of the Shenango River, a principal tributary to the Beaver River. Pymatuning State Park is designated around the reservoir, forming the biggest lake and state park in Pennsylvania. The section of Pymatuning Reservoir outlined in this BDA includes the wooded wetlands of the northeastern portion of the wetland which supports a bird species of concern, the **prothonotary warbler** (*Protonotaria citrea*). Prothonotary warblers have very specific habitat requirements, as they prefer to nest in tree cavities, near water, usually in flooded bottomland forests. Breeding populations of this species are highly localized due to habitat specificity and they are extremely susceptible to habitat destruction.

The upland area surrounding this portion of the reservoir is considered the supporting landscape for this BDA. The landscape within the sub-watershed area, which is hydrologically connected to the reservoir, contains portions of the state park, surrounding agricultural fields, and the town of Linesville.

Threats and Stresses

This BDA lies within Pymatuning State Park and faces no imminent threats. Current threats to Prothonotary Warbler population are habitat loss and destruction. This area is largely forested, however, timbering and removal of bottomland forests around the Pymatuning Reservoir would eliminate appropriate breeding habitat for this species.

Recommendations

The Bureau of Forestry should avoid clearing the bottomland forest regions around this BDA to sustain healthy breeding populations of warblers. Periodic monitoring of invasive plant species of these wetland areas is advisable to maintain optimal native plant populations.

Pymatuning Wetland Complex-North BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Sadsbury Township.

Oil Creek Township and Hydetown Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Bog Hollow BDA			*High Significance*		
Leatherleaf-sedge wetland – Natural Community	GNR	S3	-	2004	E
Oil Creek at Titusville BDA			*Notable Significance*		
Wavy-rayed lampmussel (*Lampsilis fasciola*) – Mussel	G5	S4	-	1991	E
French Creek LCA					

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Oil Creek State Park Important Bird Area

Crawford County
Natural Heritage Inventory
Oil Creek Township
Hydetown Borough
&
The City of Titusville

Biological Diversity Area:

Bog Hollow Woodlands

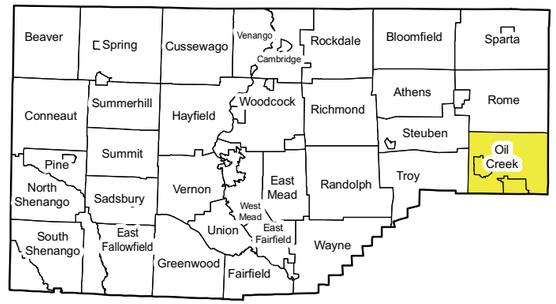
Oil Creek at Titusville

Landscape Conservation Area:

French Creek

Public Land:

None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.4 0.8 1.6 Kilometers

0 0.4 0.8 1.6 Miles

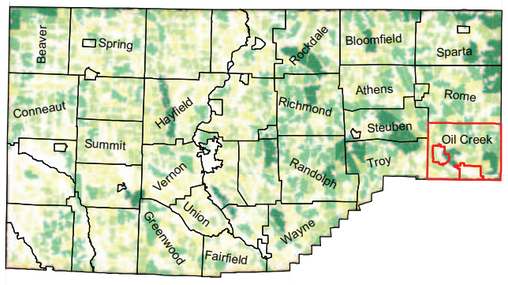
Crawford County
Natural Heritage Inventory

Oil Creek Township
Hydetown Borough
&
City of Titusville

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Oil Creek Township sits in the southeastern corner of Crawford County and is bordered by Warren County to the east and Venango County to the South. One of few areas untouched by the last glaciation, Oil Creek exhibits some of the county's hilliest topography. The steepness of these hills has left this township more forested than most other areas in the county. Less than one third of the land is in agricultural production. The entire township lies within the Oil Creek watershed with numerous tributary streams that have cut deep valleys throughout the township. This township is home to the first drilled oil well in the United States. The City of Titusville is located in the southern part of the township and is largely urbanized. Further upstream from Titusville on Oil Creek is the Borough of Hydetown, which contains a mix of urban, agricultural, and forested land.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Bog Hollow BDA – *High Significance*

This site is located at the headwaters of Thompson Creek where it flows through Bog Hollow, concentrated around a wetland complex containing a notable natural communities of conservation concern, including two bog communities. The wetland is embedded within mixed hardwood forest running along the western bank of Bog Hollow.

This bog community has a thick Sphagnum moss ground cover with a diverse fern and shrub layer. Dead trees, or snags, in the background indicate areas of high saturation. These trees provide nesting habitat for some species of birds, such as bluebirds and woodpeckers.
photo source: PNHP

Bogs are acidic, peat-dominated wetlands that receive most of their water and nutrients from precipitation (Thompson and Sorenson 2000) rather than from groundwater. The bogs of glaciated areas, such as Crawford County, are very specific communities sometimes called kettle bogs. They tend to be moss-covered by species from the genus *Sphagnum*. Other plant species generally found in these types of habitat include sedges, heath shrubs, and scattered trees which usually occur in a band near the edge of the community (Smith 1991). These communities provide critical habitat to a variety of species.

The wetland community types found within Bog Hollow BDA are a highbush blueberry –sphagnum moss wetland and a **leatherleaf-sedge wetland**, a natural community of special concern. This area is dominated by *Sphagnum* moss mats. The herbaceous layer consists of short sedge (*C. canescens*) and cinnamon fern

(*Osmunda cinnamomea*). The shrub layer consists of leatherleaf (*Chamaedaphne calyculata*), black chokeberry (*Aronia melanocarpa*), and highbush blueberry (*Vaccinium corymbosum).* Emergent trees around the wetland are scattered and exist around the basin perimeter. These include red maple (*Acer rubrum*), hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), yellow birch (*Betula allegheniensis*), and tamarack (*Larix laricina*).

Threats and Stresses

Draining, filling, or permanent flooding of this wetland complex would result in complete loss of this exceptional community. The occurrence of these communities is linked to hydrology of this wetland complex so any activity that would distinctly alter the hydrologic regime would be detrimental to this wetland complex. Furthermore, the westward migration of the hemlock wooly adelgid (*Adelges tsugae*), currently documented in 42 counties in the eastern two thirds of the state (PA Bureau of Forestry 2006), poses a threat to the hemlock trees that compose a significant part of the surrounding forest. The hemlock wooly adelgid is a sap-feeding insect native to Asia that attacks eastern hemlocks, usually resulting in high levels of hemlock mortality.

This shows the typical moss-covered, sedge-dominated wetland present at this site. Red maple, white pine, and some hemlocks are present in the background.
photo source: PNHP

Most of the supporting landscape is forested, thus creating a nice buffer around the wetland. There is a small field with row crops to the north that could contribute non-point source pollution from farm chemicals and sediment via runoff.

Recommendations

Agricultural development of this wetland and the surrounding forest should be avoided. Maintain the current forested buffer around the wetland, and limit disturbance to at least 300 feet from the edge of the wetlands. Landowners interested in timbering areas surrounding the wetland should consider using best management or sustainable forestry practices to minimize impacts associated with logging and maintain the integrity of the natural community. Periodic monitoring for the hemlock wooly adelgid, as well as other invasive species, and further surveys for birds, invertebrates, and amphibians using this wetland is desirable.

Oil Creek at Titusville BDA – *Notable Significance*

This site on Oil Creek was designated for an occurrence of **wavy-rayed lampmussel** (*Lampsilis fasciola*). The wavy-rayed lampmussel is most often found in fine gravel or sand in the creeks and headwaters of small to medium rivers (Cummings and Mayer 1992). Freshwater mussels are considered an indicator of water quality, and most mussel species are susceptible to changes in water quality. Their disappearance from a stream may be the first indication that the stream is becoming degraded.

Threats and Stresses

This site is located just upstream of the Titusville Borough boundary, and residential and industrial areas associated with Titusville occur along this stretch of Oil Creek. Gravel mining occurs in this area, and in some places has completely stripped the stream edge of all vegetation. This allows sediment from the mining operation to enter directly into Oil Creek. This sediment can cover over mussels as they are imbedded in the substrate. Other pollutants from agriculture and roadways may more easily enter the stream due to the lack of riparian vegetation.

Recommendations

Maintain the forested stream buffer where it occurs, and plant native trees where stream buffers are lacking to create a buffer of at least 300 feet to help improve water quality. Limit disturbance to outside of the 300 foot buffer to prevent sedimentation in the stream and introduction of invasive species.

Pine Township and Linesville Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Pymatuning Reservoir BDA		*Exceptional Significance*			
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
Prothonotary warbler (*Protonotaria citrea*) – Bird	G5	S3B	-	1985	E
Bog-mat (*Wolffiella gladiata*) – Plant	G5	S2	PR	1986	E
Sensitive species of concern***	-	-	-	2003	E
Pymatuning Shoreline-Bottomland Forests BDA		*High Significance*			
see North Shenango					
Pymatuning Marsh LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Pymatuning-Hartstown Complex Important Bird Area

Pine Township is located along the western border of Crawford County, not quite touching the Ohio border. The majority of this township is water, with Pymatuning Reservoir covering more than half of the township and a relatively large associated wetland complex in the southeast corner. Most of the Pymatuning shoreline is contained within Pymatuning State Park. Several small Islands, including Harris, Clark, Whaley, Ford, and Glenn Islands are within the part of the reservoir located in Pine Township. About twenty percent of the township is forested. The majority of forested areas are within the shoreline of Pymatuning and stream valley slopes of the Shenango River tributaries. Near the Borough of Linesville, which is largely residential, a small amount of the land is in agricultural production, primarily in the form of row crops. The Pymatuning, Hartstown Complex Important Bird Area (IBA) is located along the eastern side of the township, providing extensive habitat for waterfowl, shorebirds, and many other rare avian species.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Crawford County
Natural Heritage Inventory
Pine Township
&
Linesville Borough

Biological Diversity Area:

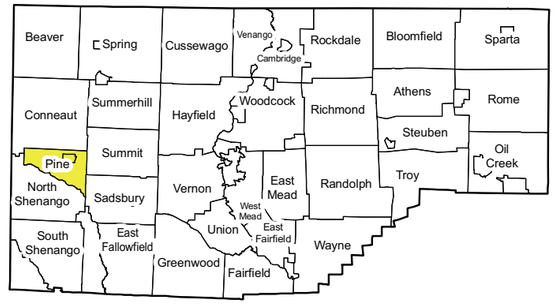
Pymatuning Resevoir
Pymatuning Shoreline -
Bottomland Forests
Pymatuning Wetland Complex - North

Landscape Conservation Area:

Pymatuning Wetland Complex

Public Land:

Clark Island Natural Area
Pymatuning State Park
State Game Land 214



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.3 0.6 1.2 Kilometers
0 0.3 0.6 1.2 Miles

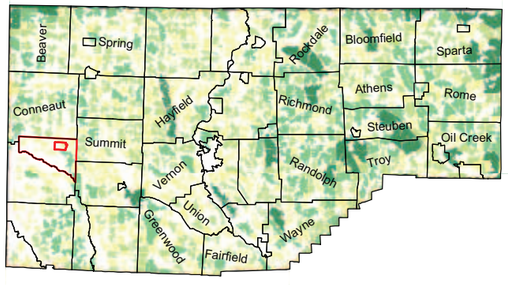
Crawford County
Natural Heritage Inventory

Pine Township
&
Linesville Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



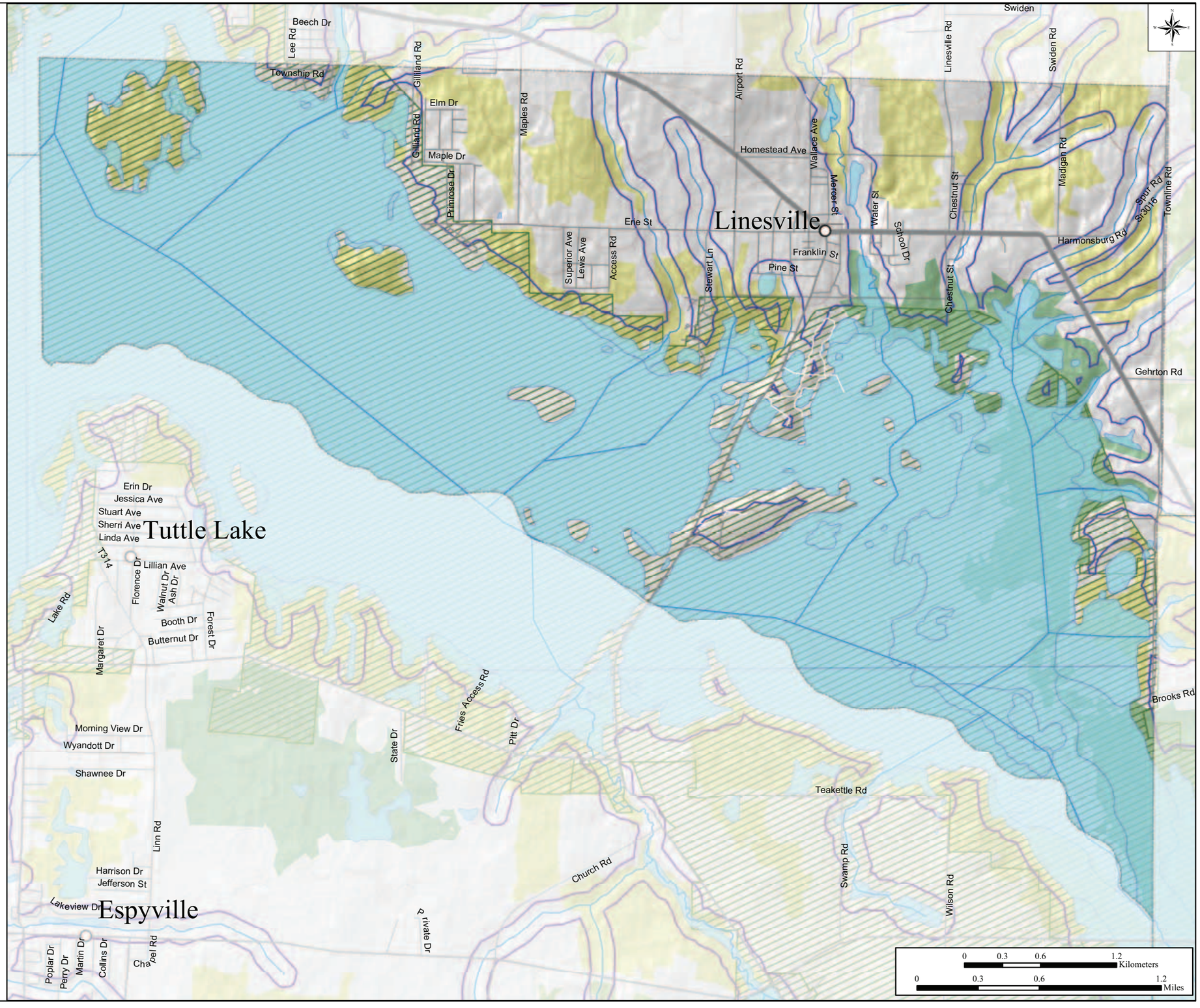
Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Pymatuning Reservoir BDA – *Exceptional Significance*

The damming of the Shenango River in the 1930's created Pymatuning Reservoir. Originally, this area contained one of the largest wetland complexes in the state, however, a substantial portion of this wetland was lost upon creation of the lake and reservoir. This BDA is designated around the northeastern portion of the Reservoir that serves as important breeding habitat for three species of concern including the **marsh wren** (*Cistothorus palustris*) and **prothonotary warbler** (*Protonotaria citrea*). Each of these species uses a different habitat within the greater ecosystem of the reservoir as it transitions to the extensive marsh that follows the Shenango River downstream. Marsh wrens prefer to nest in emergent marshes with a large cattail (*Typha* spp.) component. They use grasses and sedges to build nests that are typically secured to larger emergent plants such as cattail. Prothonotary warblers are a habitat-specific species, nesting in the trees of bottomland forests that are near to or over open water. Finally, the species of concern at this site uses large trees in forests that are near large bodies of water. Additionally, **bog-mat** (*Wolffiella gladiata*), an aquatic plant species of concern is common throughout the reservoir.

Threats and Stresses

The bird habitats contained within this BDA are also within Pymatuning State Park and are therefore afforded protection from inappropriate development. However, these species can be extremely sensitive to human disturbance during the breeding season. Even the slightest human interference such as nest observers and hikers can disturb these species. Any activity that would influence the habitat and water quality, such as pollution and nutrients that may enter the system via runoff from upland agricultural areas would have a direct effect on these species.

Recommendations

These species should be considered when management plans for Pymatuning State Park are being established. Limiting human disturbance, such as hiking and boating, in nesting areas during the breeding season is highly recommended. Best management practices applied to upland agricultural fields will reduce the risk of water pollution and habitat degradation.

Pymatuning Shoreline-Bottomland Forests BDA – *High Significance*

This Natural Heritage Area is discussed under North Shenango Township.

Randolph Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Lake Creek Valley BDA	*Exceptional Significance*				
see Wayne Township					
State Game Lands #69 BDA	*High Significance*				
Green-striped darner (*Aeshna verticalis*) – Odonate	G5	S3S4	-	2005	E
Lilypad clubtail (*Arigomphus furcifer*) – Odonate	G5	S2	-	2005	E
American emerald (*Cordulia shurtleffi*) – Odonate	G5	S3S4	-	2005	E
Slaty skimmer (*Libellula incesta*) – Odonate	G5	S3S4	-	2005	E
Cyrano darner (*Nasiaeschna pentacantha*) – Odonate	G5	S1	-	2005	E
White-faced meadowhawk (*Sympetrum obtrusum*) – Odonate	G5	S3S4	-	2005	E

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

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

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area.

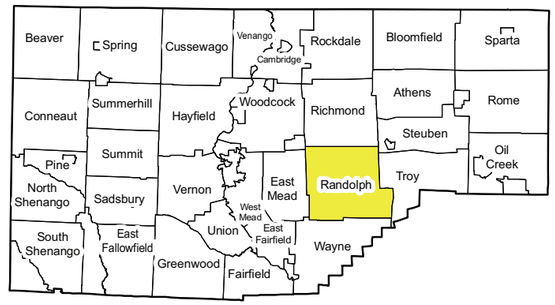
Crawford County
Natural Heritage Inventory

Randolph Township

Biological Diversity Area:
Lake Creek Valley
State Game Land 89

Landscape Conservation Area:
None

Public Land:
State Game Land 89



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

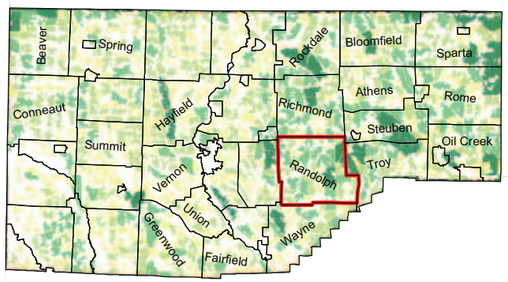
Crawford County
Natural Heritage Inventory

Randolph Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

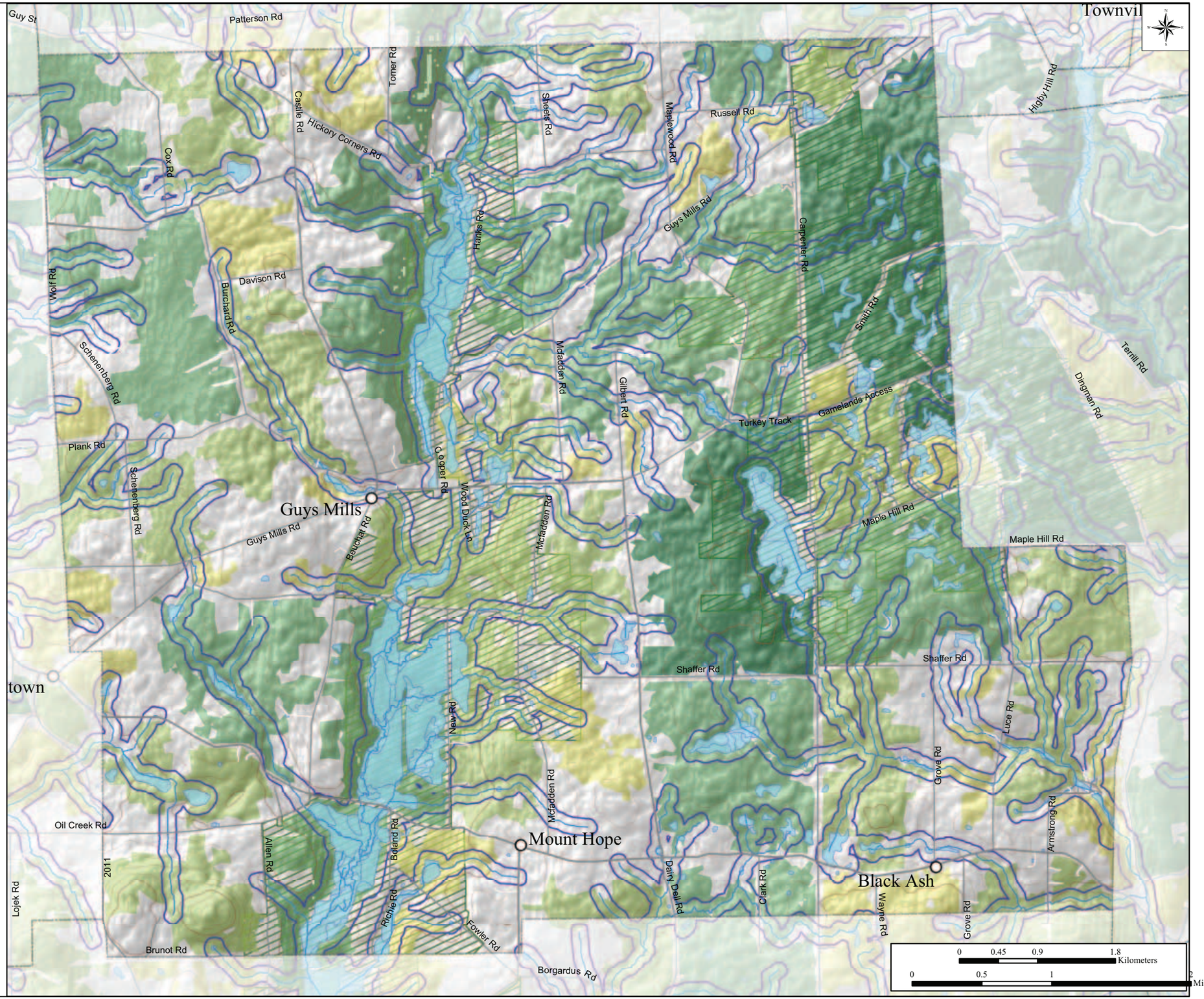
PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Randolph Township is located in the south central portion of Crawford County, near the Venango County border. A fair amount of the township is publicly-owned land. State Game Lands #69 makes up the majority of the eastern side of the township, and the Erie National Wildlife Refuge (ENWR) follows the Woodcock Creek valley through the center of the township. ENWR has been designated an Important Bird Area (IBA) because of the important breeding and wintering habitats provided to birds at this site. Over 60% of this township is forested. The managed lands within this township retain wooded wetlands and are largely forested, and both the Lake Creek and Woodcock Creek watersheds contain a fair amount of forested floodplains and terraces. The topography is rolling with some river valleys becoming slightly steep. Only about one-third of the landscape is farmland, mostly in the form of row crops.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Lake Creek Valley BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Wayne Township.

State Game Lands #69 BDA – *High Significance*

The large complex of forested wetlands in State Games Lands #69 is a good example of the wetland habitat available in Crawford County. This site contains six odonate species of concern. The **green-striped darner** (*Aeshna verticalis*), **lilypad clubtail** (*Arigomphus furcifer*), **American emerald** (*Cordulia shurtleffi*), **slaty skimme**r (*Libellula incesta*), **cyrano darner** (*Nasiaeschna pentacantha*), and **white-faced meadowhawk** (*Sympetrum obtrusum*) can all be found in these wetlands. The area in and around State Game Lands #69 comprise one of the largest forest blocks in Crawford County. These areas are important for interior forest species and should remain intact whenever possible.

Threats and Stresses

Since this site is located almost entirely on State Game Lands, there is some protection from disturbance. The roads built through this site have fragmented the forest and reduced the buffer available to filter sediments and chemicals. Construction of new roads and other disturbances, such as logging may directly affect water quality through sediment input and further reduce the amount of interior forest. Pollution entering these wetlands will reduce water quality and the sustainability of the odonate species if concern.

Recommendations

Limit activities, such as logging and road construction that will fragment the forest and impair the wetlands. All efforts should be made to keep this large forested block intact to provide habitat for interior forest species. Herbicides and other chemicals should not be used in this area to prevent them from entering into the aquatic system.

Richmond Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Muddy Creek BDA			*Exceptional Significance*		
see Athens Township					
Muddy Creek Wetlands			*Exceptional Significance*		
see Rockdale Township					
Woodcock Creek BDA			*High Significance*		
Sensitive species of concern***	-	-	-	2002	E
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area

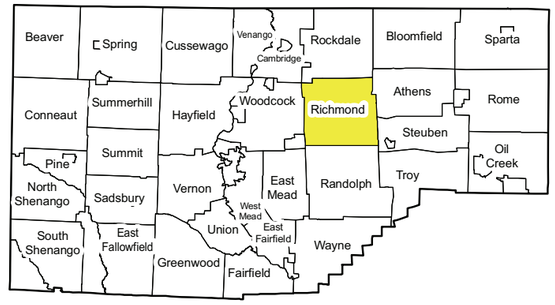
Crawford County
Natural Heritage Inventory

Richmond Township

Biological Diversity Area:
- Muddy Creek
- Muddy Creek Wetland
- Woodcock Creek

Landscape Conservation Area:
- French Creek

Public Land:
- Erie National Wildlife Refuge
- State Game Land 146
- State Game Land 200



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

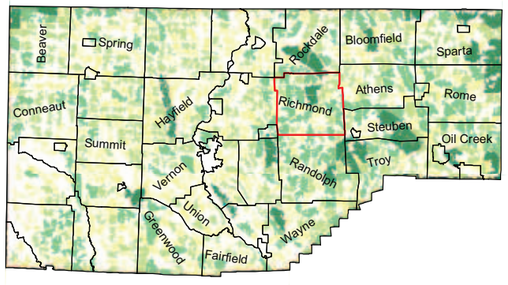
Crawford County
Natural Heritage Inventory

Richmond Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Richmond Township is located in the center of Crawford County. It is bordered by Rockdale Township to the north and Randolph to the south. The Oil Creek and Muddy Creek watersheds, both important tributaries to French Creek, drain most of this township. Almost 60% of this township is forested and many of the streams flow through rich forested valleys. Some of the headwaters to Oil Creek however, meander through farmland with little riparian vegetation. Potentially, chemicals and pollutants could enter these streams via runoff, which would have a negative impact on species using these creeks. Maintaining vegetated riparian buffers in farmland is import to control erosion and pollution into creeks. Planting native trees in areas lacking such buffers is encouraged. The managed lands in this township include State Game Lands #200 and #146, and the Erie National Wildlife Refuge (ENWR). The ENWR is designated around the wetlands supporting Muddy Creek in the northeast portion of the township. This area has also been identified as an Important Bird Area (IBA) due to the critical wetland habitat it provides to nesting marsh birds. Richmond Township, as a whole, lies within the supporting landscape to this IBA.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Muddy Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Athens Township.

Muddy Creek Wetland BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Rockdale Township.

Woodcock Creek BDA – *High Significance*

This BDA supports breeding **sensitive species of concern**. Due to the nature of this species, population declines may be attributed to the loss and decline of nesting areas. Specifically, habitat loss, the deterioration of wetlands, impaired water quality, and human disturbance during the breeding season are major factors contributing to the vulnerability of these populations (USFWS 2006).

Threats and Stresses

This species is highly sensitive to disturbance during the breeding season. Casual visitation within a few hundred meters can affect this species. Any human activities that occur within this BDA during the breeding season may also affect nest success. Timber harvesting is a potential threat to this species, as it results in direct habitat loss.

Recommendations

The landowner should be made aware of the presence of the species of concern and should avoid disturbing the species during the breeding season. Timbering should also be avoided within this BDA. To protect the nesting site, a 500 meter forested buffer is recommended (Butler 1992).

Rockdale Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Dead Creek BDA	*High Significance*				
Northern mountain ash (*Sorbus decora*) – Plant	G4G5	S1	PE	1992	E
Mohawk Run Fen BDA	*Exceptional Significance*				
Slender spikerush (*Eleocharis elliptica*) – Plant	G5	S2	PE	1992	E
Thin-leaved cottongrass (*Eriophorum viridicarinatum*) – Plant	G5	S2	PT	1994	E
Swamp fly honeysuckle (*Lonicera oblongifolia*) – Plant	G4	S1	PE	1997	E
Drooping bluegrass (*Poa languida*) – Plant	G3G4	S2	TU	1994	E
Broad-leaved willow (*Salix myricoides*) – Plant	G4	S2	-	2006	E
Buckthorn sedge (*Carex interior*) golden ragwort fen – Natural Community	GNR	S1	-	1995	E
Muddy Creek Wetland BDA	*Exceptional Significance*				
Autumn willow (*Salix serissima*) – Plant	G4	S2	PT	1992	E
River bulrush (S*choenoplectus fluviatilis*) – Plant	G5	S3	PR	1997	E
Elktoe (*Alasmidonta marginata*) – Mussel	G4	S4	-	2003	E
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	1997	C
Downy willow-herb (*Epilobium strictum*) – Plant	G5	S3	PE	1993	E
Three-ridge (*Amblema plicata*) – Mussel	G5	S2S3	-	2003	E
Cylindrical papershell (*Anodontoides ferussacianus*) – Mussel	G5	S2S3	-	2003	E
Wavy-rayed lampmussel (*Lampsilis fasciola*) – Mussel	G5	S4	-	2003	E
Round pigtoe (*Pleurobema sintoxia*) – Mussel	G4	S2	-	2003	E
Bowfin (*Amia calva*) - Fish	G5	S2S3	PC	2005	E
Brook stickleback (*Culaea inconstans*) – Fish	G5	S3	PC	1998	E
Ohio lamprey (*Ichthyomyzon bdellium*) – Fish	G3G4	S2S3	PC	2005	E
Hornyhead chub (*Nocomis biguttatus*) – Fish	G5	S1	PC	1998	E
Bigmouth shiner (*Notropis dorsalis*) – Fish	G5	S2	PT	1998	E
Central mudminnow (*Umbra limi*) – Fish	G5	S3	PC	1998	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1988	E
Alder - ninebark wetland – Natural Community	GNR	S3	-	2005	E
Hemlock - mixed hardwood palustrine forest – Natural Community	GNR	S3S4	-	2005	E
Mixed forb marsh – Natural Community	GNR	S3	-	2005	E
Red maple – black ash palustrine forest – Natural Community	GNR	S2S3	-	2005	E
Red maple - black-gum palustrine forest – Natural Community	GNR	S3S4	-	2005	E
Silver maple floodplain forest – Natural Community	GNR	S3	-	2005	E
Sycamore - (river birch) - box-elder floodplain forest – Natural Community	GNR	S3	-	2005	E
Sensitive species of concern***	-	-	-	2005	B
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	2003	E
Sensitive species of concern***	-	-	-	1998	E

Sensitive species of concern***	-	-	-	1997	E
Sensitive species of concern***	-	-	-	2006	E
Sensitive species of concern***	-	-	-	2005	E

Upper French Creek BDA	*Exceptional Significance*				
Redhead pondweed (*Potamogeton richardsonii*) – Plant	G5	S3	PT	2002	E
Three-ridge (*Amblema plicata*) – Mussel	G5	S2S3	-	1993	E
Cylindrical papershell (*Anodontoides ferussacianus*) – Mussel	G5	S2S3	-	1993	E
Long solid (*Fusconaia subrotunda*) – Mussel	G3	S1	-	1993	E
Wavy-rayed lampmussel (*Lampsilis fasciola*) – Mussel	G5	S4	-	1993	E
Creek heelsplitter (*Lasmigona compressa*) – Mussel	G5	S2S3	-	1993	E
Round pigtoe (*Pleurobema sintoxia*) – Mussel	G4	S2	-	1993	E
Paper pondshell (*Utterbackia imbecillis*) – Mussel	G5	S3S4	-	1993	E
Streamline chub (*Erimystax dissimilis*) – Fish	G4	S3	-	1998	E
Brindled madtom (*Noturus miurus*) – Fish	G5	S2	PT	1992	E
Sensitive species of concern***	-	-	-	1993	B
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	2005	E
Sensitive species of concern***	-	-	-	1998	E
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1993	E

French Creek LCA

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge, Erie National Wildlife Refuge Important Bird Area.

Rockdale Township is located on the northern county border with Erie County. French Creek and its tributaries, including the ecologically diverse wetlands associated with Mohawk Run and Muddy Creek, drain the entire township. This area is contained within the Erie National Wildlife Refuge (ENWR) and is considered an Important Bird Area (IBA) for the populations of breeding wetland birds it supports. The Pine Hill Research Area is also part of this IBA. This area, along with the French Creek floodplain and the Kelly Run valley, flowing in from Erie County, is largely forested. Overall, approximately 60% of Rockdale Township is forested. The remainder of the land is used for agriculture. State Game Lands (SGL) #277 is located in the central portion of the western border. The wetlands surrounding Muddy Creek are contained within SGL #85 and ENWR.

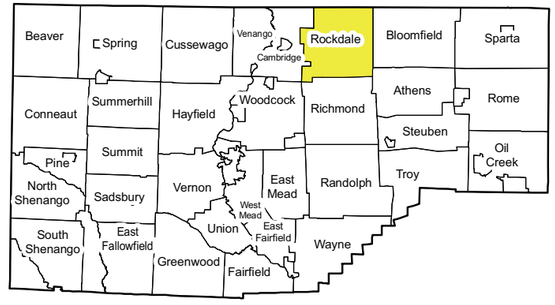
As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Crawford County
Natural Heritage Inventory
Rockdale Township

Biological Diversity Area:
- Dead Creek
- Muddy Creek Wetland
- Mohawk Run Fen
- State Game Land #277
- Upper French Creek

Landscape Conservation Area:
- French Creek

Public Land:
- Erie National Wildlife Refuge
- State Game Land 85
- State Game Land 277



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

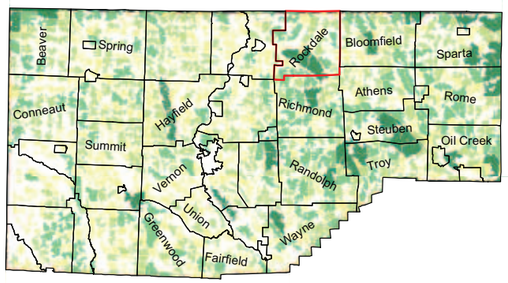
Crawford County
Natural Heritage Inventory

Rockdale Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Northern Mountain Ash
photo source: Emmet J. Judziewicz

Dead Creek BDA – *High Significance*

This site is designated around an occurrence of **northern mountain ash** (*Sorbus decora*), a critically imperiled species in Pennsylvania. A member of the Rose family (*Rosaceae*), this plant is uncommon throughout Pennsylvania, but it can be found on rocky slopes and sunny edges of secondary forests in the northern portion of the state (Rhoads and Block 2000). Pennsylvania is on the southern edge of its range. This BDA is located along the south bank of Dead Creek, a tributary to Muddy Creek, in the ENWR. This population is growing in thickets on the upland terrace of the creek.

Threats and Stresses

Since this population is contained within the ENWR, there is no imminent threat for the occurrence. However, this plant is typical of disturbed or stressed habitat. Succession and woody plant encroachment would alter the habitat conditions supporting this population.

Recommendations

Habitat management to prevent successional changes, such as selective clearing of woody plants and trees, would provide appropriate conditions for this plant. Periodic monitoring of the northern mountain ash population is also desirable.

Mohawk Run Fen BDA – *Exceptional Significance*

Mohawk Run Fen has formed at the watershed boundary between Mohawk Run and Muddy Creek. This BDA features a globally significant natural community. This **buckthorn sedge (*Carex interior*)-golden ragwort fen** is a calcareous shrub fen located within the Seneca Division of the Erie National Wildlife Refuge and extending onto State Game Lands #85. This area has been surveyed extensively by the Western Pennsylvania Conservancy and included in the Erie National Wildlife Refuge Natural Heritage Inventory Report (1999).

On a global scale, shrub fens are considered imperiled to very rare natural communities (NatureServe 2006). In Pennsylvania, this community is regarded as critically imperiled. Shrub fens are peatland communities influenced by calcareous groundwater, are dominated by deciduous shrubs and herbs, typically graminoids, and are marked by areas of visible surface flow (Fike 1999, Smith 1991). Mohawk Run Fen is fed by calcareous groundwater seepages which form surface flows throughout the fen. The seepage zones are dominated by graminoids in an otherwise shrub-dominated community. Mohawk Run Fen provides critical habitat for five plant species of conservation concern.

The shrub fen is dominated by poison sumac (*Rhus vernix*) and alder-leaved buckthorn (*Rhamnus alnifolia*) which is locally abundant. Other shrub species within this fen include winterberry *(Ilex verticillata*), alder (*Alnus* sp.), pussy willow (*Salix discolor*), Missouri willow (*S. eriocephala*), black cherry (*Prunus serotina*), highbush blueberry (*Vaccinium corymbosum*), mountain holly (*Nemopanthus mucronatus*), and silky dogwood *(Cornus amomum*). The sparse tree canopy is predominantly red maple (*Acer rubrum*). Scattered graminoid openings are populated by spikerushes (*Eleocharis* sp.), marsh fern (*Thelypteris palustris*), water horehound (*Lycopus* sp.), and skunk cabbage (*Symplocarpus foetidus*). Several species of concern can be found throughout the fen, including **slender spikerush** (*Eleocharis elliptica*), **thin-leaved cottongrass** (*Eriophorum viridicarinatum*), **drooping bluegrass** (*Poa languida*), broad-leaved willow (*Salix myricoides*), and **swamp fly honeysuckle** (*Lonicera oblongifolia*).

The supporting landscape of Mohawk Run Fen BDA is contained within the Muddy Creek watershed that is feeding the wetland complex. This includes the lower portion of the Seneca Division of the ENWR and parts of State Game Lands #85. This watershed supports an extensive wetland and several species of concern. A forested buffer protects the Refuge and gamelands, however, cleared fields lie outside the wooded border along major roads surrounding the area

Threats and Stresses

Being that Mohawk Run Fen BDA lies within the Erie NWR and State Game Lands #85, it is largely protected from development. The most imminent threat facing this exceptional community and the special plants harbored within the fen are browsing by white-tailed deer (*Odocoileus virginianus*) and invasion by exotic species such as multiflora rose (*Rosa multiflora*) and Morrow's honeysuckle (*Lonicera morrowii*). Severe deer browsing has been noted within the shrub fen and elsewhere throughout the Seneca division (Western Pennsylvania Conservancy 1995).

With the loss of major carnivores throughout much of their range, white-tailed deer have expanded and become overabundant in most areas. Forest communities are under foraging pressure, in conjunction with habitat loss due to human development and disturbance. Deer browsing can have significant impacts on the regeneration, abundance, composition, and distribution of plant species, specifically in areas with high populations of white-tailed deer (Miller et al. 1992). Deer browse has become a significant threat to rare plant populations due to loss of appropriate habitat (Cote et al. 2004, Miller 1992). With less available habitat, rare plants cannot recover from deer disturbance.

Non-point source pollution entering the system from surrounding farms and impervious surfaces such as roads could affect the health of the wetland and the dependent organisms.

Thin-leaved Cottongrass
photo source: P. Wiegman

Recommendations

Refuge managers should continue to protect the shrub fen from deer browse. Complete elimination of white-tailed deer is not recommended as they have helped suppress undesirable invasive plants such as multiflora rose and exotic shrub honeysuckles. Action should be taken to eradicate invasive species occurrences within the BDA. Periodic monitoring of plants within the fen and general condition of the fen is desirable.

Landowners of surrounding farms are encouraged to employ best management practices to reduce nutrient loading into the watershed. Continued maintenance of a forested buffer around the wetland is extremely important for the protection of water quality and habitat integrity.

Muddy Creek Wetland BDA – *Exceptional Significance*

Just south of the confluence with French Creek, a complex of different wetland communities fills the Muddy Creek Valley creating a great diversity of natural communities. This BDA, located within the Seneca Division of the Erie National Wildlife Refuge (ENWR), is designated around the Muddy Creek swamp which supports a number of plant and animal species of concern.

Most of the Muddy Creek wetland can be characterized as a circumneutral broadleaf swamp. Variations of this community occur throughout the swamp based on canopy cover and hydrology. This has contributed to the diversity of species present at this site. The main water source for the swamp is underground seepages that surface at numerous openings throughout the wetland. The soils are fairly inundated with less saturated soils tending to be along valley walls, uplands, and on small hummocks of the scattered bottomland forest. Much of the ground is covered with mossy hummocks and moss covered logs formed by downed branches or wind-thrown trees. Standing dead trees, or snags, are also common throughout the swamp, especially in areas of beaver activity. The plant species composition of this swamp is quite diverse and these varying communities support several species of concern. The common tree species found throughout the swamp are white pine (*Pinus strobus*), green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), Eastern hemlock (*Tsuga canadensis*), basswood (*Tilia americana*), yellow birch (*Betula allegheniensis*), cottonwood (*Populus deltoides*), and swamp white oak (*Quercus palustris*). The shrub component includes willows (*Salix* sp.), alders (*Alnus* sp.), elderberry (*Sambucus canadensis*), witch hazel (*Hamamelis virginiana*), spicebush (*Lindera benzoin*), and winterberry (*Ilex verticillata*). A highly diverse herbaceous layer is comprised of many fern species (*Osmunda cinnamomea, O. regalis*, *Onoclea sensibilis* and *Thelypteris palustris*), skunk cabbage (*Symplocarpus foetidus*), wild sorrel (*Oxalis* sp.), violets (Viola sp.), Canada mayflower (*Maianthemum canadense*), jewelweed (*Impatiens* spp.), foamflower (*Tiarella cordifolia*), firm aster (*Symphyotrichum firmum*), and golden saxifrage (*Chrysosplenium americanum*) are also

present. Additional species include cardinal flower (*Lobelia cardinalis*), swamp buttercup (*Ranunculus septentrionalis*), clearweed (*Pilea pumila*), goldenrod (*Solidago* sp.), southern arrowhead (*Sagittaria latifolia*), water plantain (*Alisma triviale*), duckweed (*Lemna minor*), joepye weed (*Eupatorium maculatum*), bur-reed (*Sparganium* sp.), water parsnip (*Sium suave*), and iris (*Iris* sp.). Aside from the circumneutral broadleaf swamp, several other communities of concern are located at this site: **alder-ninebark wetland, hemlock-mixed hardwood palustrine forest, mixed forb marsh, red maple-black gum palustrine forest, silver maple floodplain forest, and sycamore-(river birch)-box elder floodplain forest**.

The area around Ferris Corners, located in the northeastern section of the Seneca Division, supports several species of concern. Seepage openings along the gradually sloping valley wall form seepage swamps at the base. At one point along the slope, a concentrated seepage opening has been eroded and forms a small headwater ravine. Here among small, scattered American elms (*Ulmus americana*) and quaking aspens (*Populus tremuloides*), a population of a species of concern found in wet, open habitats of acidic Sphagnum bogs or neutral fens. At the base of the slope, autumn willow (*Salix serissima*) is growing in a seepage swamp adjacent to a large beaver pond. Common associates include speckled alder (*Alnus rugosa*), pussy willow (*Salix discolor*), lake sedge (*Carex lacustris*), and narrowleaf cattail (*Typha angustifolia*).

An extensive shrub swamp to the north supports a plants species of conservation concern, **river bulrush** (*Schoenoplectus fluviatilis*). This plant is growing in an old, gravelly stream channel adjacent to an active stream channel. The associated plant species of the old stream channel habitat are bulrushes, rushes (*Juncus* sp.), grasses, joepye weed (*Eupatorium* sp.), and smartweed (*Polygonum* sp.). Streams in this area also support mussel species of concern, including **elktoe, three-ridge, and round pigtoe**. Fish species of concern were found at this site, including **brook stickleback, Ohio lamprey, hornyhead chub, and central mudminnow**.

South of Ferris Corners, a large diverse seepage meadow supports a population of **downy willow-herb** (*Epilobium strictum*), a plant species of concern, and firm aster (*Symphyotrichum firmum*), a plant that has recently been removed from the state threatened and endangered species list. These species occupy a highly diverse seepage meadow that also supports two other species of concern.

As the wetland extends south, numerous stream channels and seepage opening have created a more open water-emergent marsh that supports a bird species of concern, the **Marsh Wren** (*Cistothorus palustris),* and several populations of **lesser bladderwort** (*Utricularia minor*), a plant species of concern. Scattered populations of this plant occur in the shallow open waters of the extensive emergent marsh dominating the stream channel. Common associates are longhair sedge (*Carex comosa*), common rush (*Juncus effusus*), mild water-pepper (*Polygonum hydropiperoides*), three-way sedge (*Dulichium arundinaceum*), and bur-reed (*Sparganium* spp.). Other areas throughout the marsh are dominated by common cattail (*Typha latifolia*), which is used by marsh wrens for nesting.

The rich forest communities surrounding the open water areas are quite diverse and support yet another species of concern, **Clinton's wood fern** (*Dryopteris clintoniana*). These forested seepage swamps, dominated by eastern hemlock and yellow birch are scattered throughout the wetland complex. The seepages themselves are lined with skunk cabbage, sensitive fern, golden saxifrage, jewelweed, bishop's cap (*Mitchella diphylla*), and bristly buttercup (*Ranunculus hispidus*). Clinton's wood fern grows upland of the seepages in these habitats.

The variety of communities that constitute this wetland create a unique habitat for many species of wildlife. According to the U.S. Fish and Wildlife Service, the refuge is home to 47 species of mammals, 37 species of reptiles and amphibians, and of the 237 species of birds that have been seen on the refuge, 113 species also nest here (2007). Several bird species of concern are included on that list. A number of species of concern have been seen in the Muddy Creek wetland during the breeding season.

The portion of the Muddy Creek watershed draining into this wetland complex and section of the stream is considered the supporting landscape for this BDA. A fair amount of the supporting landscape is forested, however, the refuge perimeter is bordered by cropland and pastureland. Additionally, there are a number of gas wells within the stream valley.

Threats and Stresses

Most of the Muddy Creek wetland complex lies within the Erie National Wildlife Refuge (ENWR) and is afforded protection and management by the USFWS. Based on field surveys and the ENWR Natural Heritage Inventory

Report (1998), nonnative, invasive plant species such as common reed, purple loosestrife, and cattail are detrimental to the habitat throughout the swamp. A number of invasive species such as garlic mustard, Japanese knotweed, and autumn olive are present in the upland habitats surrounding the wetland. These species threaten the diversity and health of native plant populations. Human disturbance to nesting birds is a serious threat to nestling success.

Any land use change that would alter the hydrology of this wetland would have an impact on this ecosystem. Pollution and sedimentation from the surrounding landscape would severely affect this wetland, and the plant and animal communities that occur here. Non-point source pollutants such as pesticides, fertilizers, and sediment from adjacent farmland and farmland within the refuge boundary could contaminate surface waters and groundwater entering the stream valley. Groundwater contamination due to nearby gas wells is another potential source of pollution.

Fragmenting features, such as roads, powerline right-of-ways, and dams limit the connectivity of the forest and wetland systems. Fragmentation will limit the ability of certain species to move between areas of the refuge. Removing existing fragmenting features, such as dams, would be best, but limiting the construction of new roads and powerlines will help to maintain the functionality of the current available habitats.

A large portion of the Muddy Creek wetland BDA is private inholding. Current land use is minimal and doesn't affect the health of the wetland, however, impacts of future land uses are uncertain.

Recommendations

Aggressive invasive plant species management is highly recommended to protect the quality of this wetland. The USFWS might organize a volunteer-based invasive species removal program with local groups, such as the Friends of the Erie National Wildlife Refuge. Human traffic through the wetland should be limited during breeding season to avoid nest disturbance.

A larger forested buffer surrounding the refuge is advisable to help filter the negative effects, such as pollution, of nearby surrounding land use. Abandoning croplands within the wetland and allowing reversion to native plant communities is recommended. Landowners should aim to reduce impacts to the hydrology by implementing best management practices on surrounding farmlands

Upper French Creek BDA – *Exceptional Significance*

Beginning in Chautauqua, New York, French Creek flows for 117 miles until the confluence with the Allegheny River in Franklin, Pennsylvania. French Creek has been recognized as one of the most intact and ecologically diverse streams in the Eastern United States. Approximately half of Crawford County lies within the French Creek watershed, which totals 1270 square miles in area (Crawford County Conservation District 2006). In Crawford County, French Creek is supported by the major drainage systems of Cussewago Creek, Muddy Creek, Sugar Creek, and Woodcock Creek. This BDA is designated around the French Creek corridor beginning near Camp Mystic in Erie County and extending downstream a little past Millers Station, there are several aquatic species of concern at both the state and federal level occupying this portion of the stream.

Due to the high water quality of this stream, this portion of French Creek supports many mussel species of concern. Mussels, as a group, are highly threatened or endangered and very susceptible to human-influenced changes in their environment such as pollution, sedimentation, and instream structures like dams. The aquatic species assemblage of the Upper French Creek BDA is quite diverse and includes a number of Pennsylvania rare species. **Brindled madtom** (*Noturus miurus*) and **streamline chub** (*Erimystax dissimilis*), two fish species of concern, are found in this stream, along with five other species of concern.

The northern portion of this BDA, just downstream from Camp Mystic supports a great diversity of mussel species. This includes the **paper pondshell** (*Utterbackia imbecillis*), **round pigtoe** (*Pleurobema sintoxia*), **creek heelsplitter** (*Lasmigona compressa*), **cylindrical papershell** (*Anodontoides ferussacianus*) and **threeridge** (*Amblema plicata*), all species of concern. Aside from the paper pondshell, which is somewhat of a habitat generalist, these species require areas of strong currents with fine gravel or sandy substrates of small to medium streams. This habitat is usually within the riffles of such streams and provides clear, highly oxygenated water for these species. Four other **sensitive species of concern** are also found in this section of French Creek. **Red-head pondweed** (*Potamogeton richardsonii*), a plant species of concern, is associated with the wetlands in this area.

Further downstream near the Crawford County border, a population of a **sensitive species of concern** occupies the riffles of French Creek. This species has suffered severe declines due to loss of habitat and water quality and habitat deterioration. This species is now restricted to short stretches of twelve streams (NatureServe 2007). This species has suffered from anthropogenic changes and destruction of appropriate habitat. Water pollution from domestic and industrial waste, insecticide and pesticide runoff, acid mine runoff, siltation and erosion, and damming of streams have created unfavorable increases in water temperature and turbidity as well as decreases in dissolved oxygen.

In northern Rockdale Township, where Campbell Run and an unnamed tributary flowing from Mackey Hill enter French Creek, the stream provides similar mussel habitat to the upstream Camp Mystic area. The species found here include the threeridge, cylindrical papershell, long-solid, creek heelsplitter, and round pigtoe. The riffle and shoal area of this portion of the stream are extremely important habitat for mussel species. Five other **sensitive species of concern** are found in this area.

As French Creek meanders around Millers Station, the natural course of the creek has created a series of pools and riffles which host a variety of aquatic species. Ten species of concern were found in the riffles and pools in this section of French Creek, including the **round pigtoe**, **long-solid**, and **threeridge** occupy the gravely riffles of the stream. The sandy shores of the creek provide habitat for the mussels. The relatively deep, slower moving pools support a fish species of concern, the **brindled madtom** (*Noturus miurus*), which is an imperiled species in Pennsylvania.

The supporting landscape of this creek encompasses the portion of the French Creek watershed feeding the stream. Most of the supporting landscape is comprised of forested valley walls, with agricultural development occurring on the valley floor and floodplain. For the most part, the stream retains a forested buffer, although it is small in some parts. Several small tributaries and Muddy Creek join French Creek within this BDA.

Threats and Stresses

Mussels are a highly threatened group of aquatic organisms which have been steadily declining due to habitat destruction and alterations by humans. As mentioned earlier, pollution, sedimentation, channelization, dredging, and invasive species are major threats to viable populations of mussels. Like mussels, fish species are also extremely vulnerable to habitat alteration and destruction. In this portion of French Creek, there are several farming operations that may pose a threat to these species of concern. Non-point source pollution such as runoff from pesticides and animal waste and livestock crossing of streams may result in pollution, sedimentation, and immediate death of species. Absent riparian buffers, especially adjacent to farms, may lead to increased pollution and temperatures within the stream. Invasive species in French Creek, specifically the zebra mussel (*Dreissena polymorpha*) are serious threats to native mussel populations. They interfere with feeding, growth, respiration, and reproduction of native species.

Recommendations

The residents of the French Creek Valley along with conservation organizations like the Western Pennsylvania Conservancy (WPC) and The Nature Conservancy, and government agencies have taken an active role in protecting the creek. WPC, Allegheny College, and Pennsylvania Environmental Council formed the French Creek Project in 1995 with the aim of developing a watershed conservation plan and initiating a watershed group. The Project performed research on French creek, provided educational resources to the public, and assisted landowners towards more sustainable agriculture. Although success has been achieved, continued efforts are necessary to maintain the quality habitat of French Creek.

Landowners not practicing sustainable agriculture are encouraged to consult best management practices for their property. Livestock should be kept out of the creek or if crossing the creek is necessary, animals should be directed around areas with known mussel beds. Continual monitoring and removal of zebra mussels is advisable. Furthermore, a riparian buffer of at least 100 meters is highly recommended to maintain cool water temperatures and to serve as a buffer from pollutants entering the creek via runoff.

Rome Township and Centerville Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
East Branch Oil Creek BDA		*Exceptional Significance*			
Ohio lamprey (*Ichthyomyzon bdellium*) – Fish	G3G4	S2S3	PC	2003	E
Mountain brook lamprey (*Ichthyomyzon greeleyi*) – Fish	G3G4	S2	PT	2003	E
American brook lamprey (*Lampetra appendix*) – Fish	G3G4	S3	PC	2003	E
Rendell's Corners North Wetland BDA		*High Significance*			
Hemlock palustrine forest – Natural Community	GNR	S3	-	2004	E

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

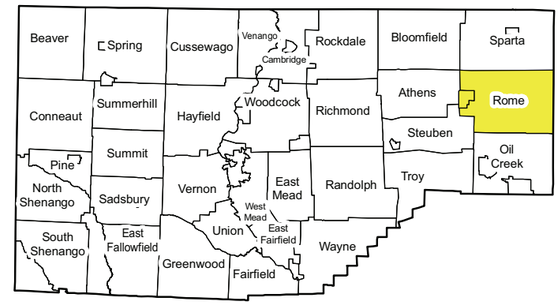
OTHER CONSERVATION AREAS: None

Crawford County
Natural Heritage Inventory
Rome Township
&
Centerville Borough

Biological Diversity Area:
East Branch Oil Creek
Rendall's Corners North Wetland

Landscape Conservation Area:
None

Public Land:
None



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

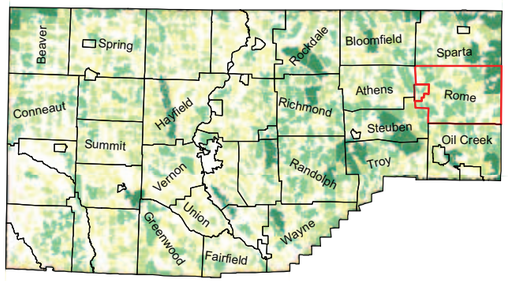
Crawford County
Natural Heritage Inventory

Rome Township
&
Centerville
Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

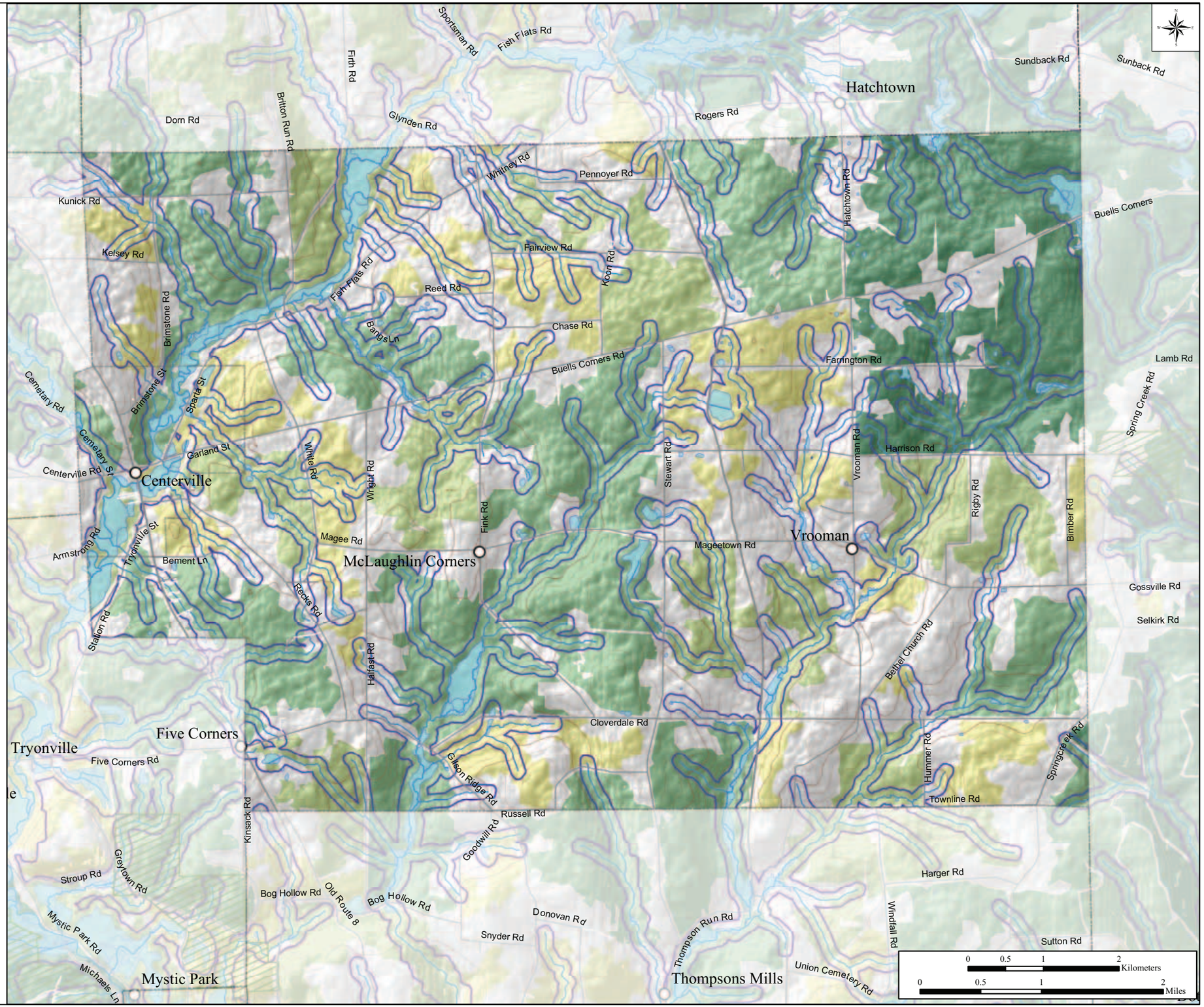
PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Located on the Warren County border, with Sparta Township to the north and Oil Creek to the south, Rome Township is one of the few townships within this county that was not glaciated during the Last Ice Age. The topography is dramatic, with steep river valleys along clear creeks like the East Branch of Oil Creek and Dolly Run. The steep wooded hillsides and valley walls of mixed hardwoods and conifers boast some of the largest forest blocks in the county. About a third of the land is used for farming with most of the fields in row crops. The Borough of Centerville is located within Rome Township. It is largely forested with sparse urban development and approximately 30% of the area being used for agriculture.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

East Branch Oil Creek BDA – *Exceptional Significance*

East Branch Oil Creek begins as the outlet of Clear Lake and drains approximately 340 square miles of Crawford, Venango, and Warren counties. The clear, clean streams within this watershed make up the majority of the Exceptional Value and High Quality streams in Crawford County. Prior to the last Ice Age, present-day Oil Creek was part of two separate watersheds. The water north of Titusville flowed into Muddy Creek to Lake Erie and the water flowing south out of Titusville drained to the Allegheny River (Crawford County Conservation District 2006). A drainage divide north of Titusville was covered by a retreating glacier that created a dam effect to northward flowing streams, this caused the streams to overtop their watershed boundaries and flow southward to the Ohio River basin. After the glaciers retreated, a new drainage divide was created and the eastern portion of Muddy Creek became the headwaters of Oil Creek at Lake Canadohta.

This BDA focuses on the large stretch of stream within the East Branch of Oil Creek that harbors three aquatic species of concern. The **Ohio lamprey** (*Ichthyomyzon bdellium*), **mountain brook lamprey** (*Ichthyomyzon greeleyi*), and the **American brook lamprey** (*Lampetra appendix*) are eel-like, boneless, jawless fishes that prefer clear rivers and streams. Both the American and mountain brook lamprey are non-parasitic and do not feed as adults, the Ohio Brook lamprey however, is parasitic and attaches to larger fishes by its sucking mouthparts. All three species, found mostly in the northwestern portion of Pennsylvania, are considered either imperiled or vulnerable in the state.

The immediate watershed drained by this portion of the East Branch of Oil Creek is considered the supporting landscape for this BDA. Rolling, forested hills, and agricultural fields characterize this landscape, and there is a fair amount of interior forest within the watershed.

Threats and Stresses

Lampreys are extremely sensitive to environmental changes such as sedimentation, temperature change, pollutants, changes in water levels, and physical alterations of streams. Instream structures, such as dams, prevent migration during the breeding season, and filter-feeding larvae are extremely susceptible to water pollution.

Recommendations

Conservation of these species requires intense watershed management. Important applications include maintaining upland and forested riparian areas to reduce erosion, or implementing soil erosion control methods, and limiting human alterations of watersheds such as damming. Landowners with agricultural land within the watershed should consider applying best management practices to reduce water pollution and nutrient loading into streams.

Rendell's Corners North Wetland BDA – *High Significance*

The core area of this site is delineated around the furthest extent of a **hemlock palustrine forest**, a community of conservation concern in Pennsylvania. The perimeter of the wetland is buffered to capture potential habitat for any bird or amphibian species that this wetland may support. This wetlands lies within the McLaughlin Run watershed and contains about 57 acres (23 hectares) of palustrine forest.

A shrub swamp area adjacent to the hemlock palustrine forest at Rendell's Corners Wetland.
Photo source: PNHP

Hemlock palustrine forests are characterized by a pit and mound microtopography, with pools of standing groundwater. The canopy of these communities are predominantly eastern hemlock (*Tsuga canadensis*), with white pine (*Pinus strobus*), red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), ash (*Fraxinus* sp.), red oak (*Quercus rubra*), white oak (Q. alba), and American beech (*Fagus grandifolia*) comprising about half of the overstory (Fike 1999). A dense understory is formed by rhododendron (*Rhododendron maxima*), with occasional highbush blueberry (*Vaccinium corymbosum*) and winterberry (*Ilex verticillata*). The herbaceous layer, which grows from a well-developed layer of sphagnum moss (*Sphagnum* sp.), is sparse but includes several fern species (*Onoclea sensibilis, Osmunda cinnamomea, and O. claytonia*), violets (*Viola* sp.), Canada mayflower (*Maianthemum canadense*), and Indian cucumber-root (*Medeola virginiana*).

The supporting landscape of this wetland includes the immediate watershed that is feeding this system. There is a road bisecting the area with adjacent pastureland and old fields however, the landscape is mostly wooded.

Threats and Stresses

The wetland lies adjacent to a major road, so consequently, runoff, pesticide spraying and mowing by road crews, and the spread of invasive species, could present potential threats to the edge of the forest. Westward migration of the hemlock wooly adelgid (*Adelges tsugae*), currently documented in 42 counties in the eastern two-thirds of Pennsylvania (PA Bureau of Forestry 2006), is a possible threat to the hemlock trees in the region.

Recommendations

Logging of this forested wetland should not occur. The application of herbicides and mowing should be avoided in the immediate vicinity of the forest. Invasive plants should be removed as practicable. Furthermore, any land management plans should take into consideration potential impacts to the hemlock palustrine forest and the natural hydrology of the supporting watershed. Additional surveys to document birds, amphibians, and insects utilizing the wetland, as well as periodic monitoring for the hemlock wooly adelgid, are recommended.

Sadsbury Township and Conneaut Lake Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Lake BDA		*Exceptional Significance*			
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1988	B
Lesser-panicled sedge (*Carex diandra*) – Plant	G5	S2	PT	1988	B
Cyperus-like sedge (*Carex pseudocyperus*) – Plant	G5	S1	PE	1988	E
Beck's water-marigold (*Megalodonta beckii*) – Plant	G4G5	S1	PE	1988	E
Northern water-milfoil (*Myriophyllum sibiricum*) – Plant	G5	S1	PE	2003	E
A swamp smartweed (*Polygonum setaceum* var. *interjectum*) – Plant	G5T4	S2	PE	1991	E
Fries' pondweed (*Potamogeton friesii*) – Plant	G4	S1	PE	2003	E
White-stemmed pondweed (*Potamogeton praelongus*) – Plant	G5	S1	PE	2003	E
Flat-stemmed pondweed (*Potamogeton zosteriformis*) – Plant	G5	S2S3	PR	2003	BC
White water-crowfoot (*Ranunculus aquatilis* var. *diffusus*) – Plant	G5T5	S3	-	1988	C
Hard-stemmed bulrush (*Schoenoplectus acutus*) – Plant	G5	S2	PE	1988	E
River bulrush (*Schoenoplectus fluviatilis*) – Plant	G5	S3	PR	1988	D
Black tern (*Chlidonias niger*) – Bird	G4	S1B	PE	1997	E
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Conneaut Lake Outlet BDA		*Exceptional Significance*			
Three-ridge (*Amblema plicata*) – Mussel	G5	S2S3	-	2006	E
White heelsplitter (*Lasmigona complanata*) – Mussel	G5	S1	-	1988	BC
Black tern (*Chlidonias niger*) – Bird	G4	S1B	PE	1997	B
Sensitive species of concern***	-	-	-	1988	BC
Sensitive species of concern***	-	-	-	1988	C
Meadville Junction BDA		*Exceptional Significance*			
see Summit Township					
Pymatuning Reservoir BDA		*Exceptional Significance*			
see Pine Township					
Pymatuning Swamp Tributaries BDA		*High Significance*			
Sensitive species of concern***	-	-	-	2003	E
Pymatuning Wetland Complex-North BDA		*Exceptional Significance*			
Small beggar-ticks (*Bidens discoidea*) – Plant	G5	S3	-	2002	E
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	2005	B
Soft-leaved sedge (*Carex disperma*) – Plant	G5	S3	PR	2004	A
Mitchell's sedge (*Carex mitchelliana*) – Plant	G3G4	S1	PE	2004	B
Downy willow-herb (*Epilobium strictum*) – Plant	G5	S3	PE	1984	E
Swampfly honeysuckle (*Lonicera oblongifolia*) – Plant	G4	S1	PE	1988	A
Bog bluegrass (*Poa paludigena*) – Plant	G5	S3	PT	1988	A

A swamp smartweed (*Polygonum setaceum* var. *interjectum*) – Plant	G5T5	S3	PE	2002	E
Flat-stemmed pondweed (*Potamogeton zosteriformis*) – Plant	G5	S2S3	PR	1996	B
Bog-mat (*Wolffiella gladiata*) – Plant	G5	S2	PR	1984	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
Black tern (*Chlidonias niger*) – Bird	G4	S1B	PE	1997	B
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3	-	1988	E
Alder sphagnum wetland – Natural Community	GNR	S4	-	1982	-
Black spruce-tamarack peatland forest – Natural Community	GNR	S3	-	1982	-
Hemlock palustrine forest – Natural Community	GNR	S3	-	1982	-
Hemlock-mixed hardwood palustrine forest – Natural Community	GNR	S3S4	-	1982	-
Northern hardwood forest – Natural Community	GNR	S4	-	1982	-
Skunk cabbage-golden saxifrage forest seep – Natural Community	GNR	G4G5	-	1982	E
Sensitive species of concern***	-	-	-	1988	A
Sensitive species of concern***	-	-	-	1982	E
Sensitive species of concern***	-	-	-	2003	E

Tryon Weber Woods BDA	*Local Significance*
none	

Conneaut Marsh-Geneva Marsh LCA

see page 53 for descriptions of LCAs

Pymatuning Marsh LCA

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

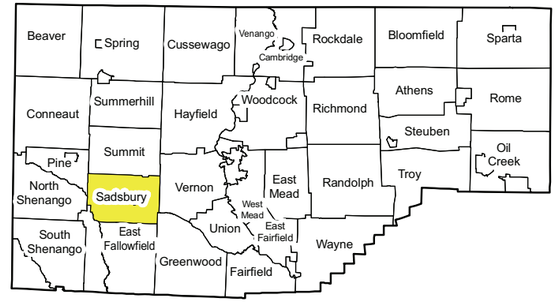
OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area (IBA), Pymatuning-Hartstown Complex IBA, Pymatuning Wildlife Management Area- SGL #214 Important Mammal Area

Crawford County
Natural Heritage Inventory
Sadsbury Township
&
Conneaut Lake Borough

Biological Diversity Area:
- Conneaut Lake
- Conneaut Lake Outlet
- Conneaut Marsh Complex North
- Meadville Junction
- Pymatuning Resevoir
- Pymatuning Swamp Tributaries
- Pymatuning Wetland Complex - North
- Pymatuning Wetland Central Complex
- Tyrone Weber Woods

Landscape Conservation Area:
- Conneaut Marsh Complex
- Pymatuning Wetland Complex

Public Land:
- Pymatuning State Park
- State Game Land 213
- State Game Land 214



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

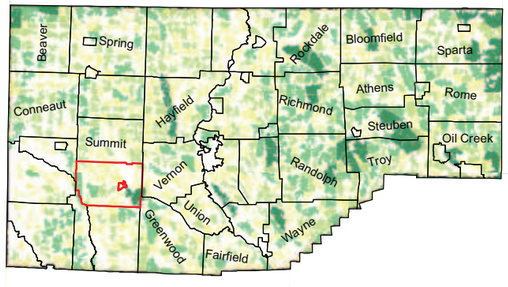
Crawford County Natural Heritage Inventory

Sadsbury Township & Conneaut Lake Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

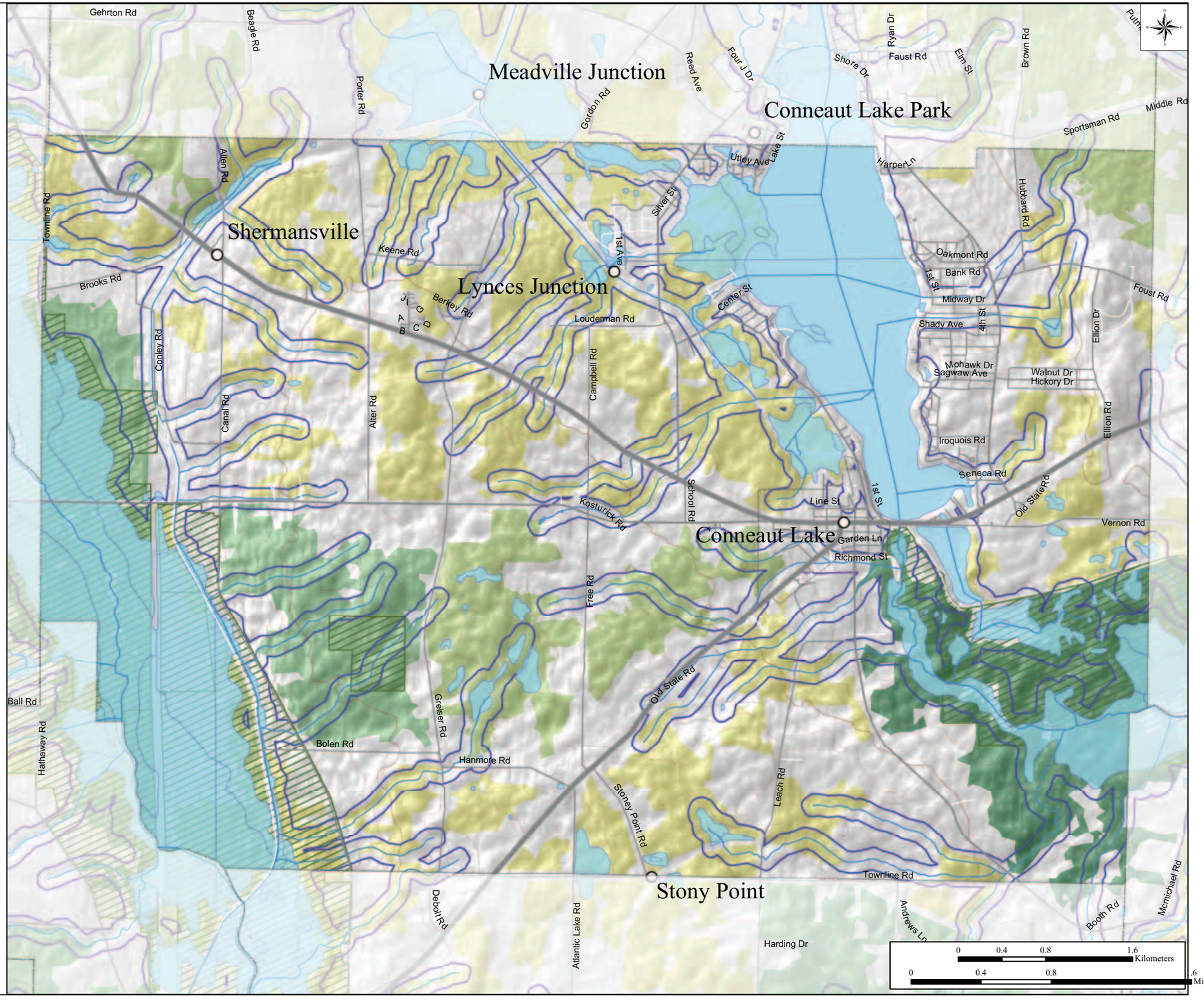
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Sadsbury Township is located in central Crawford County. Nearly half of the township is forested, however, most of the forest blocks have been fragmented by roads and agriculture. These forests do not provide suitable habitat for interior forest species that prefer large tracts of intact forest. The larger forest blocks that remain in this township are within State Game Land #214 in the southwest and State Game Land #213 in the southeast, which makes up part of the Conneaut Marsh - Geneva Marsh Important Bird Area (IBA). Both of these managed areas should help to protect the larger forest blocks and wetlands in this area. Conneaut Lake occupies a large part of the county in the northeast. In addition to Conneaut Lake Park, this lake provides recreational opportunities for residents and visitors. Associated commercial and residential development surrounds most of the lake's perimeter. The Borough of Conneaut Lake is located to the southwest of Conneaut Lake. The Shenango River flows through a series of wetlands in the southwestern corner of Sadsbury comprising a portion of the Pymatuning Hartstown Complex IBA and the Pymatuning Wildlife Management Area / SGL 214 Important Mammal Area (IMA). Agriculture is the predominant land use in this township.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

hard-stemmed bulrush
photo source: USDAPlants, Mohlenbrock

Conneaut Lake BDA – *Exceptional Significance*

Conneaut Lake is the largest natural lake in Pennsylvania. The lake was formed as glaciers retreated during the Wisconsin Age, the last glacial episode to reach western Pennsylvania (Shepps et. al. 1959). As the glaciers retreated, a large block of ice broke off and was surrounded by accumulating sediment. Once the ice melted, the lake filled in. The lake is fed by Inlet Run and five primary unnamed tributaries. Groundwater also contributes to water received by the lake (Ostrofsky and Owen 1989). There is a small impoundment at the southern end of the lake. The outlet of the lake, Conneaut Outlet proceeds through Conneaut Marsh, an extensive wetland on State Game Lands #213 and joins French Creek at Shaw's Landing.

This BDA consists of Conneaut Lake as the core, and the immediate watershed draining into the lake is considered the supporting landscape. The lake is located in the southwestern portion of Crawford County and extends through Summit and Sadsbury Townships. The supporting watershed includes portions of Vernon, Hayfield, and Summerhill Townships, as well as Borough of Conneaut Lake at the south end of the lake. The entire watershed of Conneaut Lake is 6800 hectares. A comprehensive survey of the flora and fauna of Conneaut Lake was performed by the Pennsylvania Natural Heritage Program (PNHP) for the Glacial Lakes Report (Grund and Bissell 2006).

The lake and emergent marsh margins of the lake support a number of plants of special concern: **river bulrush** (*Schoenoplectus fluviatilis*), **hard-stemmed bulrush** (*S. acutus*), **white-stemmed pondweed** (*P. praelongus*), **flat-stem pondweed** (*P. zosteriformis*), **Fries' pondweed** (*P. friesii*), **Cyperus-like sedge** (*Carex pseudocyperus*), **lesser panicled sedge** (*C. diandra*), **soft-leaved sedge** (*Carex alata*), **white water-crowfoot** (*Ranunculus aquatilis* var. *diffusus*), **Beck's water marigold** (*Megalodonta beckii*), **a swamp smartweed** (*Polygonum setaceum* var. *interjectum*), and **northern water-milfoil** (*Myriophyllum sibiricum*). A population of firm aster (*Symphyotrichum firmum*) occurs in the wet meadow on the western side of the lake. This species was once considered endangered in Pennsylvania but has recently been updated to Pennsylvania-rare and remains on the PNHP Watch List.

White-stemmed pondweed is one of the many aquatic plant species of concern found in Conneaut Lake.
photo source: USDAPlants, Duft

The emergent marsh areas that surround Conneaut Lake support a number of wildlife species. **black terns** (*Chlidonias niger*) and **common moorhens** (*Gallinula chloropus*), two wetland bird species of concern, are known to nest here. Black terns tend to utilize thickly vegetated emergent marshes. They build floating platform nests from vegetation and use the tall plants for cover. Common moorhens nest along the margins of lakes with emergent vegetation. This species is less secretive than most wetland birds and is commonly seen feeding on open water.

The immediate shoreline of Conneaut Lake has been intensely developed with residential areas along the border and Conneaut Lake Park, an amusement park on the northwest shore. Numerous wetlands surrounding the lake have been drained or filled for residential development and agriculture. However, a large marsh remains along the western side of the lake. The surrounding landscape is mostly agricultural or forested, and most of the streams draining into the lake retain forested riparian corridors. There are over 100 hectares of wetlands, fens, and calcareous seeps, communities of special conservation concern, within the lake's watershed. This includes all areas around Meadville Junction and Clear Lake.

Threats and Stresses

The lake was severely invaded by Eurasian water-milfoil (*Myriophyllum spicatum)*, an exotic aquatic plant that contributed to the decline of native aquatic plant populations in the early 1980's. Successful control using a mechanical harvester and annual herbicide treatments of diquat, has allowed native plants to recover throughout portions of the lake (Grund and Bissell 2006). Another invasive, fanwort (*Cabomba caroliniana*), has become increasingly more abundant around two of the boat access canals in the lake. The lake is intensively used for recreational boating. As there are no current horsepower restrictions on the lake, hydrocarbon emissions associated with boating are becoming a problem for quality of the lake environment. Attempts to reduce submerged and emergent vegetation for recreational use via herbicides and mowing also poses threats to sensitive species. Furthermore, human disturbance to birds during the breeding season can affect nesting success.

The shoreline of the lake has been converted to lawns and contains many impervious surfaces that can facilitate water pollution problems if mismanaged. Runoff from lawns and roads during storm events could cause nutrient loading in the lake, resulting in the mortality of the endemic plants and animals. The marsh on the western side of the lake has been invaded by invasive species, such as purple loosestrife (*Lythrum salicaria*), which could pose a threat to the extant native diversity.

Nutrient loading from upland agricultural lands and golf courses threaten the health of the lake ecosystem. Agricultural runoff from pesticide and herbicide application and animal waste may cause nutrient loading and may contribute to the death of aquatic organisms, harmful algal blooms, and the eventual dentrification, or nutrient overload, of a lake (Vellidis et al 2003). Logging and clearing of riparian buffers would also detrimentally affect the water quality of the lake and its watershed.

Recommendations

Continued management for invasive aquatic species within the lake by the Pennsylvania Fish and Boat Commission is strongly recommended. Targeting known occurrences of fanwort is extremely important. Considering imposing horsepower restrictions on the lake would also be desirable. Human traffic and recreation should be limited in bird nesting areas during the breeding season to prevent human-influenced nest failure.

Eliminating development on wetlands is strongly encouraged. An invasive species management plan to aid in removal of exotics from wetlands is also highly recommended. Continued monitoring to evaluate establishment and spread would be advantageous. Control measures should be implemented if populations indicate spread. Preference should be given to control methods that would be least toxic and least disruptive to the natural community. Organizing a community-based volunteer program to hand pull invasive species within the area is a potential option for invasive species control. Best management practices (BMPs) to control stormwater and agricultural runoff, should be employed at a watershed scale to reduce the risk of polluting the lake.

Conneaut Marsh Complex North BDA

This Natural Heritage Area is discussed under Vernon Township.

Conneaut Lake Outlet BDA – *Exceptional Significance*

Conneaut Outlet, the outlet for Conneaut Lake, meanders through a series of extensive marshlands downstream from the lake through State Game Lands #213 eventually draining into French Creek at Shaw's landing. The marsh, locally known as Geneva Marsh, is an Important Bird Area (IBA) designated by the Audubon Society. This area provides excellent habitat for several animal and plant species of concern. This particular BDA is located where the outlet drains the lake and extends about 2 km downstream. Included in this BDA is a large marsh on the eastern side of the outlet, which provides habitat for nesting **black terns** (*Chlidonias niger*), a bird species of concern.

Within the stretch of stream immediately leaving Conneaut Lake, there is a mussel species considered imperiled in Pennsylvania. The **white heelsplitter** (*Lasmigona complanata*) is found in lower gradient areas of streams. Two other **sensitive species of concern** were also found at this site.

Also, included in this BDA is a wetland complex, which lies south of the lake, and east of the outlet, harboring an occurrence of breeding black terns. Black terns were listed as endangered by the Pennsylvania Game Commission in 1990 (Gill 1985 *In* Brauning 1992). According to the Breeding Bird Atlas, black terns are one of the rarest nesting birds in Pennsylvania, historically and during the Atlas work, as they only occur in the Eastern Lake or Glaciated sections of northwestern Pennsylvania (Brauning 1992). These birds nest in loose colonies or in scattered pairs in freshwater marshes with emergent vegetation including spatterdock (*Nuphar* sp.), bulrushes (*Scirpus* sp.), and cattails (*Typha* sp.) (Naugle 2004). Thus, the marshes of Crawford and Erie Counties are critical habitats for the conservation of this species in Pennsylvania.

The supporting landscape includes the upland watershed that drains into the outlet and marsh, however, this BDA is tied to Conneaut Lake and is influenced by the greater watershed of the lake. This BDA is largely protected by a forested buffer although a major road with adjacent residential development intersects the

area between the lake and lower marsh. Some agricultural fields and pasture occupy the uplands of Conneaut Outlet.

Threats and Stresses

Maintaining suitable stream habitat is key to the continued success of these mussel species. Most of Conneaut Outlet lies within gamelands and is largely protected from inappropriate development. A small portion of the stream lies outside of public land, however, threats to freshwater mussels such as damming, dredging, and channelization, are unlikely to occur. Nutrient loading from upland farms and clearing riparian corridors may adversely affect water quality, inherently affecting the mussel populations.

The eastern side of the marsh is extremely saturated and inappropriate for any kind of development, and draining and filling of this wetland would eliminate black tern nesting habitat, which is protected by the Migratory Bird Treaty Act. Black terns are highly susceptible to human disturbance and presence. The intensive recreation on Conneaut Lake may threaten the success of nesting colonies. Declines of black terns have also resulted from habitat loss, contaminants such as organochlorides and chemicals, declines in water and food quality, and invasion of exotic species that change the character of a wetland (Novak 1990, Weseloh et al. 1997).

Recommendations

Preserving forested stream corridors is essential to maintaining high water quality. Riparian borders should be maintained. Road development should also be kept away from the stream corridor in order to avoid degrading aquatic and streamside habitat. The Pennsylvania Game Commission may choose to include the small portion of stream outside of the game land boundary as well as the marsh, in management plans or try to coordinate an appropriate management plan with landowners. Human disturbance of black tern areas should be avoided, specifically during the breeding season. Best management practices should be applied to upland farms and surrounding residential areas regarding stormwater management, so as to reduce water pollution entering into these systems.

Meadville Junction BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Summit Township.

Pymatuning Reservoir BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Pine Township.

Pymatuning Swamp Tributaries BDA – *High Significance*

This BDA is delineated around unnamed tributaries of Pymatuning Swamp containing three occurrences of a species of concern. This area extends from the known occurrences upstream to the headwaters as well as a downstream buffer, all contained within State Game Lands #214. The supporting landscape, the immediate watershed, consists largely of forested land with some agricultural development to the north and south.

Threats and Stresses

Most of this site is located within SGL #214 and Tryon Weber Woods, which is owned by the Western Pennsylvania Conservancy (WPC) and is protected by management plans. However, upstream portions are privately owned and any activity contributing to the decline of water quality or the alteration of the stream hydrology would directly effect these fish populations. Specifically, loss of forest cover in core areas may contribute to increased water temperatures, reduced critical habitat preferred by fish schools, and disruption of nutrient cycling linked to the streams.

Recommendations

In addition to limiting water pollution from agricultural runoff, preservation of forested stream corridors is the best method for maintaining water quality. Avoid any major changes to the stream hydrology, such as damming the stream that connects these occurrences, to allow interaction and genetic variation via reproduction to occur. This will allow this species a better chance at surviving any future catastrophic events or natural selection pressures.

Pymatuning Wetland Complex-North BDA – *Exceptional Significance*

This area includes the primary wetland communities that together form the northern portion of Pymatuning Swamp. The remaining area of the swamp represents only a part of what once was one of the most extensive wetland complexes in the state. When the Shenango River was dammed in the early 1930's to form Pymatuning Lake, a substantial part of the original wetland was lost. Changes that occurred as a result of the dam are not fully known but historic records suggest the area currently underwater once supported a rich flora and fauna of calcareous conditions. The community features of this BDA include open water areas, emergent marshes, shrub wetlands, and palustrine forests. The wetland as a whole extends upstream for several miles from the lake edge. This BDA is delineated around the northern portion of the wetland that lies within Pymatuning State Park and State Game Lands #214.

A number of noteworthy communities are present throughout the wetland complex, which supports several animal and plant species of conservation concern. The area around the Shenango River supports an emergent wetland community. The shrub layer that develops adjacent to the stream corridor is characterized as an **alder sphagnum wetland**, a natural community of special concern. In this type of wetland, sphagnum (*Sphagnum* spp.) mosses cover a substrate of peat, and alder (*Alnus serrulata, A. incana*) shrubs are predominant throughout (Fike 1999). Common plant associates include highbush blueberry (*Vaccinium corymbosum*), winterberry (*Ilex verticillata*), and swamp dogwood (*Cornus racemosa*). Ferns, including cinnamon fern (*Osmunda cinnamomea*) and sedges (*Carex* spp.) are common. Several plant species of concern are located throughout this shrub swamp: **soft-leaved sedge** (*Carex disperma*), **broad-winged sedge** (*C. alata*), **small beggar-ticks** (*Bidens discoidea*) and **a swamp smartweed** (*Polygonum setaceum* var. *interjectum*). The interface of emergent vegetation, open water areas, and shrub swamp create a habitat that supports **marsh wrens** (*Cistothorus palustris),* a bird species of concern. **Common moorhen** (*Gallinula chloropus*) and **black tern** (*Chlidonias niger*) are two other bird species of concern documented to use the emergent vegetation along the river as breeding habitat.

The shrub swamp lining the Shenango River gives way to palustrine forests on the outer edges of this BDA. Another **sensitive species of concern** was also found in this section of the wetland. This forested area along Blair Road is characterized as a **black spruce-tamarack peatland forest**, a natural community of conservation concern. This community is typically dominated by black spruce (*Picea mariana*) and tamarack (*Larix laricina*) with white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), and red maple (*Acer rubrum*) present in smaller amounts. Ferns, sundews (*Drosera* sp.), cottongrass (*Eriophorum* sp.) and sedges (*Carex* sp.) are all common in the herbaceous layer which is supported by an extensive bryophyte (moss) layer.

Several species of concern occur within the blue spruce-tamarack peatland. This includes **soft-leaved sedge**, **broad-winged sedge**, **Mitchell's sedge** (*Carex mitchelliana),* **a swamp smartweed**, **downy willow-herb** (*Epilobium strictum*), **bog bluegrass** (*Poa paludigena*), **flat-leaved pondweed** (*Potamogeton zosteriformis*), **bog mat** (*Wolffiella gladiata*), and **swamp-fly honeysuckle** (*Lonicera oblongifolia*). Firm aster (*Symphyotrichum firmum*) is also present in this community. Once considered endangered, this species has recently been upgraded to rare but remains on the PNHP watch list. Intermittent forest seeps within this portion of the wetland are characterized as **skunk cabbage-golden saxifrage forest seeps,** a community of conservation concern. These communities occur in areas where groundwater comes to the surface in a diffuse flow for much of the growing season (Fike 1999). Species composition is variable, usually including skunk cabbage (*Symplocarpus foetidus*), golden saxifrage (*Chrysosplenium americanum*), cinnamon fern (*Osmunda cinnamomea*) and a variety of small herbaceous plants.

The uplands of this BDA consist of a **hemlock palustrine forest** and a **hemlock-mixed hardwood palustrine forest**, natural communities of special concern that also host a species of concern. Hemlock palustrine forests can be identified by their pit-and-mound microtopography, with pools of standing water or organic material, dominance of sphagnum groundcover, and the canopy dominance of eastern hemlock (*Tsuga canadensis*). Hardwood species such as red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), and black ash (*Fraxinus nigra*) comprise about a quarter of the canopy. Hemlock-mixed hardwood palustrine forest is a closely associated community that exhibits a more even distribution of conifer and hardwood species. Eastern pine (*Pinus strobus*), tamarack (*Larix laricina*), red spruce (*Picea rubens*), and black-gum (*Nyssa sylvatica*) are common overstory species. The shrub and herbaceous layer are quite similar between these communities.

A **northern hardwood forest**, another natural community of special concern, buffers the outer edge of this BDA. Northern hardwood forests are typically dominated by American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), sugar maple (*A. saccharum*), and black cherry (*Prunus serotina*). Birches (*Betula* spp.), ashes (*Fraxinus* sp.), and oaks (*Quercus* sp.) are commonly present at smaller amounts. The understory is fairly diverse with a sparse herbaceous layer reflecting a northern affinity. Including such plants as partridge-berry (*Mitchella repens*), Indian cucumber-root (*Medeola virginiana*), Canada mayflower (*Maianthemum canadense*), and star flower (*Trientalis borealis*).

A **sensitive species of concern** was seen nesting in the northeast corner of Pymatuning State Park near Cameron Island. Additionally, records indicate that the Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*) once existed within this marsh although it has not been documented in Crawford County since 1967 and recent surveys by PNHP herpetologists (2003 – 2004) have yielded no new sightings.

The supporting landscape for Pymatuning Swamp is the immediate watershed of the wetland complex and includes a large percentage of agricultural lands. Numerous small tributaries flow through these predominately agricultural areas directly into the swamp which then drains to the Shenango River to the north and Crooked Creek to the south.

Threats and Stresses

The existence of this wetland and its various natural communities depends solely on the quality and quantity of water entering the system. Changes in hydrology, whether from human impoundments, beaver dams, or changes in drainage characteristics of the watershed, such as an increase in impervious surfaces, ditching and draining, or loss of forest cover can affect the wetland. Natural processes such as beaver and seasonal flooding have resulted in the dynamic mix of habitats currently exhibited at this site. Large-scale, permanent alterations to the hydrology, as occurred when the river was impounded to form Lake Pymatuning, will eliminate the natural cycle of wetland succession and change. Nutrient inputs from agriculture, the introduction and spread of exotic species from nearby activities, and loss of vegetative cover from adjacent lands can all negatively affect the wetland. Furthermore, human disturbance to nesting marsh birds can severely affect nest success of these species.

Recommendations

The sensitivity of the core area is high and any activities taking place within have the possibility of impacting the wetland and some or all species of concern occurring there. A good deal of protection is in place given that the swamp is almost entirely on public land and is considered an exceptional value (EV) wetland, however, there are really no safeguards to limit the introduction and spread of invasive species. Incorporating policy and strategy for controlling invasive species into the management plans for both the Bureau of State Parks and the PA Game Commission lands will be essential in managing this threat. Likewise, the coordination of those plans and the resultant management will be equally important.

All activities that have the capacity to affect water quality should be carefully reviewed and measures taken to limit such impact. Nutrient inputs from agriculture are of concern, and programs to help farmers best manage their livestock, pastures and crop fields will go a long way in maintaining good water quality. Forested buffers along streams are very important for absorbing surface water and the accompanying pollutants and for helping to limit the spread of invasive species that respond to high light conditions. Control of those invasive species which thrive in wetlands, such as purple loosestrife (*Lythrum salicaria*) and giant reed (*Phragmites australis*), are of greatest concern. Understanding the distribution, learning options available for control, planning for such control, and implementing those plans are an essential part of the overall conservation picture for Pymatuning Swamp.

Tryon-Weber Woods BDA – *Local Significance*

This site is designated around a patch of maturing forest that is owned by the Western Pennsylvania Conservancy and is home to the Pymatuning Laboratory of Ecology, part of the University of Pittsburgh. This mature forest is transitioning into old-growth and it contains some trees that are over 100 years old. A relatively large stand of mature American beech (*Fagus grandifolia*) - sugar maple (*Acer saccharum*) forest occupies approximately half of this BDA.

Threats and Stresses

The major threat to the forest diversity of this site is over-browsing by white-tailed deer (*Odocoileus virginianus*). Deer populations have become out of control throughout their range in recent history. This can be attributed to the loss of natural predators and changes in habitat i.e. increased forest fragmentation and edges, which provide more habitat for deer. As deer populations become too high to be supported by their habitats, the quality of forests declines as a result. Overbrowsing by deer reduces forest plant diversity and forest structure, which reduces habitats and food sources for other species of wildlife.

Southern migration of the beech scale (*Cryptococcus fagisuga*), an exotic insect that facilitates the fungal infection of beech trees, causing beech bark disease, is a threat to the mature stand of beech-maple forest of this site. The insect feeds on trees with piercing mouthparts which transmits the fungus to the tree. The fungus kills the bark and cambium causing cankers to form which leads to the eventual death of the tree. Currently, Pennsylvania is the advancing front of the pest, and beech bark disease is currently known to exist as far west as the Allegheny National Forest.

Recommendations

Maintaining this stand of maturing forest will provide important habitat for wildlife species that require large blocks of interior forest. Deer exclusion fences can be installed in areas with high browse to allow the natural re-growth of forest plants. Periodic monitoring for the presence of the beech scale is desirable.

South Shenango Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			

NATURAL HERITAGE AREAS:

Pymatuning Marsh LCA

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Pymatuning-Hartstown Complex Important Bird Area

SOUTH SHENANGO TOWNSHIP

South Shenango Township is in the southwest corner of Crawford County. West Shenango lies to the southwest with Ohio on the western border and Mercer County to the south. The Pymatuning Reservoir, part of Pymatuning State Park, creates the border between West Shenango and South Shenango townships. Numerous small tributaries of the Shenango River drain the agricultural fields and urbanized areas of this township. Most of the streams flow through narrow valleys that are largely forested. Some streams flow across farmland with little vegetated riparian buffers. This is a significant problem because chemicals and pollutants can enter the streams with little interference. Pymatuning Reservoir, the Shenango River, and associated wetlands are an important complex that supports a diversity of species, and pollutants entering streams can have a negative impact on the whole ecosystem. This region has also been designated an Important Bird Area (IBA) because of the significant habitat provided to breeding and wintering birds. There have been no Natural Heritage areas identified in this township, however, it is included in the supporting landscape for the Pymatuning wetland complexes.

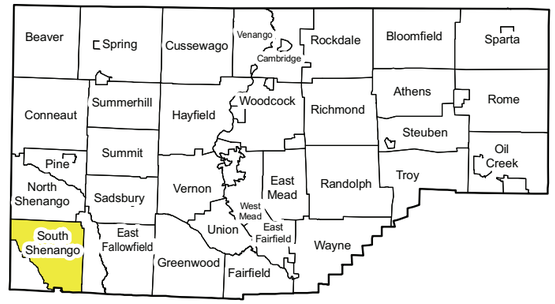
Crawford County Natural Heritage Inventory

South Shenango Township

Biological Diversity Area:
None

Landscape Conservation Area:
Pymatuning Wetland Complex

Public Land:
Pymatuning State Park



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)
State Land
Federal Land
National Wetland Inventory
Streams
40 Ft. Contour Line

0 0.45 0.9 1.8 Kilometers
0 0.45 0.9 1.8 Miles

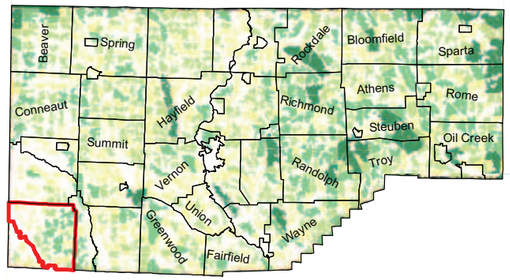
Crawford County Natural Heritage Inventory

South Shenango Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

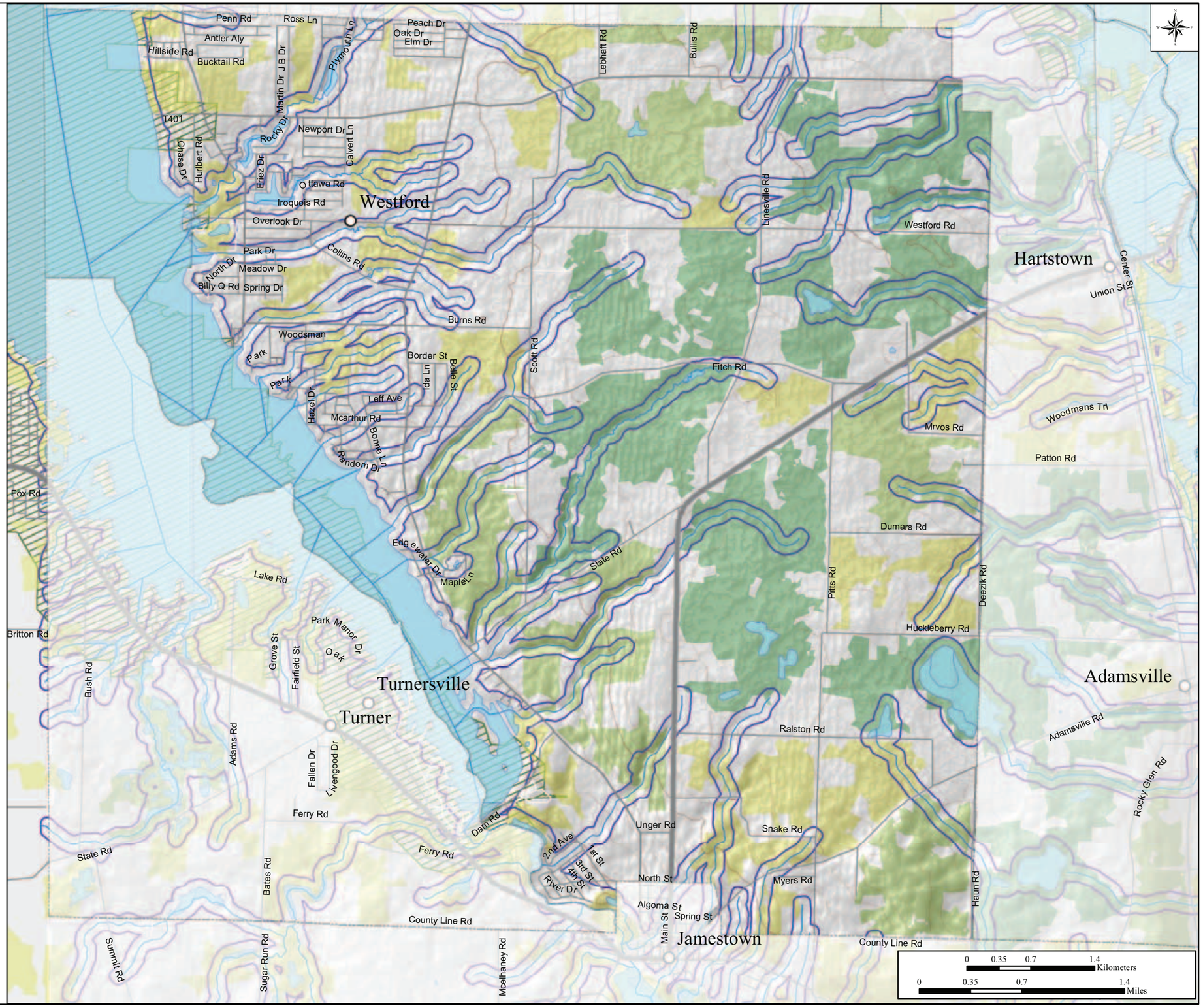
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Sparta Township and Spartansburg Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Clear Lake Swamp BDA	*High Significance*				
White water crowfoot (*Ranunculus aquatilis* var. *diffusus*) – Plant	G5T5	S3	-	1986	BC
Red maple-black ash palustrine forest – Natural Community	GNR	S2S3	-	2003	E

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: None.

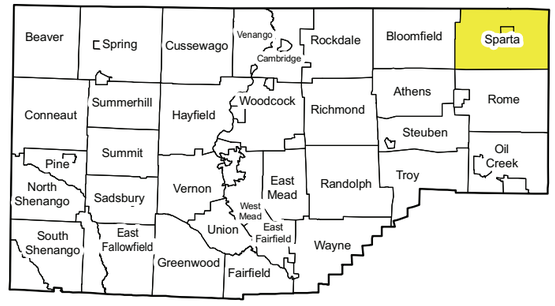
Clear Lake Wetlands
photo source: PNHP

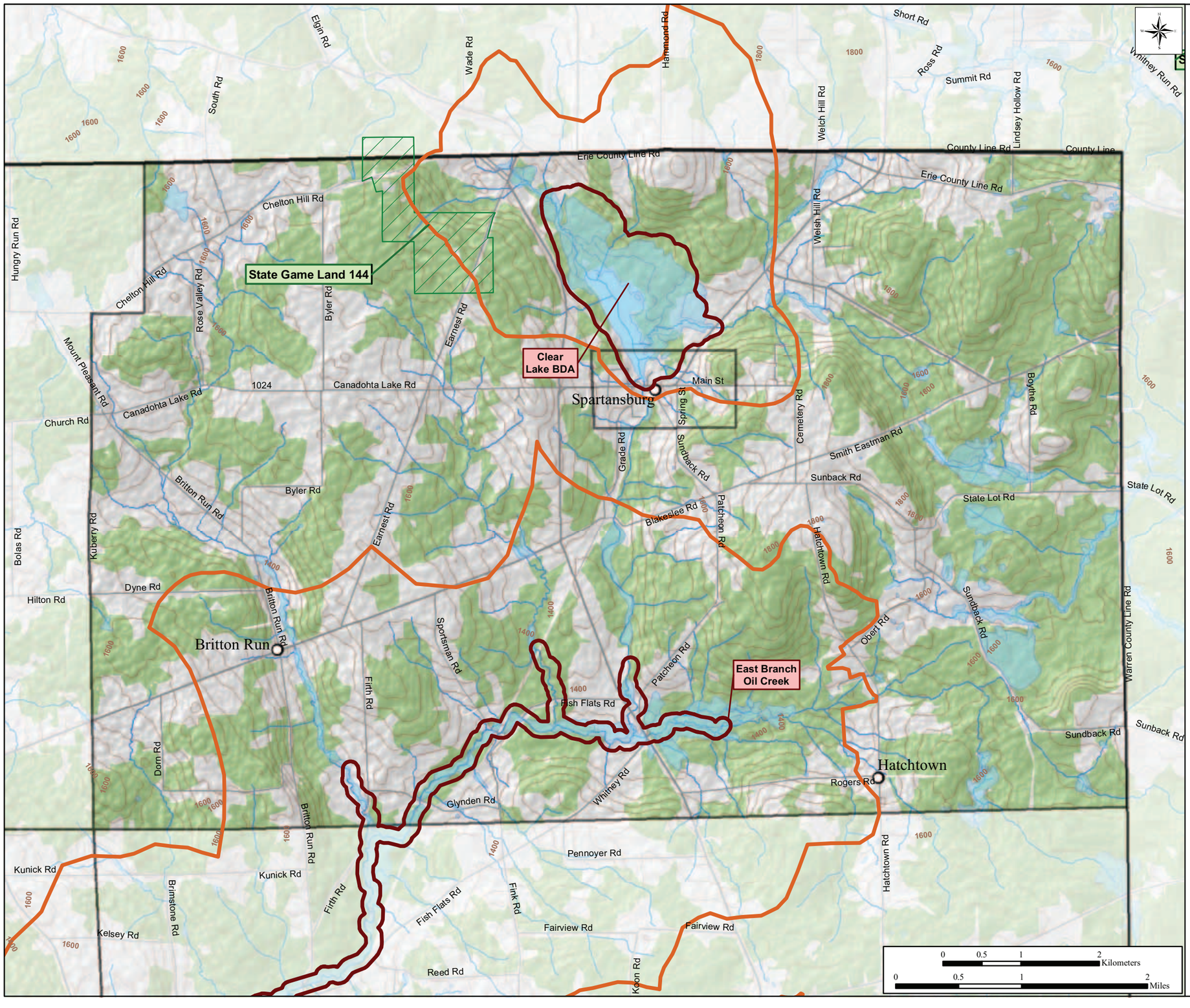
Crawford County
Natural Heritage Inventory
Spartansburg Borough
&
Sparta Township

Biological Diversity Area:
Clear Lake
East Branch Oil Creek

Landscape Conservation Area:
None

Public Land:
State Game Land 144





Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

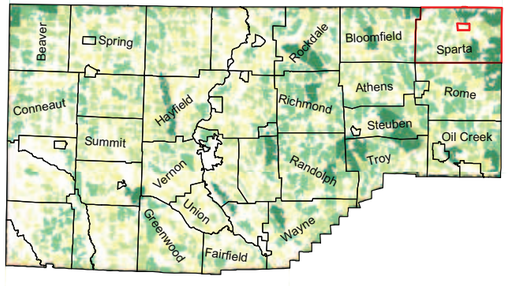
Crawford County
Natural Heritage Inventory

Sparta Township
&
Spartansburg Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

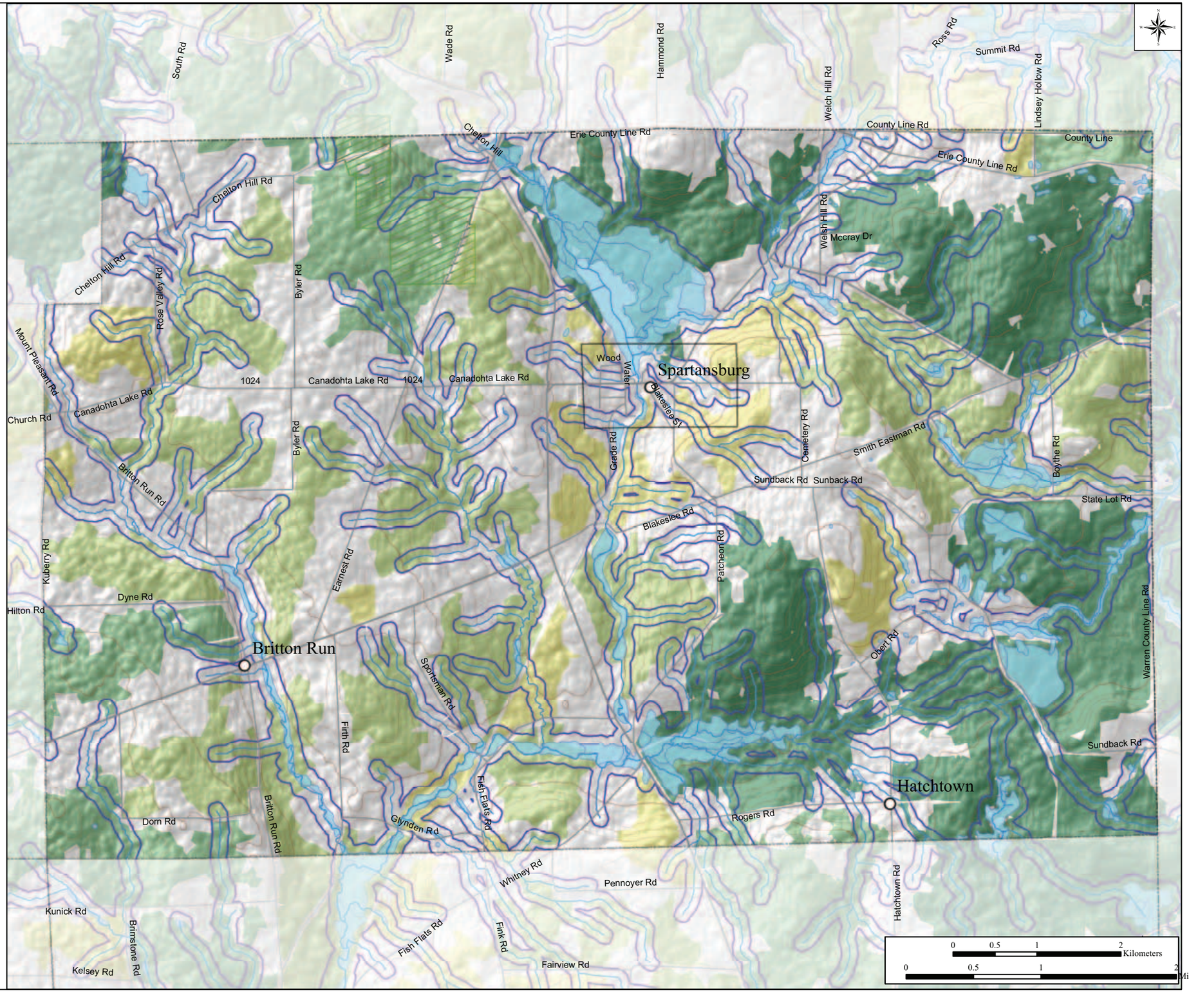
PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Sparta Township occupies the northeast corner of Crawford County. It is bordered by Warren County to the east and Erie County to the north. The land is rolling and hilly with some of the highest elevations in the county, rising over 1200 ft above Lake Erie. More than half of the township is forested and there are several large blocks of interior forest in the southeast corner, which provide important natural resources. The majority of the forests are of the mixed beech-maple type with intermittent pine groves. Sparta is drained by the East Branch of Oil Creek, which has been dammed at Spartansburg to create Clear Lake. The Borough of Spartansburg contains a mix of residential, agricultural, and forested land.

Clear Lake Swamp BDA – *High Significance*

Clear Lake was formed through the impoundment of several streams including Stranahan Run and Patrick Run. Prior to impoundment, this area was likely a large, mostly forested wetland complex. Currently, the lake is surrounded by a succession of vegetation with dense shrub thickets that transition into a conifer mixed hardwood forest, except where the town of Spartansburg sits at the southern end of the lake. The lake supports populations of **water smartweed (***Polygonum amphibium* var. *stipulaceum*), an aquatic plant species of concern. On the northern end of the Lake, water backs up along Stranahan Run, making this area wetter and keeping conditions relatively open. An area of palustrine forest lies between the base of the slope to the north and the stream to the south, which appears to have been minimally affected when water levels rose during impoundment.

This section of forest includes a swamp forest classified as a **red maple-black ash palustrine forest** and is of conservation concern in Pennsylvania. Dominant species within this forest are black ash (*Fraxinus nigra*), eastern hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolia*), green ash (*Fraxinus pennsylvanica*), and red maple (*Acer rubrum*). Understory associates include musclewood (*Carpinus caroliniana*), basswood (*Tilia americana*) and bitternut hickory (*Carya cordiformis*). The herbaceous layer includes many wetland species: water parsnip (*Sium suave*), bur reed (*Sparganium americanum*), willow herb (*Epilobium coloratum*), skunk cabbage (*Symplocarpus foetidus*), lake sedge (*Carex lacustris*), cinnamon fern (*Osmunda cinnamomea*), wild sarsaparilla (*Aralia nudicaulis*), a sedge (*Carex bromoides*), and rough-leaved goldenrod (*Solidago patula*).

The supporting landscape of this swamp includes its immediate watershed and involves the slope and upland to the north. This area is largely wooded but contains some agricultural land, some of which are in row crops.

Threats and Stresses

This swamp forest exists from the input of water from upslope surface flow as well as ground water inputs. Changes in the amount and quality of water that flow in and through the area could affect the forest and its composition. Nutrients from agriculture, soil disturbances, or loss of vegetative cover would likely affect water quality. ATVs are active in other sections of the greater wetlands around the lake and could cause disruptions in this area.

Recommendations

Maintaining the current hydrological conditions of the wetland is essential for the health of this unique natural community. Timbering or other removal of vegetation would not be compatible with the maintenance of the forested wetland. The continued minimal use of the areas surrounding this section of the lake would allow these communities to mature and flourish. Deer browsing could be an issue and should be evaluated for its impact on the regeneration of the forest. ATV activity, if noted, should be discouraged.

Best management practices, applied to the agricultural areas in the upper watershed would help to ensure limited input of nutrients and silt into drainages that feed the wetland. Maintain the forest cover on the adjacent slopes to provide an important buffer for the wetland and help maintain current hydrological conditions.

Spring Township, Conneautville and Springboro Boroughs

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Creek Slope- Springsboro South BDA			*High Significance*		
Harbinger-of-spring (*Erigenia bulbosa*) – Plant	G5	S2	PT	2000	E
Pont Road Wetlands BDA			*High Significance*		
A swamp smartweed (*Polygonum setaceum* var. *interjectum*) – Plant	G5T5	S2	PE	1999	E
Sensitive species of concern***	-	-	-	1996	E
French Creek LCA					

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Cussewago Bottom Important Bird Area

Crawford County
Natural Heritage Inventory
Spring Township
Conneautville Borough
&
Springboro Borough

Biological Diversity Area:

Conneaut Creek Slope - Springsboro South

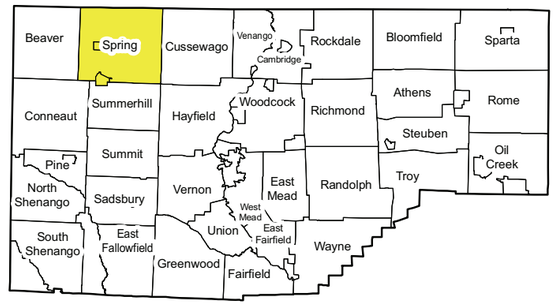
Pont Road Wetland

Landscape Conservation Area:

French Creek

Public Land:

None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.45 0.9 1.8 Kilometers

0 0.45 0.9 1.8 Miles

Crawford County
Natural Heritage Inventory

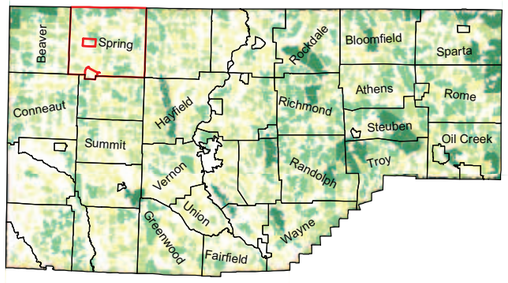
Spring Township

Springsboro Borough
Conneautville Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



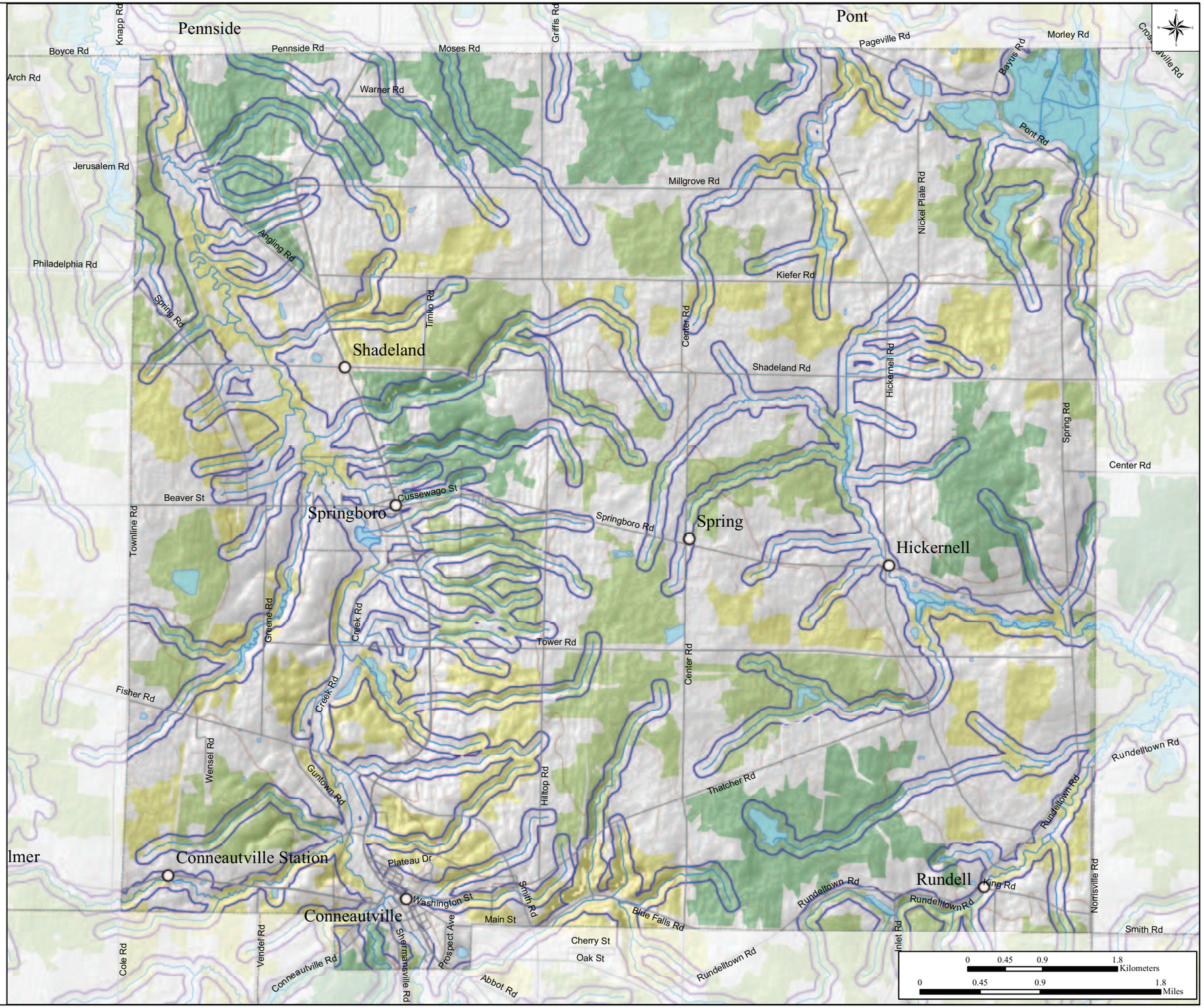
Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Spring Township, the largest township in the county, is located in northern Crawford County on the Erie County border. More than half of the township is used for agriculture, most of which is in row crops, which provides little natural habitat compared to pasture lands. Forests cover 43% of the township, but the majority of the forested areas is small, fragmented forest blocks. Conneaut Creek flows through western Spring Township, and tributaries to Cussewago Creek flow into the eastern part of the township. Since much of the land use in the township is agricultural, most of the streams lack a sufficient riparian buffer. The Cussewago Bottom Important Bird Area (IBA), along with its associated supporting landscape, is located in the eastern portion of the township. This site was chosen because it is a high-quality wetland that includes bottomlands and hardwood forests. This IBA also provides important habitat for the large number of Neotropical migrant birds are seen here every year. Springboro Borough is located within Spring Township. This borough is more residential than the surrounding townships, but most of the land is still in agricultural production and forests. Conneautville Borough is also located in southern Spring Township. Almost half of this borough is residential, but 30% of the borough remains forested.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Harbinger-of-spring, a spring ephemeral wildflower that appears on rich forest floodplains beginning in March.
photo source: Steve Grund

Conneaut Creek Slope- Springsboro South BDA – *High Significance*

This BDA is designated around a section of floodplain forest along Conneaut Creek, south of Springsboro. This community supports a population of **harbinger-of-spring** *(Erigenia bulbosa)*, an ephemeral wildflower of special concern in Pennsylvania. This wildflower is one of the first to appear in the spring and is usually found in rich woods with moderately well-drained soils and good canopy cover. This particular population, located on the lower slope along the western bank of the creek, lies within a rich woodland consisting of white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), and black walnut (*Juglans nigra*). The herbaceous layer consists of false hellebore (*Veratrum* sp.), Christmas fern (*Polystichum acrostichoides*), and skunk cabbage (*Symplocarpus foetidus*). Agricultural fields dominate the area considered the supporting landscape for this BDA.

Threats and Stresses

Only a small amount of floodplain forest supports this population and it is bordered by developed land. Timbering the remaining forest or clearing for grazing by domesticated animals could threaten this occurrence. Invasive species present potential threats to this habitat as well.

Recommendations

Landowners should be informed of the occurrence of harbinger-of-spring and cautioned against timbering this woodland. It is also advisable to restrict livestock from accessing this section of the forest to prevent trampling of populations of this species. Periodic monitoring of populations for health of plants and invasion by exotic plants would be desirable.

Pont Road Wetlands BDA – *High Significance*

This site contains a fairly large wetland along a headwater tributary to Temple Creek near the Erie County border that supports a plant and animal species of concern. Another stream, an unnamed tributary to Cussewago Creek, flows through the eastern portion of wetland. The hydrologic features of this area support several natural communities which contribute to the natural diversity of this BDA. The landscape that supports this wetland lies within the supporting watershed of the Cussewago Creek BDA. Most of the landscape, which is drained by the tributaries flowing through this wetland, is a mix of forests and agricultural fields.

Pont Road Wetland
Photo source: Robert Coxe

The wetland area on the eastern side of Pont Road is an open alder-dominated swamp with seepage meadows along the stream's embankment. Common shrubs in this habitat include willows (*Salix* sp.), buttonbush (*Cephalanthus occidentalis*), winterberry (*Ilex verticillata*), and highbush blueberry (*Vaccinium corymbosum*). The herbaceous layer is dominated by ferns and sedges with sedge meadows being more dominant adjacent to the creek. This wetland supports a breeding **sensitive species of concern.**

Two populations of **swamp smartweed** (*Polygonum setaceum* var. *interjectum*) have been located along the wet meadow flats near the periphery of the forested sections of this wetland, with populations on both sides of the road. These areas are open, most likely grazed by livestock, sedge and rush dominated wet meadows. The chief plant species here include Canadian rush (*Juncus canadensis*), inland sedge (*Carex interior*), longhair sedge (*Carex comosa*), and *Polygonum* spp.

Threats and Stresses

Human disturbance to nesting areas during the breeding season is the greatest threat to nesting success to this sensitive species of concern. Even small disturbances such as casual visits by observers and hikers can cause behavioral changes in adults ultimately affecting survival of their young (Steidl and Anthony 2000). Major disturbances such as road or building construction and logging may also initiate such behavioral changes.

Livestock grazing has impacted the areas of the wetland supporting the population of swamp smartweed. Continued browsing or trampling by cows could reduce population numbers of this species. Invasive species that may disperse via roadsides may become established and threaten the native plant diversity of this wetland.

Recommendations

Human activities within close proximity of nesting areas should be limited from January through August. Major disturbances should be kept a few hundred meters away from nest sites. Landowners with livestock should consider avoiding livestock browsing in areas with rare plants. Periodic monitoring for the establishment of invasive species is also recommended.

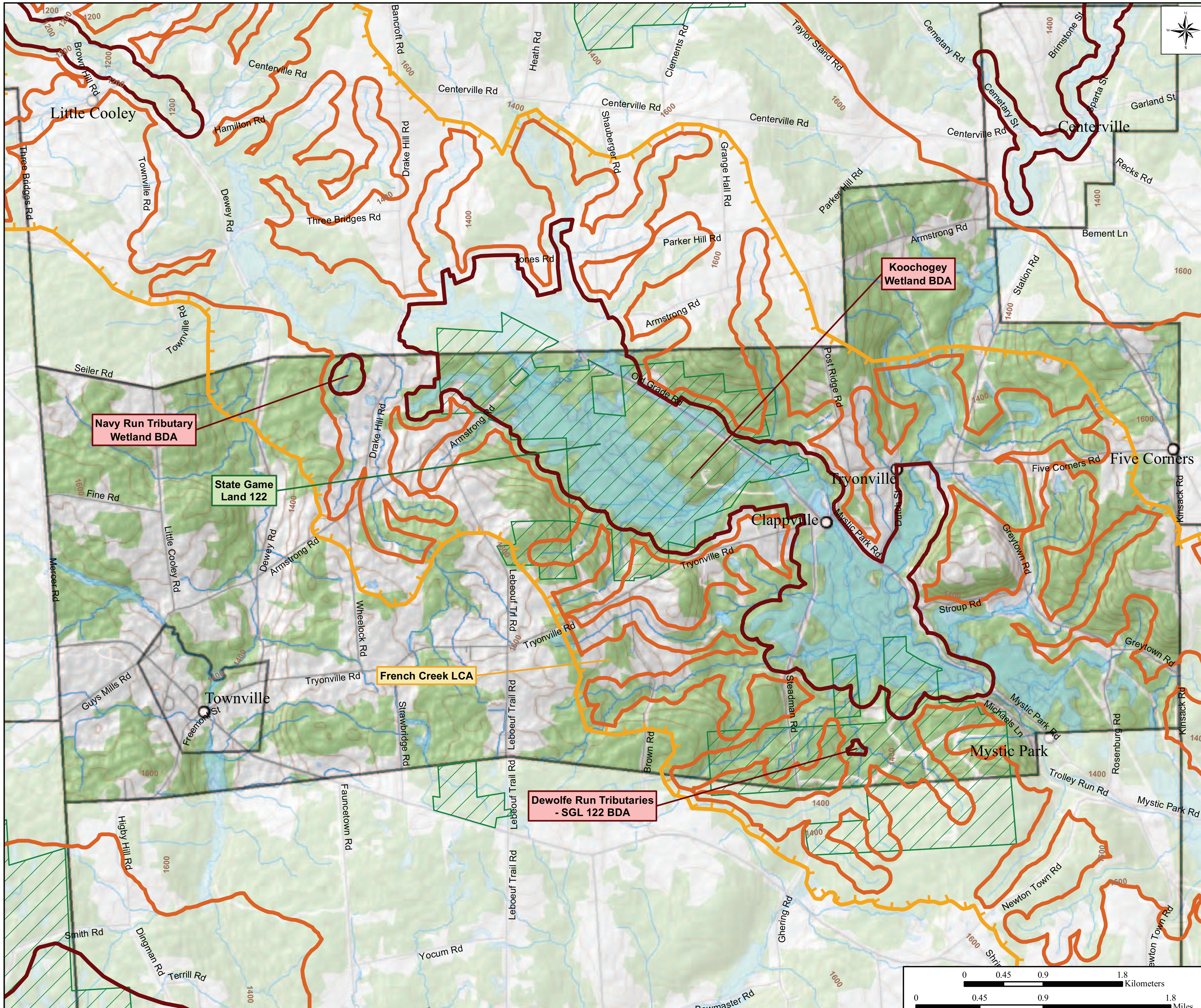
Steuben Township and Townsville Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Dewolfe Run Tributaries-SGL #122 BDA		*High Significance*			
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2003	E
Koochogey Wetlands BDA		*Exceptional Significance*			
Lesser panicled sedge (*Carex diandra*) – Plant	G5	S2	PT	1993	E
Soft-leaved sedge (*Carex disperma*) – Plant	G5	S3	PR	1998	E
Prairie sedge (*Carex prairea*) – Plant	G5	S2	PT	2004	E
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2004	E
Matted spikerush (*Eleocharis intermedia*) – Plant	G5	S2	PT	1992	E
Thin-leaved cottongrass (*Eriophorum viridicarinatum*) – Plant	G5	S2	PT	1992	E
Marsh bedstraw (*Galium trifidum*) – Plant	G5	S2	-	1993	E
Bog bluegrass (*Poa paludigena*) – Plant	G3	S3	PT	1992	E
Autumn willow (*Salix serissima*) – Plant	G4	S2	PT	1992	E
Hooded ladies' tresses (*Spiranthes romanzoffiana*) – Plant	G5	S1	PE	1995	E
Rush aster (*Symphyotrichum boreale*) – Plant	G5	S1	PE	1992	E
Highbush cranberry (*Viburnum trilobum*) – Plant	G5T5	S3S4	TU	2002	E
Black dash (*Euphyes conspicuus*) – Butterfly	G4	S3	-	2005	E
American brook lamprey (*Lampetra appendix*) – Fish	G4	S3	PC	2003	E
Buckthorn sedge (*Carex interior*)-golden ragwort fen – Natural Community	GNR	S1	-	1995	E
Sensitive species of concern***	-	-	-	2004	E
Navy Run Tributaries BDA		*High Significance*			
Red currant (*Ribes triste*) – Plant	G5	S2	PT	2004	E
French Creek LCA					

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area Conservation Region

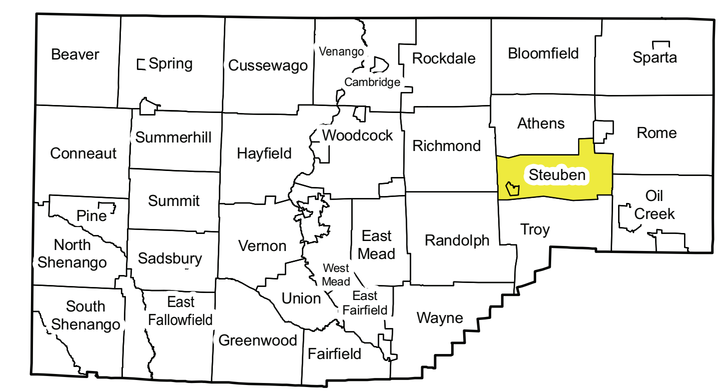


Crawford County
Natural Heritage Inventory
Steuben Township & Townville Borough

Biological Diversity Area:
- Navy Run Tributary Wetland
- Koochogey Wetland
- Dewolfe Run Tributaries - SGL 122

Landscape Conservation Area:
- French Creek

Public Land:
- State Game Land 122



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

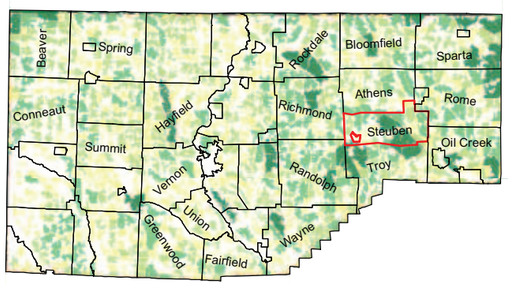
Crawford County
Natural Heritage Inventory

Steuben Township
&
Townville Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

Steuben Township lies in the southeast corner of Crawford County. Muddy Creek flows northeast, draining the western third of the township. Oil Creek drains the majority of Steuben Township, flowing south through the eastern portion of the township. The lowland areas along the Oil Creek tributaries are fairly wet, and a large portion is contained with State Game Lands #122. Over 60% of this township is forested with some larger forest blocks remaining. Crawford County Forest lies in the southeast corner, and a fair amount of forest is retained within the two sections of game land. The agricultural production in the township is predominantly in the form of row crops. The borough of Townsville, located in the southeast corner, contains a mix of agricultural, residential, and forested lands.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Dewolfe Run Tributaries- SGL #122 BDA – *High Significance*

This site is delineated around a northern hardwood forest located on State Game Lands #122 that supports a population of **Clinton's wood fern** (*Dryopteris clintoniana*), a plant species of concern. Clinton's wood fern is found in swamps and wet woods in northeastern United States and Canada (Gleason and Cronquist 1991). In Pennsylvania, this is a rare plant associated with red maple swamps and other swampy woods (Rhoads and Block 2000). This plant hybridizes with evergreen wood fern (*Dryopteris intermedia*) and marginal wood fern (*Dryopteris marginalis*).

This site is a maturing northern hardwood forest with a canopy dominated by black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula allegheniensis*), and hemlock (*Tsuga canadensis*). The rich herbaceous layer is dominated by spreading Jacob's ladder (*Polemonium reptans*), dewdrop (*Dalibarda repens*), jack-in-the-pulpit (*Arisaema triphyllum*), false Solomon's seal (*Smilacina racemosa*), and Enchanter's nightshade (*Circaea lutetiana*).

soft-leaved sedge
photo source: PHNP

Threats and Stresses

This site is currently managed by the Pennsylvania Game Commission. They have fenced the center of the forest for protection against deer browse. It is apparent in areas that are not fenced that deer browse is a significant threat to the herbaceous plant layer. There are also occurrences of multiflora rose (*Rosa multiflora*) and other invasive exotic species throughout the game land.

Recommendations

Continued deer management by the Game is Commission is recommended. Monitoring and removal of invasive species from this area is also advised. Periodic monitoring of Clinton's wood fern is desirable.

highbush cranberry
Photo source: USDAPlants, Herman

Koochogey Wetlands BDA – *Exceptional Significance*

This site is delineated around the main wetland complex that occupies the northern portion of State Game Land #122. Lying between the watershed divide of Oil Creek and Muddy Creek, this area supports a wide diversity of wetland types. Seeps, originating from northern and southern slopes, define the extent of the wetland. Glacial deposits rich in limestone within these hills enrich the water flowing from the seeps. These seeps influence the outer edges of the wetland and create areas of high pH, giving way to unique plant species and communities.

There are three areas in the wetland complex that should be recognized. The southern portion, at the base of the slope, consists largely of partially shaded seepage areas and of areas dominated by hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and speckled alder (*Alnus rugosa*). Locally unique habitats support five plant species of concern: **lesser panicled sedge** (*Carex diandra*), **soft-leaved sedge** (*C. disperma*), **marsh bedstraw** (*Galium trifidum*), **Clinton's wood fern** (*Dryopteris clintoniana*), and **bog bluegrass** (*Poa paludigena*). The bog bluegrass in this wetland represents one of the best populations known in the state.

The central wetland area supports one of the rarest natural communities in Pennsylvania, **a buckthorn sedge (*Carex interior*) - golden ragwort fen**, as well as a mix of seepage wetland habitats. The area, marked by sphagnum moss (*Sphagnum* sp.) hummocks, is covered in sedges including **prairie sedge** (*Carex prairea*), **lesser panicled sedge** (*C. diandra*), and **soft-leaved sedge** (*C. disperma*), all species of concern. Other plants of conservation concern located among the seepage flats and throughout the fen include **rush aster** (*Aster borealis*), **hooded lady tresses** (*Spiranthes romanzoffiana*), **thin-leaved cotton-grass** (*Eriophorum viridicarinatum*), **bog bluegrass** (*Poa paludigena*), **matted spike-rush** (*Eleocharis intermedia*), **robust smartweed** (*Polygonum robustius*), and **highbush cranberry** (*Viburnum trilobum*). Scattered shrubs throughout the fen are alder-leaved buckthorn (*Rhamnus alnifolia*), and **autumn willow** (*Salix serissima*), a species of concern, as well as speckled alder (*Alnus rugosa*) and chokeberry (*Aronia* sp.).

The northern part of the wetland contains a pond dominated by creeping manna-grass (*Glyceria acutiflora*) surrounded by sphagnum moss (*Sphagnum* spp.) kettle flats. Marked by high shrub diversity, this area contains winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), pussy willow (*Salix discolor*), witherod viburnum (*Viburnum cassinoides*), and nannyberry (*Viburnum lentago*). Moving away from the central wetland, shrubs give way to a hemlock-mixed hardwood savannah swamp. Common species include Eastern hemlock *(Tsuga canadensis),* red maple *(Acer rubrum),* yellow birch *(Betula allegheniensis),* white pine (*Pinus strobus*), and black ash (*Fraxinus nigra*).

This section of the wetland also contains habitat for the **black dash** (*Euphyes conspicuus*), a butterfly in the skipper family. This species of concern is most often found in boggy marshes and wet meadows where there is uptight sedge (*Carex stricta*), the larval food plant for the black dash.

Threats and Stresses

Most of this wetland complex falls within SGL #122 and is protected from development. Any activity that would alter water quality or the hydrology, such as flooding of proximate impoundments, gravel extraction, and beaver activity, would impact these plants and communities of special concern. Eventual succession to full canopy may pose a threat to the vitality of some plant occurrences throughout the wetland.

Recommendations

Game officers are aware of the communities present on this site, though a detailed report of threatened and endangered plants should be submitted to aid in proper management. Periodic monitoring of plant populations

and the general health of the community is recommended. If succession to other community types begins to threaten existing populations, a management plan to protect these plants should be developed.

Navy Run Tributary Wetland BDA - *High Significance*

This BDA centers around a tributary to Navy Run which supports a plant species of concern, **red currant** (*Ribes triste*). This plant is known to grow in wet, rocky woods and swamps and is considered threatened in Pennsylvania, although it is secure across its full range. In this case, the plants are growing in a moist hemlock northern hardwoods forest dominated by eastern hemlock (*Tsuga canadensis*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*) and sugar maple (*Acer saccharum*). Black ash (*Fraxinus nigra*) and black willow (*Salix nigra*) are common within the forests along Navy Run. Understory species within this community include the canopy dominants plus winterberry (*Ilex verticillata*), juneberry (*Amelanchier arborea*), spicebush (*Lindera benzoin*), and witch hazel (*Hamamelis virginiana*). Herbs common in this community are wrinkled-leaf goldenrod (*Solidago rugosa*), agrimony (*Agrimonia gryposepala*), golden saxifrage (*Chrysosplenium americanum*), a sedge (*Carex bromoides*), downy willow herb (*Epilobium coloratum*), false-violet (*Dalibarda repens*), Canada mayflower (*Maianthemum canadense*), wood sorrel (*Oxalis montana*) and rough-leaved goldenrod (*Solidago patula*). The area also includes a section of stream and surrounding area that has been impacted by beaver damming and flooding.

Threats and stresses

Habitat conditions at this site are good and disturbance is low. This section of stream valley is surrounded by active and abandoned agricultural fields and pastures, these areas may invite invasive species into the site or lead to future disturbance. Removal of trees and opening of the canopy with the BDA would more directly impact the community and plant species at this site. Beaver activity within the area may change the immediate landscape, having a larger impact on the forest communities at the site than on the red currant population.

Recommendations

Generally, maintaining the current conditions at the site would be a pragmatic approach to conservation of the area. Timbering or use of the forested area within the BDA for new or expanded agricultural activity could change the conditions sufficiently to negatively impact the natural communities and species of concern. Periodic monitoring for invasive species is recommended.

Summerhill Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Creek at Dicksonburg BDA			*High Significance*		
Brook stickleback (*Culaea inconstans*) – Fish	G5	S3	PC	2003	E
American brook lamprey (*Lampetra appendix*) – Fish	G4	S3	PC	2003	E
Conneaut Marsh-Geneva Marsh LCA					

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area (IBA) and Cussewago Bottom IBA Conservation Regions

Conneaut Creek at Dicksonburg

photo source: PNHP

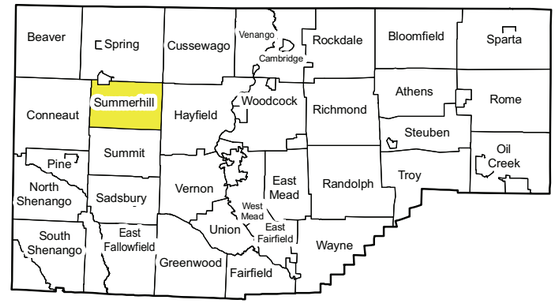
Crawford County
Natural Heritage Inventory

Summerhill Township

Biological Diversity Area:
Conneaut Creek at Dickonsburg

Landscape Conservation Area:
Conneaut Creek Complex

Public Land:
None



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

Conneaut Creek at Dicksonburg BDA

Conneaut Marsh Complex

Conneautville
Rundell
Dantown
Dicksonburg
Norrisville
Guntown Rd
Smith Rd
Hilltop Rd
Thatcher Rd
Hickernell Rd
Rundeltown Rd
Norrisville Rd
Washington St
King Rd
Blue Falls Rd
Center Rd
Rundelltown Rd
Main St
Smith Rd
Mulberry Ln
Vendel Rd
Oak St
Inlet Rd
Morris Rd
Carpenter Rd
Abbot Rd
Canal Rd
Crozier Rd
Carr Rd
Locke Rd
Turkey Track Rd
Shermansville Rd
Genter Rd
Conneautville Rd
Fish Rd
Wiseman Rd
Foster Rd
Hill Rd
Wing Rd
Woodring Rd
Dicksonburg Rd
Gaut Rd
Townline Rd
Meirshon Rd
Robinson Rd
Cole Rd
Thompson Rd
Porter Rd
Hindman Rd
Agnew Rd
Wheeler Rd
McDowell Rd
Center Rd
Gaut Rd
Cole Rd

0 0.375 0.75 1.5 Kilometers
0 0.375 0.75 1.5 Miles

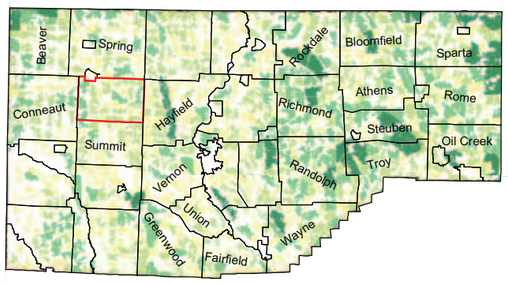
Crawford County
Natural Heritage Inventory

Summerhill Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

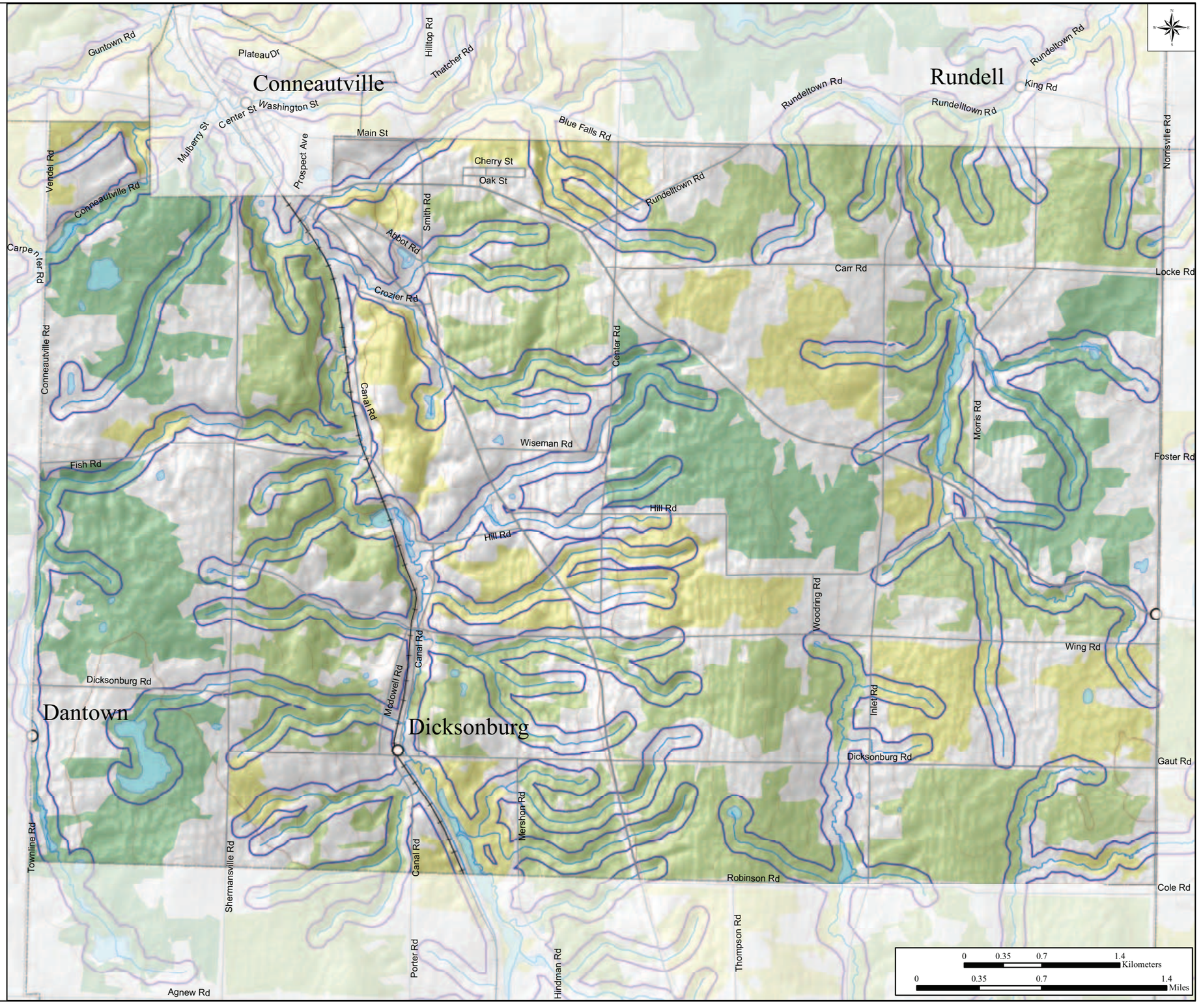
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Summerhill Township is located in central Crawford County. Forests cover more than half of the township, but similar to the rest of the county, these forest blocks have been fragmented by roads and agriculture. Agriculture contributes 40% to the land use in Summerhill Township. Conneaut Creek, along with its many tributaries, are the major streams flowing through this township. Many of these streams are flowing through the forested areas, which provide a good filter to remove pollutants before they enter into the streams. The old Beaver and Erie Canal crosses Summerhill Township through the Conneaut Creek Valley. The landscape is rolling and hilly throughout the Conneaut Creek Valley. It levels out in the eastern half of the township where the headwaters of Rundelltown Creek flow north eventually draining into Cussewago Creek. Pine Creek and Inlet Run, in the southeast, are the main tributaries to Conneaut Lake.

Conneaut Creek at Dicksonburg BDA – *High Significance*

This section of Conneaut Creek, starting slightly north of Dicksonburg and flowing south approximately 2 miles (3.2 kilometers), supports a high diversity of aquatic organisms including two fish species of concern, **brook stickleback** (*Culaea inconstans*) and **American brook lamprey** (*Lampetra appendix*). Other fish species found in this stretch of stream include members of the perch family, (Percidae: *Etheostoma nigrum*, *E. caeruleum*, *E. flabellare*, *Percina maculata*, *P. caprodes*), the minnow family (Cyprinidae: *Campostoma anomalum*, *Luxilus cornutus*, *Nocomis micropogon*, *Notropis rubellus*, *N. buccatus, Rhinichthys atratulus*, *Semotilus atromaculatus*), and sucker family (*Catostomidae*: *Catostomus commersoni*, *Hypentelium nigricans*), and rock bass (*Ambloplites rupestris*).

The two fish species of concern found within this BDA require cool, clear water creeks that are typically spring fed. The brook stickleback prefers shallow areas with emergent vegetation and a sandy or muddy stream bottom for reproduction (NatureServe 2006). American Brook lampreys utilize two specific habitats. Spawning adults require clear, high-gradient riffles with gravel and sand. Ammocoetes (larval lamprey) need low-gradient streams with bottoms consisting of organic debris and sand for their development (Mundahl 1999). Although these fish exploit different instream habitats, both species are intolerant to turbidity and damming.

The core area of this BDA is buffered to capture riparian areas that influence the hydrology and temperature of the stream. Most of the areas surrounding the stream are forested. The north is more heavily forested than the south, which contains some open areas adjacent to pasture and cropland. The riparian forest canopy is comprised of maples (*Acer rubrum*, *A. saccharum*), black cherry (*Prunus serotina*), and slippery elm (*Ulmus rubra).* The understory contains green ash (*Fraxinus pennsylvanica*) and black willow (*Salix nigra*). There are scattered occurrences of the invasive multiflora rose (*Rosa multiflora*). Sensitive fern (*Onoclea sensibilis*), bulbous buttercup (*Ranunculus bulbosus*), crooked-stemmed aster (*Symphyotrichum prenanthoides*), deer tongue grass (*Panicum clandestinum*), and wild geranium (*Geranium maculatum*) make up the understory. Running along the core area of this BDA to the west is the Lake Erie extension railroad. The supporting watershed consists of forested and agricultural land, most of which is oldfield or pastureland.

Threats and Stresses

Both of the fish species of concern are extremely intolerant to changes in hydrology such as sedimentation, damming, and increases in temperature. Any stream projects that would alter the existing conditions would be detrimental to these populations. Runoff from surrounding agricultural lands and loss of forest cover may also contribute to changes in the natural nutrient cycling within the stream, which would be detrimental to the extant populations of aquatic organisms. The railroad adjacent to the stream produces edge effects along the creek, thereby altering microhabitats within the stream. Some invasive species associated with disturbed areas are present throughout the riparian corridor, including multiflora rose (*Rosa multiflora*), curly dock (*Rumex crispus*), and dame's rocket (*Hesperis matronalis*).

Recommendations

Preserving forested stream buffers is a key factor to maintaining high water quality and the continued success of these species. Restoring forested buffers in agricultural lands is recommended and programs such as the Conservation Reserve Program (CRP) can aid landowners in the reestablishment of riparian corridors on farmland. Riparian buffers reduce the effect of runoff and sedimentation and also provide cover for aquatic species and maintain even temperatures throughout the channel. Landowners may also aim to apply proper management of agricultural nutrients to avoid polluting the stream. Road development and other construction activities should be kept away from this creek to protect aquatic and streamside habitat. Additionally, any damming, whether human or beaver influenced, should be limited to sustain the aquatic diversity of this creek.

Summit Township

	PNHP Rank* Global	State	State Status	Last Seen	Quality**
NATURAL HERITAGE AREAS:					
Conneaut Creek at Dicksonburg BDA			*High Significance*		
see Summerhill Township					
Conneaut Lake BDA			*Exceptional Significance*		
see Sadsbury Township					
Harmonsburg Wetlands BDA			*Exceptional Significance*		
Cuckoo flower (*Cardamine pratensis* var. *palustris*) – Plant	G5T5	S1	PE	1994	E
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1997	E
Northeastern sedge (*Carex cryptolepis*) – Plant	G4	S1	PT	1993	C
Lesser panicled sedge (*Carex diandra*) – Plant	G5	S2	PT	2006	E
Slender sedge (*Carex lasiocarpa*) – Plant	G5	S3	PR	1993	B
Prairie sedge (*Carex prairea*) – Plant	G5	S2	PT	1993	B
Twig rush (*Cladium mariscoides*) – Plant	G5	S2	PE	1993	E
Slender spikerush (*Eleocharis elliptica*) – Plant	G5	S2	PE	1994	B
Thin-leaved cotton-grass (*Eriophorum viridicarinatum*) – Plant	G5	S2	PT	1981	E
Labrador marsh bedstraw (*Galium labradoricum*) – Plant	G5	S1	PE	1994	E
Swampfly honeysuckle (*Lonicera oblongifolia*) – Plant	G4	S1	PE	1993	E
Autumn willow (*Salix serissima*) – Plant	G4	S3	PT	1993	E
Rush aster (*Symphyotrichum boreale*) – Plant	G5	S1	PE	1993	B
Oligotrophic glacial kettlehole bog – Natural Community	GNR	S3	-	1985	B
Poison sumac-red cedar-bayberry fen – Natural Community	GNR	S1	-	1995	B
Meadville Junction BDA			*Exceptional Significance*		
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1993	E
Soft-leaved sedge (*Carex diandra*) – Plant	G5	S2	PT	1993	C
Downy willow-herb (*Epilobium strictum*) – Plant	G5	S3	PE	1993	C
Swampfly honeysuckle (*Lonicera oblongifolia*) – Plant	G4	S1	PE	1993	E
Bog bluegrass (*Poa paludigena*) – Plant	G3	S3	PT	1993	B
A swamp smartweed (*Polygonum setaceum* var. *interjectum*) – Plant	G5T4	S2	PE	1997	E
Autumn willow (*Salix serissima*) – Plant	G4	S2	PT	1993	B
Black tern (*Chlidonias niger*) – Bird	G4	S1B	PE	1997	B
Conneaut Marsh-Geneva Marsh LCA					
see page 53 for descriptions of LCAs					
Pymatuning Wetland Complex LCA					
see page 53 for descriptions of LCAs					

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

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

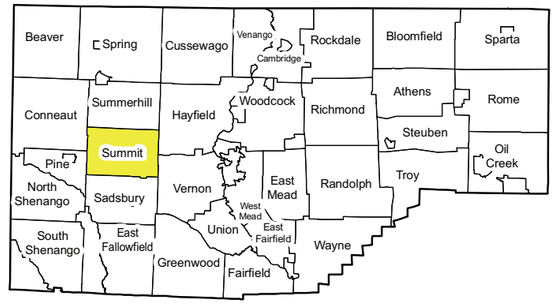
OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area

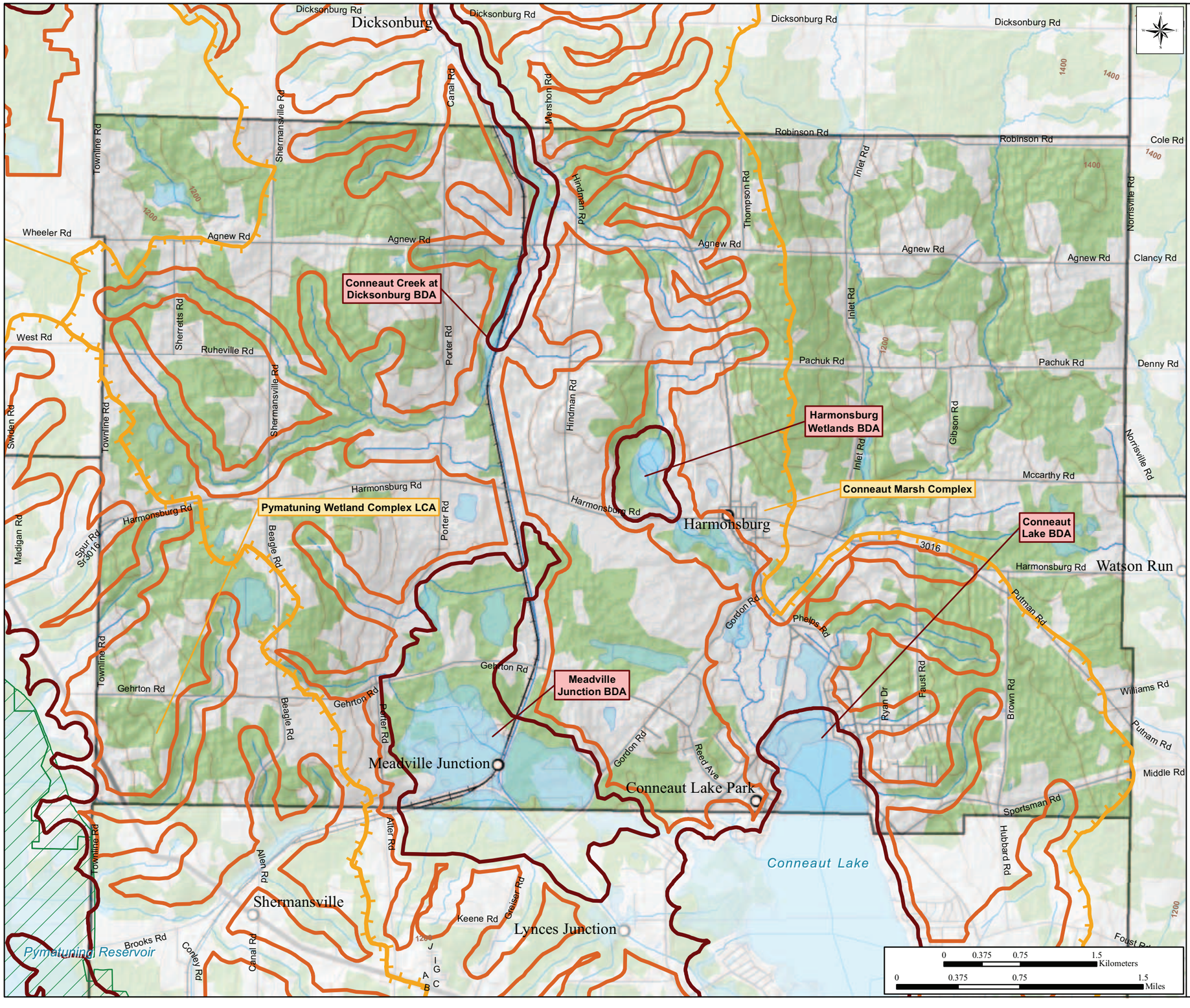
Crawford County
Natural Heritage Inventory
Summit Township

Biological Diversity Area:
- Conneaut Creek at Dickonsburg
- Conneaut Lake
- Harmonsburg Wetlands
- Meadville Junction

Landscape Conservation Area:
- Pymatuning Wetland Complex
- Conneaut Marsh Complex

Public Land:
- None





Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

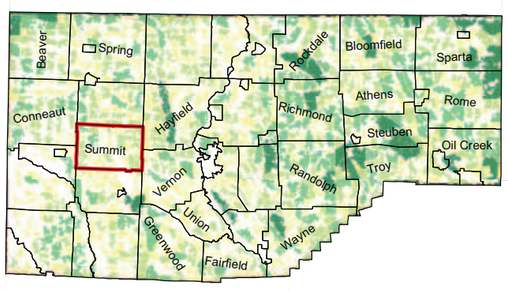
Crawford County
Natural Heritage Inventory

Summit Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land

Dicksonburg Rd
Townline Rd
Canal Rd
Mershon Rd
Inlet Rd
Robinson Rd
Cole Rd
Thompson Rd
Wheeler Rd
Agnew Rd
Norrisville Rd
Sherretts Rd
West Rd
Ruheville Rd
Shermansville Rd
Hindman Rd
Pachuk Rd
Denny Rd
Mccarthy Rd
Harmonsburg
Plum St
Harmonsburg Rd
Gibson Rd
3016
Spur Rd
Beagle Rd
Townline Rd
Phelps Rd
Putman Rd
Faust Rd
Williams Rd
Gehrton Rd
Gordon Rd
Ryan Dr
Brown Rd
Putnam Rd
Reed Ave
Four J Dr
Shore Dr
Elm St
Middle Rd
Porter Rd
Meadville Junction
Henry St
Lakeland Dr
Sportsman Rd
Conneaut Lake Park
Lake St
Harper Ln
Allen Rd
Greiser Rd
Silver St
Alter Rd
Hubbard Rd
Shermansville
Keene Rd
Lynces Junction
Brooks Rd

0 0.35 0.7 1.4 Kilometers
0 0.35 0.7 1.4 Miles

Summit Township is centrally located in the western portion of the county. Approximately 43% of the land is used for agriculture, which is primarily row crops, and about half of the township is dominated by deciduous forest. Numerous headwater streams drain through rolling glacial valleys that support unique forested wetland communities. Water quality of these wetlands and stream is quite good despite the amount of land being used for agriculture. Several small tributaries in the southeastern corner of the township feed Conneaut Lake, Pennsylvania's largest natural lake. The outlet to Conneaut Lake is surrounded by a large, extensive emergent marsh, locally known as Geneva Marsh. This area is managed by the PA Game Commission as State Game Lands #213 and has been designated as an Important Bird Area (IBA) by the Audubon Society.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Conneaut Creek at Dicksonburg BDA – *High Significance*

This Natural Heritage Area is discussed in Summerhill Township.

Conneaut Lake BDA – *Exceptional Significance*

This Natural Heritage Area is discussed in Sadsbury Township.

cuckoo flower
photo source: Kenneth J. Systma

Harmonsburg Wetlands BDA – *Exceptional Significance*

Located just west of Harmonsburg along the inlet to Clearwater Lake is a unique wetland community once known as Brown's Cranberry Marsh. Around 1900, this area was mined for marl, an underlying calcium carbonate that has been formed by decaying plant material (McKillen 2001). The process of marl extraction has created deep mine pits that are scattered throughout the wetland. The marl underpinnings have mineralized the soils of this wetland, creating habitat conditions for a variety of plant species similar to those of the oak opening wetlands of western Ohio. The central wetland, or fen, is surrounded by a white pine-mixed hardwood forest. Included in this BDA are another small fen and numerous seep communities. The fen, seeps, vernal pools, and forested wetlands that comprise this site are important habitat to many wildlife species. There are a few historical records of federally listed threatened plants and animals inhabiting this fen. The watershed feeding the wetland complex contains a mix of forested and agricultural lands.

The larger, southern core of this site is an open, acidic sedge-dominated (*Carex* sp.) peatland with intermittent seeping areas. Poor fens are low to weakly minerotrophic communities characterized by floating sedge mats and acidic water (Smith 1991). This community is an uncommon type restricted to glaciated regions in Pennsylvania. Common plants throughout this wetland include cattails (*Typha latifolia*), cinnamon fern (*Osmunda cinnamomea*), scattered shrubs such as winterberry (*Ilex verticillata),* highbush blueberry (*Vaccinium corymbosum*), and white pine (*Pinus strobus)*. Sphagnum (*Sphagnum* spp.) hummocks are common throughout. There are many fen indicative plants that are also of conservation concern. Those present in this wetland include:

several sedge species (*Carex lasiocarpa*, *C. prairea*, *C. cryptolepis*, *C. diandra*, *C. alata*), **rush aster** (*Symphyotrichum boreale*), **a swamp smartweed** (*Polygonum amphibium* var. *stipulaceum*), **labrador marsh bedstraw** (*Galium labradoricum*), **cuckooflower** (*Cardamine pratensis* var. *palustris*), **twig rush** (*Cladium mariscoides*), **slender spike-rush** (*Eleocharis elliptica*), **autumn willow** (*Salix serissima*), and **swamp-fly honeysuckle** (*Lonicera oblongifolia*). Just north of this marsh is a population of firm aster (*Symphyotrichum firmum*), a plant that was once considered endangered in the state that has recently been de-listed and is currently on the PNHP watch list.

Threats and Stresses

Non-point sources pollution from surrounding agricultural lands and residential areas pose the biggest threat to this wetland complex. Due to the proximity to a major road, invasive species that disperse along road corridors may also threaten native plant communities in the lower wetland complex. Succession of open wetland areas into forest may alter habitat conditions for some endangered plants requiring open canopy cover. There are scattered clumps of an invasive honeysuckle (*Lonicera morrowii*) throughout the wetland.

Recommendations

Landowners should be informed of the rare species and community types occurring at this location. Proper management of farm nutrients and chemicals is essential to maintain the health of the wetland. Road workers should also be informed of the rare species here and avoid spraying and mowing adjacent to the forested border of the wetland. Periodic monitoring and removal of invasive species is recommended. If successional growth begins to threaten rare plant occurrences, removal of larger woody species may be necessary.

Meadville Junction BDA – *Exceptional Significance*

firm aster
photo source: Kenneth J. Sytsma

This site consists of privately owned wetland areas around Meadville Junction, the junction of the old Bessemer and Lake Erie railroads. The railroad lines, coming north from Greenville in Mercer County, once lead to Conneaut Lake Park to the east and Meadville to the northeast. Wetlands persist to the north, northwest, and southeast of the Junction. These wetlands, part of the Conneaut Outlet watershed, contain a hummocky raised fen that gradually opens up to a marsh, supporting many plants of special concern.

The northern most extent of the wetland is a successional shrub swamp with outer lying mixed hardwood forest consisting of white pine (*Pinus strobus*), birch (*Betula* sp.), and tupelo (*Nyssa* sp.). Intermittent larch (*Larix laricina*) and buckthorn (*Rhamnus* sp.) seeps traverse the open **autumn willow** (*Salix serissima*) shrub swamp which gives way to a herbaceous marsh clearing towards the southern part of the wetland. This area harbors several plant species of concern such as **swamp-fly honeysuckle** (*Lonicera oblongifolia*), **downy willow-herb** (*Epilobium strictum*), **bog bluegrass** (*Poa paludigena*), and **broad-winged sedge** (*Carex alata*). Additionally, there are several known populations of firm aster (*Symphyotrichum firmum*) throughout this wetland. Once considered endangered in the Commonwealth, its status was recently upgraded to Pennsylvania Rare and it is currently on the PNHP Watch List.

The central wetland, to the north of the railroad junction, contains intermittent seeps, which are areas of visible surface flow, covered by a sedge-dominated herbaceous layer. This community, classified as a **buckthorn-sedge-golden ragwort fen**, is one of Pennsylvania's rarest community types (Fike 1999). It is a type of peat-forming wetland found in the glaciated northwest region. Fens, unlike bogs, receive water from groundwater or upslope drainage, so they are less acidic and can support a higher diversity of plants and animal communities (Bedford and Godwin 2003; EPA 2006). This wetland contains several plant species of concern including **autumn willow** (*Salix serissima*), **broad-winged sedge** (*Carex alata*), **lesser panicled sedge** (*Carex diandra*),

downy willow-herb (*Epilobium strictum*), and **a swamp smartweed** (*Polygonum setaceum* var. *interjectum*). Common plants found in this fen include many willows (Salix sp.) and sedges (*Carex* sp.), red-osier dogwood (*Cornus sericea*), marsh fern (*Thelypteris palustris*), highbush blueberry (*Vaccinium corymbosum*), alder-leaved buckthorn (*Rhamnus alnifolia*), and common cattails (*Typha latifolia*). The southern portion of the wetland gives way to a more extensive marsh system that continues on the other side of the canal.

The marsh community, located in the southeast corner of the wetland, supports a breeding pair of **black terns** (*Chlidonias niger*). Black terns, a member of the gull family, are considered critically imperiled in Pennsylvania. Throughout the state, breeding populations have been declining since the 1930s and 1940s (Shuford 1999). These birds nest in freshwater marshes and wetlands with emergent vegetation (Naugle, 2004). This portion of the wetland is dominated by emergent aquatic plants such as cattails (Typha spp.), bulrushes (*Scirpus* spp.), and spatterdock (*Nuphar* spp.).

This wetland complex was not surveyed for other animal species other than birds. However, it does represent a potential habitat for aquatic insects, such as dragonflies and damselflies, as well as amphibians. These species contribute to the biological diversity of wetland habitat types and surrounding upland areas.

The surrounding landscape supporting this core wetland complex is predominantly used for agriculture.

Threats and Stresses

As true with any wetland system, hydrologic alteration, pollution, and conversion to agriculture or development are common threats to the Meadville Junction complex (EPA 2001; Heimlich et al 1998). Given the agricultural context, pollution of the wetland via runoff could present a problem to the water quality of this system. Furthermore, this wetland is currently not protected from development, draining or filling, all of which would eliminate these communities and species of conservation concern.

The lower portion of the marsh, which supports breeding black terns, is an extremely important habitat due to the current population trend. These birds tend to be most vulnerable to stochastic events such as human disturbance, habitat loss, and storm events (Shuford 1999).

Recommendations

The core of this site could benefit from intermediate disturbance such as infrequent clearing of larger woody plants by the property owner. Without management, this area will most likely succumb to succession and develop more canopy cover. Overgrowth and shading by woody species would pose a threat to many of the rare plants that are found here. Areas used by black terns for breeding, primarily the southeastern portion of the marsh, should be protected from disturbance, specifically during the breeding months of May and June.

Best Management Practices (BMPs) are recommended for the surrounding agricultural lands to prevent water pollution. Enrollment in the Wetlands Reserve Program (WRP) is also an option for the landowner. This program, implemented through the Natural Resources Conservation Service (NRCS), offers technical and financial support to landowners interested in restoring, protecting, and enhancing wetlands on their property (NRCS 2004). Additional information on this program can be obtained from the NRCS website (http://www.pa.nrcs.usda.gov/programs/WRP/).

Troy Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			

NATURAL HERITAGE AREAS:

Koochogey Wetland BDA — *Exceptional Significance*

see Steuben Township

French Creek LCA

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area Conservation Region

TROY TOWNSHIP

Troy Township, which borders Mercer County in the southeastern portion of the county, covers a large portion of the Sugar Creek watershed including Sugar Creek, the East Branch of Sugar Creek, and Little Sugar Creek. The tributaries of Sugar Creek drain the township by steep valleys in a southerly fashion. Agricultural lands, predominantly in row crops, lie above the rich stream valleys. About 65% of the township is forested with several large forest blocks in the western portion of the township including the area within State Game Lands #69 and along Little Sugar Creek. A large wetland complex in the northeast corner is contained within State Game Lands #122.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county.

Koochogey Wetland BDA

This Natural Heritage Area is discussed under Steuben Township.

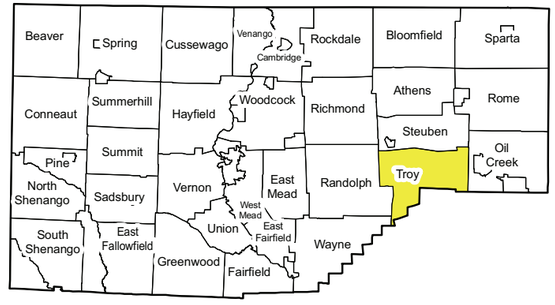
Crawford County
Natural Heritage Inventory

Troy Township

Biological Diversity Area:
State Game Land 69

Landscape Conservation Area:
French Creek

Public Land:
State Game Land 122
State Game Land 69



Legend

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

Pennsylvania Natural Heritage Program

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

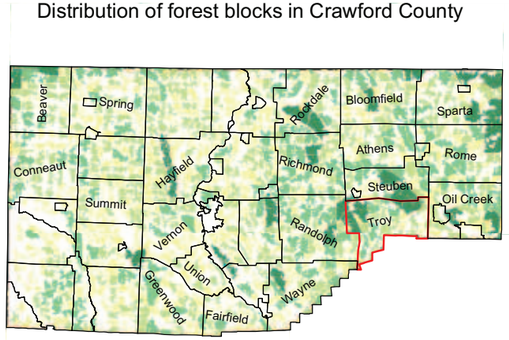
Crawford County
Natural Heritage Inventory

Troy Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

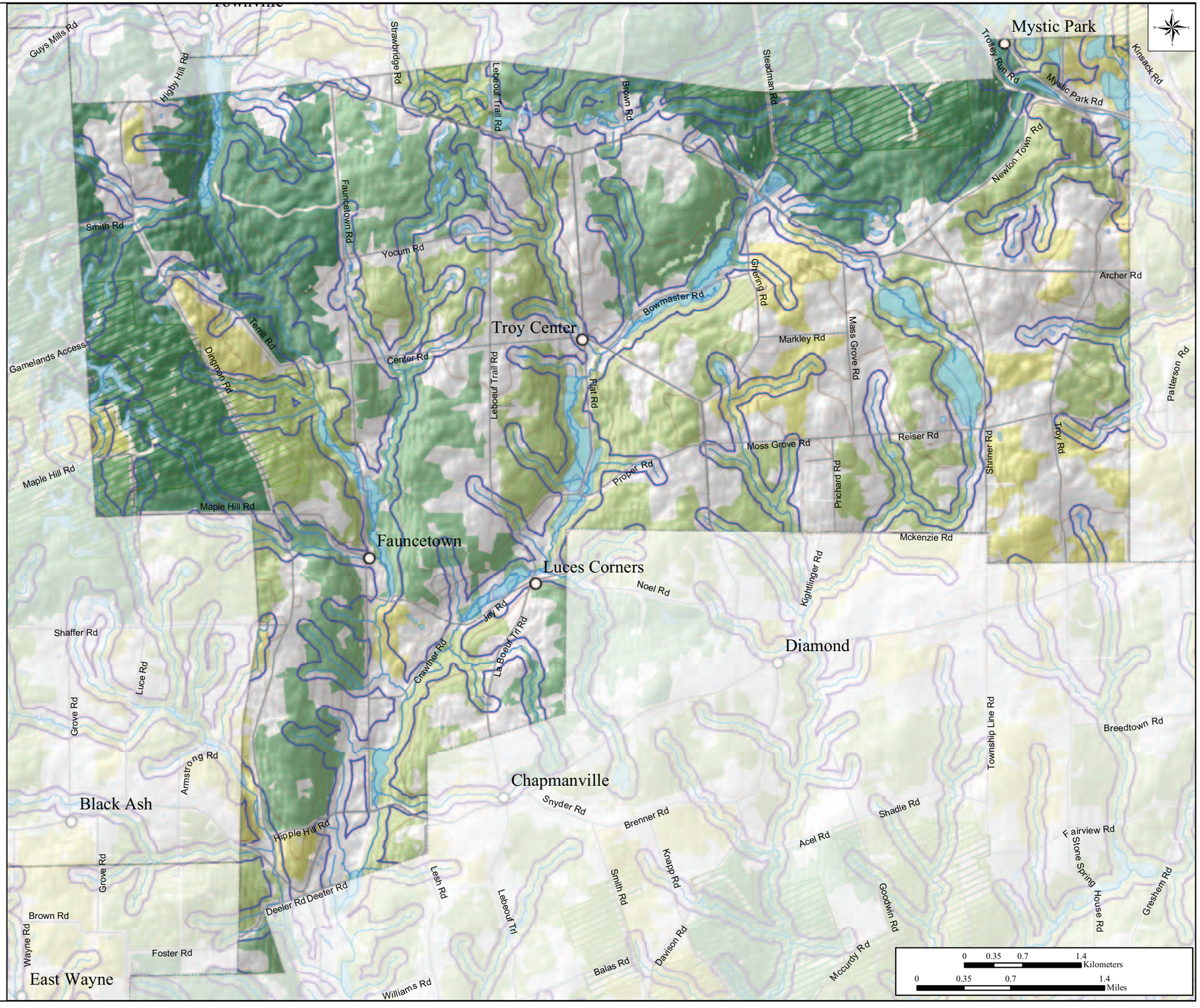
PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Union Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Conneaut Creek-French Creek Confluence BDA		*High Significance*			
Cattail sedge (*Carex typhina*) – Plant	G5	S2	PE	1998	E
Bowfin (*Amia calva*) – Fish	G5	S2S3	PC	1999	E
River redhorse (*Moxostoma carinatum*) – Fish	G4	S3S4	PC	1999	E
Conneaut Marsh Complex Central BDA		*Exceptional Significance*			
see Greenwood Township					
Conneaut Marsh Complex North BDA		*Exceptional Significance*			
see Vernon Township					
Conneaut Marsh Complex-South BDA		*Exceptional Significance*			
Cattail sedge (*Carex typhina*) – Plant	G5	S2	PE	1998	E
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Pied-billed grebe (*Podilymbus podiceps*) – Bird	G5	S3BS4N	-	1996	E
Prothonotary warbler (*Protonotaria citrea*) – Bird	G5	S2S3B	-	1996	E
Sensitive species of concern***	-	-	-	2005	AB
French Creek BDA		*Exceptional Significance*			
see Woodcock Township					
Conneaut Marsh-Geneva Marsh LCA					
see page 53 for descriptions of LCAs					
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area

Crawford County
Natural Heritage Inventory
Union Township

Biological Diversity Area:

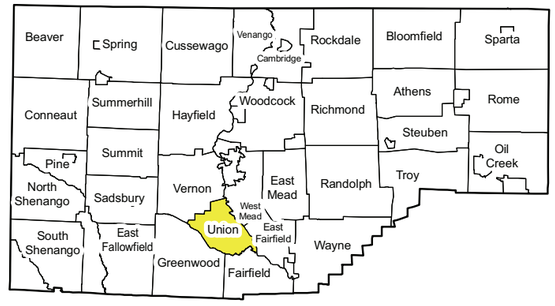
Conneaut Marsh Complex Central
Conneaut Marsh Complex North
Conneaut Marsh Complex South
Conneaut Creek - French Creek Confluence
French Creek

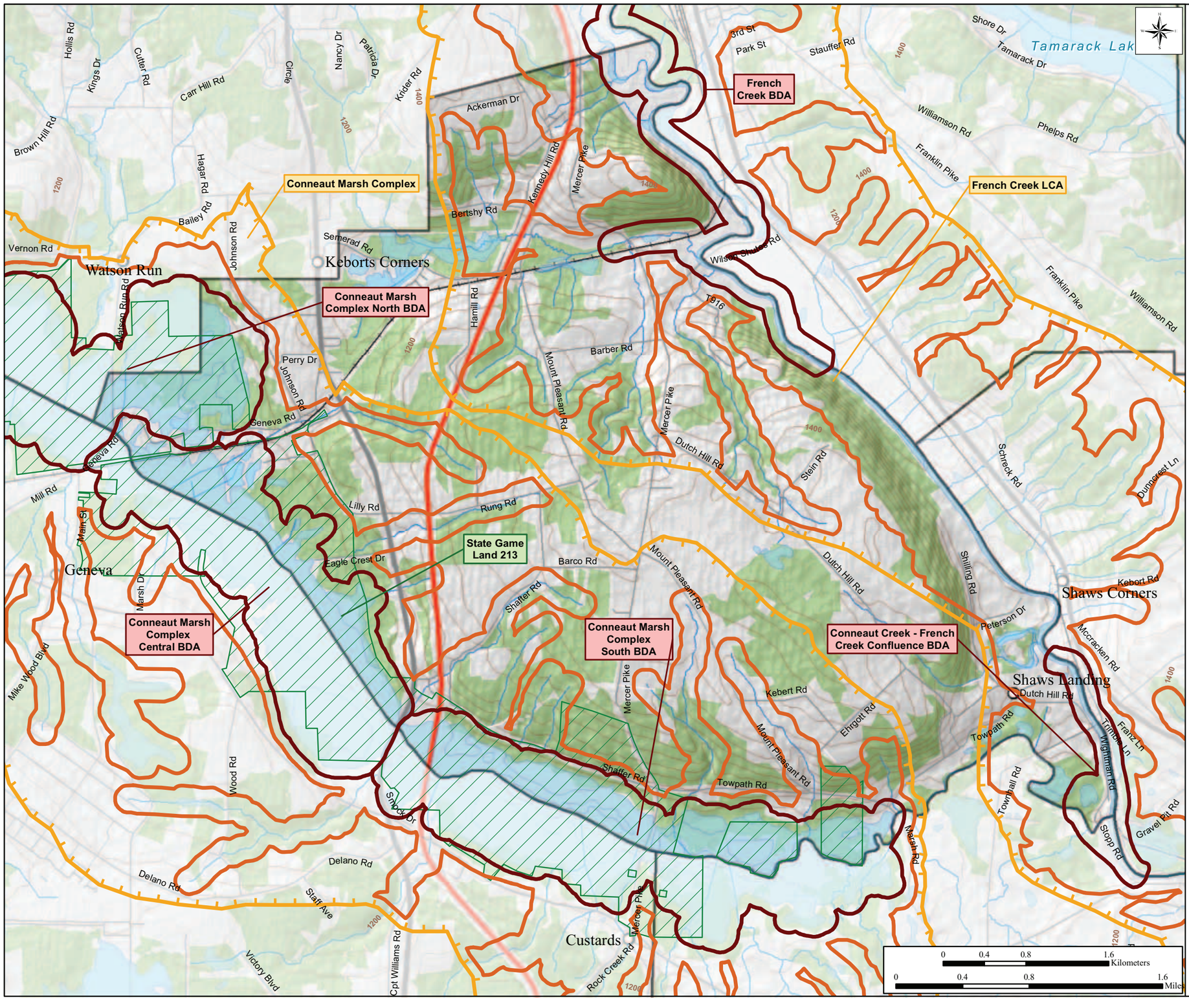
Landscape Conservation Area:

French Creek
Conneaut Marsh Complex

Public Land:

State Game Land 213





Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

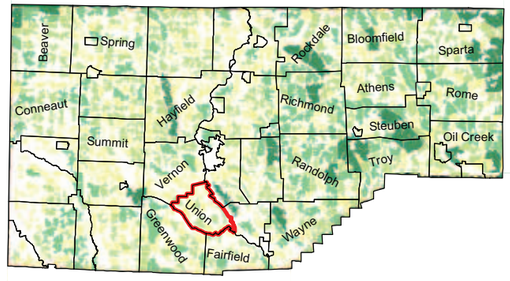
Crawford County
Natural Heritage Inventory

Union Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land

Keborts Corners
Watson Run
Geneva
Shaws Corners
Shaws Landing
Patricia Dr
Circle
Nancy Dr
Krider Rd
Kings Dr
Cutler Rd
Carr Hill Rd
Hagar Rd
Watson Run Rd
Bailey Rd
Ackerman Dr
Kennedy Hill Rd
Mercer Pike
Southwood Dr
Bertshy Rd
Semerad Rd
Lakeview Dr
Hamill Rd
Perry Dr
Johnson Rd
Barber Rd
Geneva Rd
Lilly Rd
Main St
Rung Rd
Berry Dr
Shaffer Rd
Mount Pleasant Rd
Eagle Crest Dr
Barco Rd
Marsh Dr
Dutch Hill Rd
Hafer Rd
Kebert Rd
Wood Rd
Smock Dr
Autumn Wood Dr
Delano Rd
Staff Ave
Towpath Rd
Ehrgott Rd
Townhall Rd
Fairfield Acres
Marsh Rd
Stoopp Rd
Wightman Rd
Trimble Ln
Mccracken Rd
Old Creek Ln
Shilling Rd
Peterson Dr
Oak St
Schreck Rd
Heckman Rd
Wilson Shutes Rd
T916
Stein Rd
3rd St
Park St
Stauffer Rd
Tamarack Dr
Williamson Rd
Franklin Pike
Phelps Rd

0 0.25 0.5 1 Kilometers
0 0.25 0.5 1 Miles

Union Township, located in south central Crawford County, is bounded by French Creek to the east and Conneaut Outlet to the south. The land use in this township is mainly split between forest and agriculture, with each making up about 40% of the total land use. The forests in this township have been fragmented into small forest blocks by roads and agriculture. Row crops are the predominant form of agriculture. The woody wetlands surrounding Conneaut Outlet, which make up approximately 10% of the land cover of Union Township, provide habitat to many wetland species. Conneaut Marsh, locally known as Geneva Marsh, is contained within State Game Lands #213 and has been designated an Important Bird Area (IBA) due to the different wetland communities that provide excellent breeding and wintering grounds for a number of avian species. This wetland complex comprises the largest emergent marsh in the Commonwealth.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Conneaut Creek-French Creek Confluence BDA – *High Significance*

This BDA encompasses the wetland area at the confluence of Conneaut Outlet and French Creek, supporting a plant species of concern. **Cattail sedge** (*Carex typhina*) is a rare plant of wet woods, swamps, and calcareous bottomlands (Rhoads and Block 2000). This sedge is rare throughout the wetland, only documented growing along the edge of a vernal pool, located within a swampy forest. The supporting landscape includes the watershed that directly feeds the wetland. The landscape is a matrix of wooded and agricultural areas. **Bowfin** (*Amia calva*) and **river redhorse** (*Moxostoma carinatum*), both fish species of concern, were located in the deep, muddy water of French Creek. Bowfins are typically found in vegetated, slow-moving backwater and oxbow lakes. The river redhorse is usually found in larger creeks and rivers, but young fish may be found in backwater areas.

Threats and Stresses

This wetland and vernal pool would be highly affected by development on the floodplain of the confluence. Any changes in the hydrology of the area, such as damming, would eliminate the habitat for this plant. Water pollution from agricultural lands within the supporting landscape may also threaten the health of the wetland.

Recommendations

Draining, filling or permanently flooding wetlands should be prohibited. Land managers or planners responsible for French Creek should be informed of the importance of maintaining the natural hydrology of this portion of the stream. Best management practices to reduce nutrient loading and water pollution in the watershed should be applied to adjacent agricultural lands and those in the upstream watershed. Continual monitoring of the vernal pool and the cattail sedge population is recommended. **Conneaut Marsh Complex Central BDA –** *Exceptional Significance*

This Natural Heritage Area is discussed under Greenwood Township.

Conneaut Marsh Complex North BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Vernon Township.

Conneaut Marsh Complex-South BDA – *Exceptional Significance*

Conneaut Outlet leaves Conneaut Lake meandering through a series of extensive marshlands through State Game Lands #213, eventually draining into French Creek at Shaw's Landing. This marsh is locally known as Geneva Marsh. It was formed by glacial outwash and is Pennsylvania's largest freshwater marsh system. A variety of habitats, including forested wetlands, shrub-scrub wetlands, and open emergent marshes, a few oldfields, reverting forests, and mixed hardwood forests, creates a unique ecosystem that is used by a diversity of wildlife species. The entire Marsh has been designated an Important Bird Area by the Audubon Society of Pennsylvania and a BDA for the purposes of this report. This portion of the Marsh extends slightly downstream from Watson Run to Towpath Road, a little outside of Game Lands property.

Conneaut Marsh is an extremely important habitat for many migrating and resident bird species. Approximately 10,000 waterfowl use the marsh during spring and fall migration, and a number of Pennsylvania avian species of concern are known to occur within the marsh (Tautin 2004). Three bird species of conservation concern were documented in this southern section, including **pied-billed grebe** (*Podilymbus podiceps*), **prothonotary warbler** (*Protonotaria citrea*), and **common moorhen** (*Gallinula chloropus*).

This portion of the marsh is comprised of emergent wetlands dominated by spatterdock (*Nuphar* spp.), cattails (*Typha* spp.), and smartweeds (*Polygonum* spp.). A wetland plant of special concern, **cattail sedge** (*Carex typhina*) is found among the sphagnum hummocks of this marsh. This type of habitat is critical for nesting marsh birds such as common moorhens and pied-billed grebes. Pied-billed grebes prefer bodies of water with thick vegetation such as rushes, reeds, or cattails for nesting. Emergent vegetation is used for cover and anchorage for floating nests. Likewise, common moorhens nest in marshes and the edges of open water with sufficient emergent vegetation with which they build floating platform nests.

Swamp forest flats bordering sedge-dominated vernal pond flats surround the core emergent marsh. The canopy is comprised of sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), elms (*Ulmus* sp.), pin oak (*Quercus palustris*), and swamp white oak (*Quercus bicolor*). Prothonotary warblers utilize this area for nesting. Prothonotary warblers breed in wooded areas near water specifically in flooded bottomland forests. They are extremely susceptible to habitat destruction due to the specificity of their habitat requirements.

The landscape supporting this wetland complex is within the immediate watershed that feeds this marsh. The landscape contains a mix of forested and agricultural lands. Most fields are pasturelands and farmland reverting to natural conditions is present in smaller amounts.

Threats and Stresses

Conneaut/Geneva Marsh lies completely within State Game Lands #213 and is largely protected and managed by the Pennsylvania Game Commission (PGC). As with other wetlands in the area and the upstream portion of this marsh, however, invasive species establishment is a problem. Narrow-leaf cattail (*Typha angustifolia*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and multiflora rose (*Rosa multiflora*) are all present throughout the marsh. Without management of these populations, dense stands begin to form, which begin to encroach in areas of open water. The PA Game Commission is currently using a mechanical vegetation cutter to remove stands and maintain areas of open water in the marsh.

Human disturbance to nesting birds is a potential threat at this site due to the amount of birdwatchers, hikers, and hunters who frequent the gamelands. Currently, protection is given to some species during the breeding season.

Landscape changes within the watershed are potentially the most imminent threats to this ecosystem. The headwaters of the marsh is Conneaut Lake which is heavily developed and may contribute to problems associated with pollution and runoff. Currently the lake is treated with chemicals to reduce invasive aquatic plant species and Conneaut Outlet flows directly out of the lake into the marsh. Although this portion of the marsh is furthest downstream for the lake, pollution in the headwaters region can still impact the communities present here. Lastly, because the area surrounding the marsh is rich in glacial deposits, gravel mining within the watershed is a potential threat.

Recommendations

The Pennsylvania Game Commission has developed a management plan for SGL #213 with ongoing efforts in habitat management, invasive species management, and seasonal protection for nesting birds. A more active invasive species management plan is highly recommended, and an opportunity for a volunteer-based hand removal program may be an option given the large amount of visitors who enjoy the marsh for recreation. The PGC may consider working with local groups to help reduce the impacts of watershed-scale activities.

French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Woodcock Township.

Venango Township and Venango Borough

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
French Creek BDA			*Exceptional Significance*		
see Woodcock Township					
French Creek Floodplain Forest BDA			*High Significance*		
Pumpkin ash (*Fraxinus profunda*) – Plant	G4	S1	-	2001	E
Torry Run BDA			*High Significance*		
Cylindrical papershell (*Anodontoides ferussacianus*) – Mussel	G5	S2S3	-	1993	E
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area

Crawford County
Natural Heritage Inventory
Venango Township
&
Venango Borough

Biological Diversity Area:

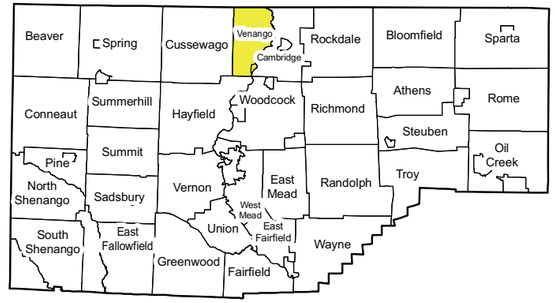
French Creek
Torry Run
French Creek Floodplain Forest

Landscape Conservation Area:

French Creek

Public Land:

None



Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

Torry Run BDA
French Creek LCA
French Creek Floodplain Forest BDA
French Creek BDA

Florek Rd
Wetsell Ridge Rd
Ferry Rd
Capp Rd
Irish Rd
Hecker Rd
Elm Rd
Forest Rd
Skeltontown Rd
Center Rd
Fox Rd
Willow Rd
Terrill Rd
Bear Rd
Gospel Hill Rd
Hillview Rd
Merritt Rd
Beechtold Rd
Acker Rd
Hill Rd
Gravel Run Rd
Tobin Rd
Sherred Rd
Zimmerman Rd
Kightlinger Rd
Cemetery Rd
Blystone Rd
Van Kirk
Sherred Hill Rd
Walters Rd
Ball Rd
Allen Rd
Henry Rd
Ellis Rd
Humes Hill Rd
Jericho Rd
Kreitz Rd
Racop Rd
Plank Rd
Drakes Mills Rd
Mcclellan St
Skeltontown Rd
Thomas Rd
Brink Dr
Lura Rd
Electric Dr
Ridge Rd
Center St
Mount Pleasant Rd
Lake Dr
Armeman Rd
Timb
Drakes Mills
Skeltontown
Venango
Cambridge Springs
1200
1400

0 0.45 0.9 1.8 Kilometers
0 0.45 0.9 1.8 Miles

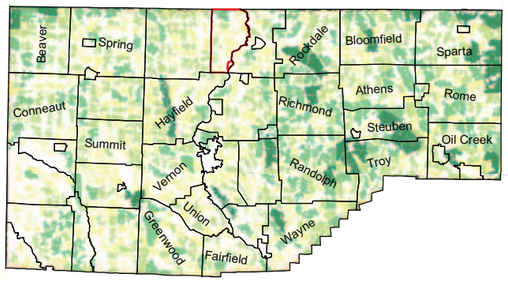
Crawford County
Natural Heritage Inventory

Venango Township
&
Venango Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



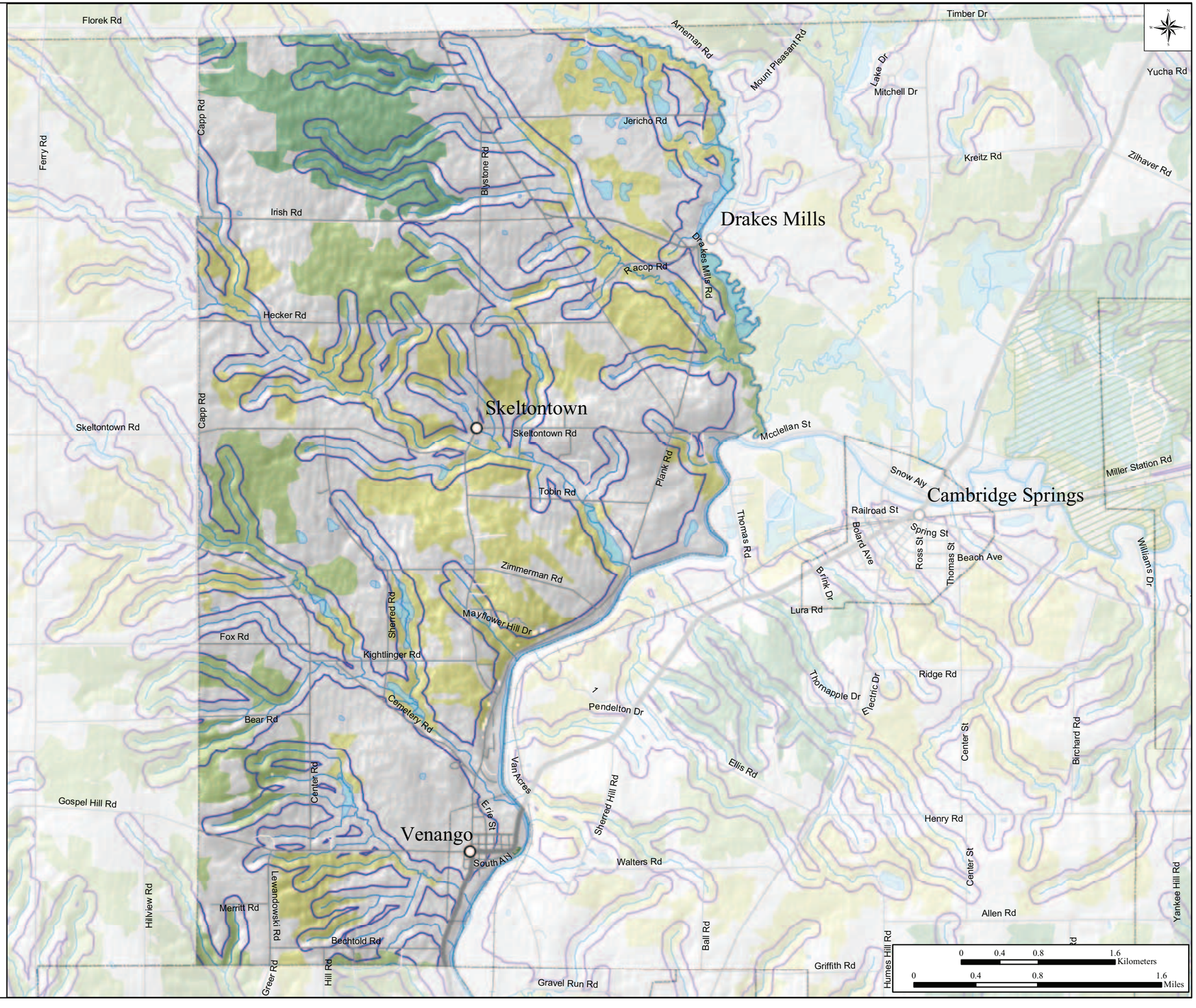
Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Venango Township is located in northern Crawford County, bordered by Erie County to the north. Conneauttee Creek and French Creek form the eastern border of the township. Forests make up only 35% of the land use in Venango Township and have been highly fragmented by roads and agriculture. Venango Township has the highest agricultural land use in Crawford County, 63%, most of which is row crops. The fragmented forests and agricultural lands do not protect the streams as well as a continuous forest buffer. Native trees should be planted along the streams where they are lacking to filter out chemicals and other pollutants. French Creek is an important watershed in Crawford County and should be protected to maintain its high water quality. Venango Borough is located along southeastern Venango Township. Much of this borough is residential, however, about a quarter of the borough is used for agriculture.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Woodcock Township.

French Creek Floodplain Forest BDA – *High Significance*

This site is designated around an occurrence of **pumpkin ash** (*Fraxinus profunda*), a critically imperiled wetland plant in Pennsylvania. This BDA contains a small patch of forested wetland lying adjacent to French Creek, west of Cambridge Springs. Pumpkin ash is typically found in areas where surface water stands well into the growing season, such as swamps, sloughs, and poorly drained flats of major river floodplains (Burns and Honkala 1990). In Pennsylvania this tree is limited to Erie, Crawford, and Warren Counties (Rhoads and Klein 1993; NatureServe 2006). Common overstory associates of this tree include red and sugar maple (*Acer rubrum*, *A. saccharum*), black willow (*Salix nigra*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and poison sumac *(Toxicodendron vernix*). This site lies adjacent to the French Creek BDA and is encompassed within the supporting landscape of that watershed.

Threats and Stresses

Currently the areas surrounding this forested wetland are used for agriculture. Most likely, this site has not been cleared due to the saturated nature of the soils. Major threats to this occurrence would be logging the forest patch and draining or filling the wetland for agriculture or development, or flooding for an artificial impoundment. Any major changes to French Creek, such as damming that would subsequently alter the hydrology of the surrounding floodplain and related wetlands, would also negatively impact this occurrence of pumpkin ash.

The emerald ash borer (*Agrilus planipennis*), which has been documented in Ontario, Michigan, Illinois, Indiana, Ohio, Maryland, Virginia and most recently in parts of western Pennsylvania, is a potential threat to all ash (*Fraxinus* sp.) trees. The larvae of the emerald ash borer, an Asian beetle, feeds in the cambium

between the bark and the wood, where it forms a feeding gallery that eventually girdles the branches of the tree, resulting in death (McCullogh and Katovich 2004). The emerald ash borer has infested over 5 million trees in Michigan alone and has been spreading to states surrounding Pennsylvania quite rapidly (McCullogh and Katovich 2004).

Recommendations

The landowner should be made aware of this occurrence of pumpkin ash. Logging is not recommended in this area. Land managers and planners responsible for making decisions regarding French Creek should take into consideration the importance of floodplain forests and wetlands to the integrity of the stream and refrain from implementing structures that would severely alter the hydrology of the French Creek watershed. Periodic monitoring for the presence of the emerald ash borer is recommended.

Torry Run BDA – *High Significance*

The core area of this BDA is delineated around Torry Run, a tributary to Little Conneauttee Creek, just upstream from the confluence with French Creek and two smaller tributaries to the stream. This portion of the stream consists of optimal habitat to supports a mussel species of concern, **cylindrical papershell** (*Anodontoides ferussacianus)*. This mussel prefers mud and sand substrates in small creeks and the slower moving headwater areas of larger streams.

The portion of stream supporting this population of mussels is directly influenced by the immediate watershed which is drained by the stream. Therefore, the supporting landscape for this BDA is considered the immediate watershed. Much of the supporting land is currently being used for agriculture and there is a major roadway that crosses the stream near the known location of this imperiled species.

Threats and Stresses

The cylindrical papershell has a fairly widespread distribution. Recent and local declines can be attributed to pollution, diversion of rivers for irrigation and water supply, and eutrophication from agricultural runoff. Maintaining suitable stream habitat is key to protecting aquatic species. Important habitat features include water quality and forested riparian cover regulation of stream temperatures and input of organic material. Much of this BDA cuts through agricultural land and is lacking forested riparian buffers in some areas. In areas with reduced forest cover, water quality is likely to be decreased, and contain sediment and nutrient loads due to erosion following storm events and agricultural runoff.

Recommendations

A forested riparian buffer of 328 feet (100 meters) on either side of Torry Run should be maintained to help reduce erosion and sedimentation and control water temperatures. Landowners are encouraged to allow regeneration of woody riparian vegetation, in those areas lacking stream buffers. Such a buffer is beneficial to aquatic species as well as creating habitat for other terrestrial wildlife species. Best management practices should also be applied to surrounding agricultural lands to reduce nutrient inputs and pollution.

Vernon Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			

NATURAL HERITAGE AREAS:

Conneaut Marsh Complex-North BDA		*Exceptional Significance*			
Small beggar-ticks (*Bidens discoidea*) – Plant	G5	S3	-	2003	B
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1988	A
Buttonbush dodder (*Cuscuta cephalanthi*) – Plant	G5	SU	TU	1988	E
Clinton's woodfern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2004	E
Swamp lousewort (*Pedicularis lanceolata*) – Plant	G5	S1S2	-	2003	B
Flat-stem pondweed (*Potamogeton zosteriformis*) – Plant	G5	S2S3	PR	1988	E
Dotted water-meal (*Wolffiella borealis*) – Plant	G5	S4	TU	1988	E
Bog-mat (*Wolffiella gladiata*) – Plant	G5	S2	PR	1988	E
Spatterdock darner (*Rhionaeschna mutata*) – Odonate	G4	S1	-	1995	A
Bowfin (*Amia calva*) – Fish	G5	S2S3	PC	2002	E
Warmouth (*Lepomis gulosus*) – Fish	G5	S2	PE	2002	E
Central mudminnow (*Umbra limi*) – Fish	G5	S3	PC	2002	E
American bittern (*Botaurus lentiginosus*) – Bird	G4	S1B	PE	1986	A
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
American coot (*Fulica americana*) – Bird	G5	S3BS3N	-	1988	E
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Least bittern (*Ixobrychus exilis*) – Bird	G5	S1B	PE	1982	E
Pied-billed grebe (*Podilymbus podiceps*) – Bird	G5	S3BS4N	-	1996	E
Sensitive species of concern***	-	-	-	2005	AB

French Creek BDA	*Exceptional Significance*
see Woodcock Township	

Conneaut Marsh-Geneva Marsh LCA
see page 53 for descriptions of LCAs

French Creek LCA
see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

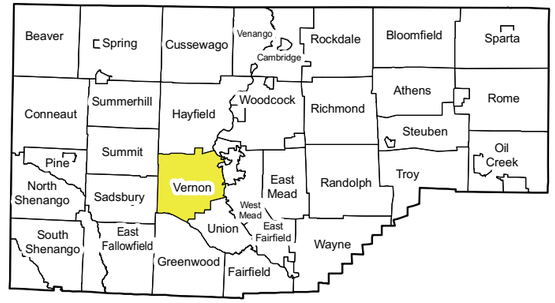
OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area (IBA) and Cussewago Bottom IBA

Crawford County
Natural Heritage Inventory
Vernon Township

Biological Diversity Area:
Conneaut Marsh Complex North
French Creek

Landscape Conservation Area:
French Creek
Conneaut Marsh Complex

Public Land:
None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)
State Land
Federal Land
National Wetland Inventory
Streams
40 Ft. Contour Line

0 0.45 0.9 1.8 Kilometers
0 0.45 0.9 1.8 Miles

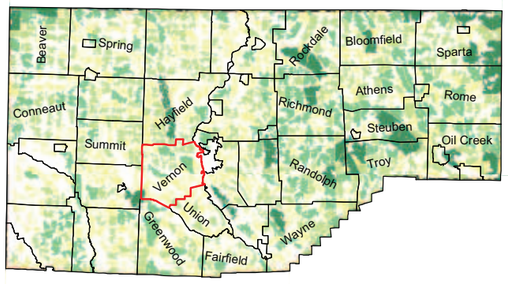
Crawford County
Natural Heritage Inventory

VernonTownship

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



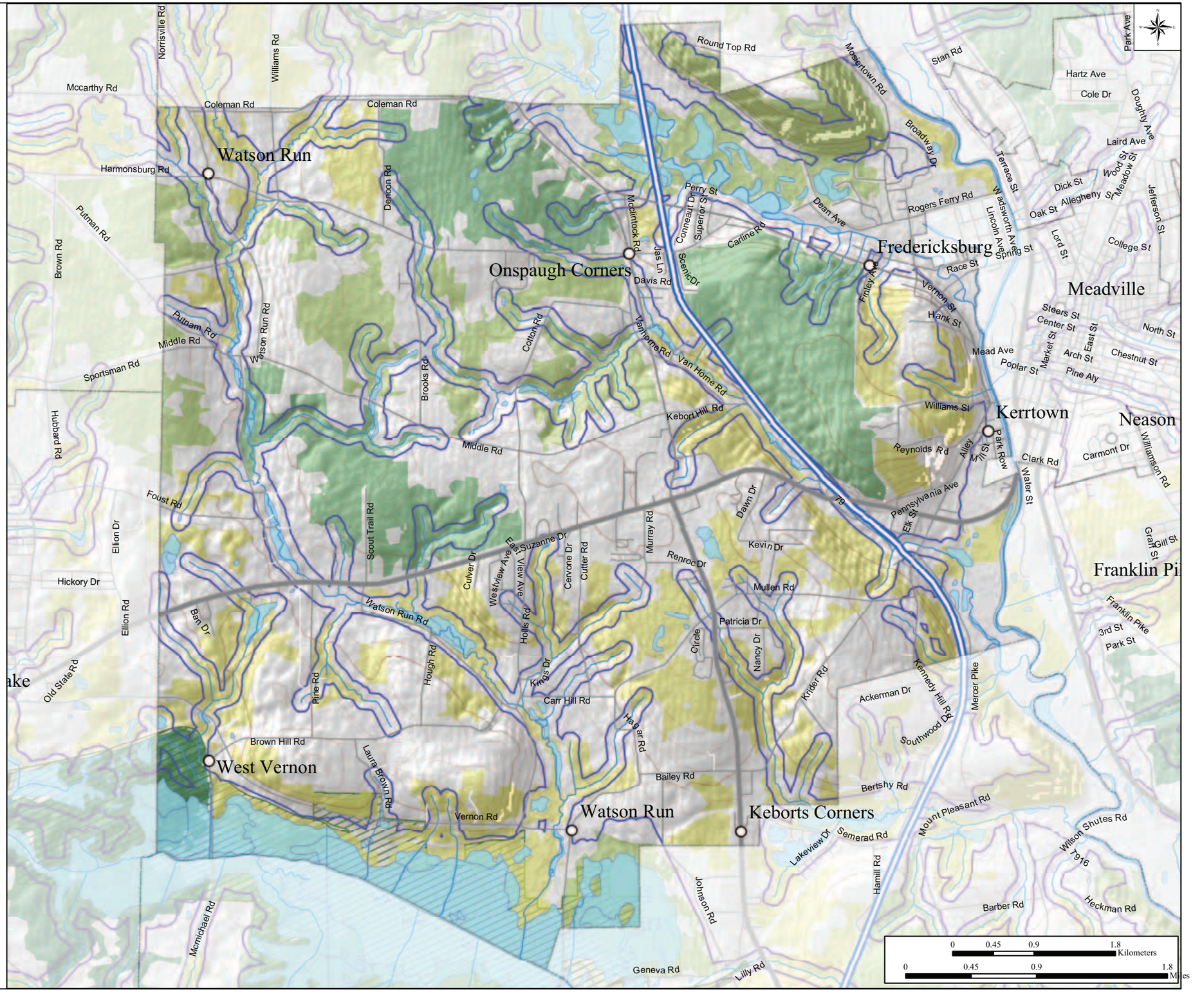
Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Formed by French Creek to the east, Conneaut Outlet to the south, and a small stretch of Cussewago Creek to the north, Vernon Township sits in central of Crawford County. This township lies entirely within the Conneaut Outlet and French Creek watersheds. Cussewago Creek flows into French Creek in the northeast, and Conneaut Outlet drains into French Creek in Union Township to the southeast. These watersheds are extremely influential on the habitat and water quality of both streams, which in turn support a diversity of wildlife, plants, and natural communities. Approximately 40% of this township is forested, with contiguous tracts present as the bottomland forests surrounding Cussewago Creek in the northeast where it joins French Creek and the forested wetlands surrounding Conneaut Outlet. Cussewago Creek and its supporting landscape comprise the Cussewago Bottom Important Bird Area (IBA) based on the unique habitat matrix of the area. Along the southern border, Conneaut Marsh has been chosen an IBA because it is the largest emergent marsh in the state and it provides habitat to some of the largest breeding populations of wetland species. Aside from those areas, this township is largely agricultural and residential.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Conneaut Marsh Complex North BDA – *Exceptional Significance*

Conneaut Marsh, locally known as Geneva Marsh, is the largest marsh complex in Pennsylvania. Formed as a result of an ancient stream channel that was filled with glacial material, it extends approximately thirteen miles along Conneaut Outlet from Conneaut Lake almost reaching French Creek. The entire marsh is owned and managed by the Pennsylvania Game Commission as State Game Lands #213 and is recognized as an Important Bird Area (IBA) by the Pennsylvania Audubon Society. A variety of habitats, including forested wetlands, shrub-scrub wetlands, and open emergent marshes, dominate the central wetland complex. A few oldfields, immature forests, and mixed hardwood forests populate the remainder of the area. The entire marsh has been designated as a BDA. Due to the size of the area, it has been broken into three smaller sections. This BDA extends from the outlet of the lake downstream slightly past the confluence with Watson Run and includes the area around Hidden Lake. This area supports a number of bird, fish, and plant species of concern.

Conneaut Marsh is an extremely important habitat for many migrating and resident bird species. Approximately 10,000 waterfowl use the marsh during spring and fall migration and a number of Pennsylvania avian species of concern are known to occur within the marsh (Tautin 2004). The species of conservation concern found in this northern section include **marsh wren** (*Cistothorus palustris*), **pied-billed grebe** (*Podilymbus podiceps*), **American coot** (*Fulica americana*), and **common moorhen** (*Gallinula chloropus*). The later three species all prefer marshes or wetlands with dense vegetation for breeding. Another species of concern was also found nesting at this site. This species tends to nest in forested areas near larger bodies of water. Here, the canopy is composed of white pine (*Pinus strobus*), Eastern hemlock (*Tsuga canadensis*), and red maple (*Acer rubrum*).

This section of Conneaut Marsh also provides habitat for several fish species of concern. **Bowfin** (*Amia calva*), **central mudminnow** (*Umbra limi*), and **warmouth** (*Lepomis gulosus*) are all found in the slow moving, vegetated waters.

The plant species composition of this wetland is quite diverse as it varies between communities. The open, emergent wetlands are dominated by pond lilies (*Nuphar* sp.) and common cattail (*Typha latifolia*) with a large graminoid component throughout. Yellow pond lily (*Nuphar lutea*) provides habitat for the **spatterdock darner** (*Rhionaeschna mutata*), a Pennsylvania dragonfly species of concern. Several wetland plant species of concern found throughout the emergent marsh are **Clinton's wood fern** (*Dryopteris clintoniana*) **flat-stemmed pondweed** (*Potamogeton zosteriformis*), **buttonbush dodder** (*Cuscuta cephalanthi*), and **bog-mat** (*Wolffiella gladiata*). This wetland contains some areas of open water and numerous canals.

The area around Hidden Lake supports three plant species of concern, **broad-winged sedge** (*Carex alata*), **swamp lousewort** (*Pedicularis lanceolata*), and **small beggartick** (*Bidens discoidea*). These plants are found growing on saturated hummocks with common cattail (*Typha latifolia*), broadleaf arrowhead (*Sagittaria latifolia*), bald spikerush (*Eleocharis erythropoda*), clearweed (*Pilea pumila*), bulbet-bearing water hemlock (*Cicuta bulbifera*), and skunk cabbage (*Symplocarpus foetidus*). Other associates include true forget-me-not (*Myosotis scorpioides*), nodding beggarticks (*Bidens cernua*), owlfruit sedge (*Carex stipata*), and northern bugleweed (*Lycopus uniflorus*), with dogwood (*Cornus* sp.) and southern arrowwood (*Viburnum recognitum*) as shrub components.

Moving outward from the central wetland, a scattered shrub component has developed on slightly drier soils. The dominant species include willows (*Salix* spp.), silky dogwood (*Cornus amomum*), buttonbush (*Cephalanthus occidentalis*), and bush blueberries (*Vaccinium* spp.) Scattered snags are present throughout the wetland. The canopy eventually closes up, forming mixed-hardwood forested wetlands and uplands. Some species present within the forest include pin oak (*Quercus palustris*), black cherry (*Prunus serotina*), and green ash (*Fraxinus pennsylvanica*). This wetland complex also supports a population of firm aster (*Symphyotrichum firmum*), a plant species once considered endangered in Pennsylvania that has recently been upgraded to rare status. This plant remains on the PNHP Watch List.

The landscape supporting this wetland complex is confined within the immediate watershed that feeds this marsh. The landscape contains a mix of forested and agricultural lands. Most field are row crops with some pasturelands and reverting farmland present in smaller amounts. Conneaut Lake makes up the headwaters of Conneaut Outlet which is the main channel flowing through the marsh.

Threats and Stresses

Conneaut/Geneva Marsh lies completely within State Game Lands #213 and is largely protected. As with other wetlands in the area however, invasive species establishment is a problem in the marsh. Narrow-leaf cattail (*Typha angustifolia*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and multiflora rose (*Rosa multiflora*) are all present throughout the marsh. Mismanagement of these plants could lead to the formation of dense stands and encroachment into open water. The PA Game Commission is currently using a mechanical vegetation cutter to remove stands and maintain areas of open water in the marsh.

Human disturbance to nesting birds is a potential threat at this site due to the amount of birdwatchers, hikers, and hunters who frequent the gamelands. A Rails-to-Trails project has been proposed for the abandoned railroad running alongside the northern portion of SGL #213 that would greatly increase human activity in this area.

Watershed-scale impacts are potentially the most imminent threats to this ecosystem. The headwaters of the marsh is Conneaut Lake, which is heavily developed and may create problems associated with pollution and runoff. Currently the lake is treated with chemicals to reduce invasive aquatic plant species and Conneaut Outlet flows directly out of the lake and into the marsh. The area surrounding the marsh is rich in glacial deposits, so gravel mining within the watershed is a constant threat.

Recommendations

The Pennsylvania Game Commission has developed a management plan for SGL #213 with such intended efforts as habitat management, invasive species management, and seasonal protection for nesting birds. A more active invasive species management plan is highly recommended, and an opportunity for a volunteer-based

hand removal program may be an option given the large amount of visitors who enjoy the marsh for recreation. The Game Commission may consider working with local groups to help reduce the impacts of watershed-scale activities.

French Creek Floodplain BDA – *High Significance*

This BDA focuses on a bottomland floodplain forest along French Creek, which supports an occurrence of **pumpkin ash** (*Fraxinus profunda*), a tree species of concern in Pennsylvania. Pumpkin ash grows in shallow, swampy forests in Pennsylvania, and is native only to the northwestern portion of the state. Pumpkin ash gets its name from the large swollen base that develops in older trees. This tree is an obligate wetland plant and prefers damp to saturated soils. This BDA lies in a small patch of forest along French Creek and it is surrounded by farmland on all sides.

Threats and Stresses

Due to the location of this element, clearing this patch of land for agriculture is the most imminent threat for this small population of pumpkin ash. Any alteration to the hydrology and the natural flow of French Creek, causing this bottomland area to become less saturated may also threaten this occurrence. Furthermore, the eastward migration of the emerald ash borer (*Agrilus planipennis*), an invasive Asian beetle that attacks native ash (*Fraxinus* sp.) trees, is a potential threat for all ash trees of the region. Movement of firewood by campers has created a fast and unfortunately effective method of travel for this species into many surrounding states including Michigan, Indiana, Ohio and recently western Pennsylvania. Many of these areas are under quarantine to prevent the further spread of this species. Additional information on emerald ash borer in Pennsylvania can be obtained from the PA Bureau of Forestry website (http://www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx).

Recommendations

Landowners should be made aware of this population of pumpkin ash trees and should be advised to refrain from clearing this small patch of forest. Maintain forest cover with the goals of increasing contiguity, and a greater portion of forest interior to provide better habitat for edge sensitive species. Aldo establish forested buffers around wetlands to ensure high quality water inputs into the wetland. Any changes to the French Creek watershed that would greatly alter stream flow should be seriously reviewed and implemented so as to create the least impact as possible. Periodic monitoring of the emerald ash borer at this site and statewide is recommended.

French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Woodcock Township.

Wayne Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
Lake Creek Valley BDA		*Exceptional Significance*			
Clinton's wood fern (*Dryopteris clintoniana*) – Plant	G5	S2	-	2004	BC
Downy willow-herb (*Epilobium strictum*) – Plant	G5?	S3	PE	2004	B
Paper pondshell (*Utterbackia imbecillis*) – Mussel	G5	S3S4	-	1994	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1988	A
Alder - ninebark wetland – Natural Community	GNR	S3	-	2005	E
Hemlock-mixed hardwood forest – Natural Community	GNR	S3S4	-	2004	E
Mixed forb marsh – Natural Community	GNR	S3S4	-	2004	E
Red maple-black ash palustrine forest – Natural Community	GNR	S2S3	-	2005	E
Sensitive species of concern***	-	-	-	1987	E
Sensitive species of concern***	-	-	-	2003	C
Lower French Creek BDA		*Exceptional Significance*			
see Fairfield Township					
Pine Knoll BDA		*Local Significance*			
Sugar Lake BDA		*Exceptional Significance*			
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1988	A
Glacial lake – Natural Community	G?	S1	-	2006	-
Yoset Lake Palustrine Forests BDA		*High Significance*			
see East Mead Township					
Conneaut Marsh-Geneva Marsh LCA					
see page 53 for descriptions of LCAs					
French Creek LCA					
see page 53 for descriptions of LCAs					

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks
***This species is not named at the request of the agency overseeing its protection

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Marsh Important Bird Area

Crawford County
Natural Heritage Inventory

Wanye Township

Biological Diversity Area:

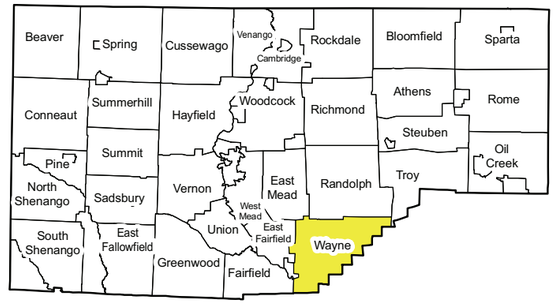
Sugar Lake Glacial Lake
Pine Knoll Forest
Lake Creek Valley
Lower French Creek

Landscape Conservation Area:

French Creek

Public Land:

Erie National Wildlife Refuge



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

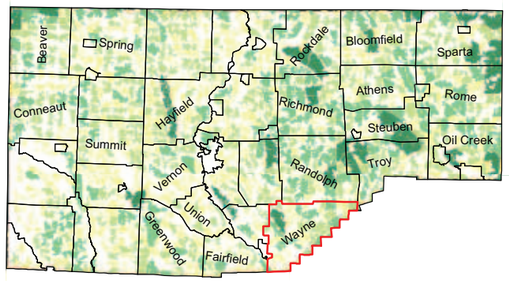
Crawford County
Natural Heritage Inventory

Wayne Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

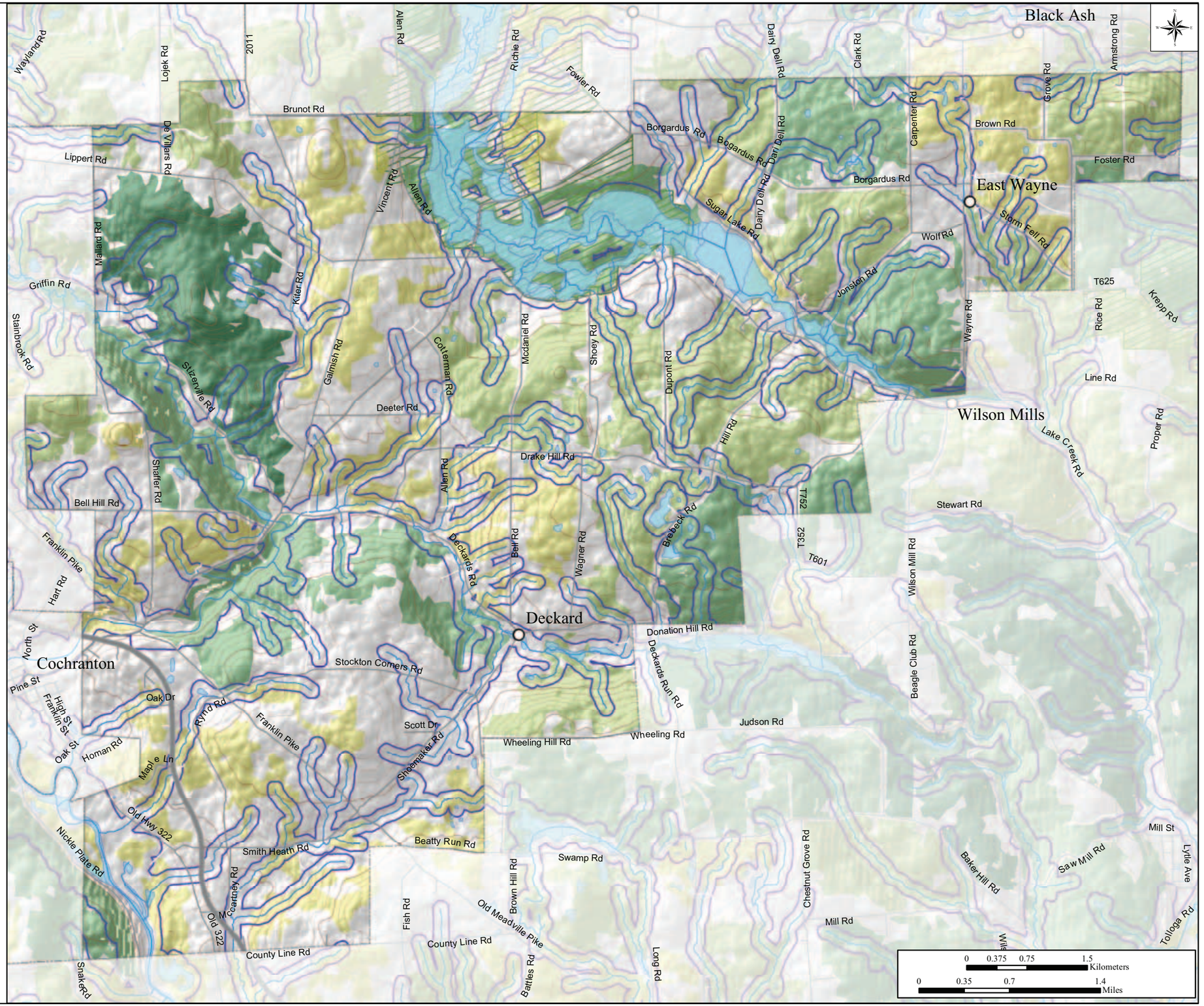
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



Wayne Township is located in the southern section of Crawford County. It lies on the border of Venango County to the southeast and Mercer County to the south. The numerous tributaries of the French Creek watershed drain this township including the Lake Creek watershed, which supports Sugar Lake. The Lake Creek Valley, part of the Erie National Wildlife Refuge, is low, marshy, and ecologically rich. This area has been designated an Important Bird Area (IBA) by the Audubon Society based on the important nesting and wintering habitat provided by this wetland complex. Fertile, forested stream valleys drain a fairly hilly landscape with sandstone outcroppings in some places that make tillage difficult. More than half of the township is forested, with some larger forest blocks in the Lake Creek and Little Sugar Creek watersheds. This township is predominantly rural, and about two thirds of all farmlands are in the form of row crops.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

Lake Creek Valley BDA – *Exceptional Significance*

This BDA is delineated around Lake Creek and the extensive associated wetlands that feed Sugar Lake. This is an extremely biologically diverse area that provides habitat for numerous rare species of birds and several natural communities of biological significance. The valley lies entirely within the Erie National Wildlife Refuge (ENWR) and has been named an Important Bird Area (IBA) by the Pennsylvania Audubon Society. The Western Pennsylvania Conservancy performed extensive surveys of the plants, animals, and natural communities within the refuge for the ENWR Natural Heritage Inventory Report (1994).

Lake Creek is a low gradient clearwater creek that meanders throughout the nearly level vegetated stream valley floor. This creek has a sparsely vegetated channel with floating, submerged, and emergent vegetation. The width of the stream ranges from 10 to 30 feet with a silty, clayey substrate. Cow lily (*Nuphar luteum* var. *variegatum*) is scattered along the edges of the stream channel, cow lily also forms aquatic beds throughout the creek. Other aquatic vegetation includes floating brownleaf (*Potamogeton natans*), leafy pondweed (*P. foliosus*), large-leaved pondweed (*P. amplifolius*), a water milfoil (*Myriophyllum spicatum*), a lesser duckweed (*Lemna minor*), bladderwort (*Utricularia* sp.), greater duckweed (*Spirodela polyrhiza*), coontail (*Ceratophyllum* sp.), and bur-reed (*Sparganium* sp.).

Lake Creek meanders through a valley of extensive freshwater wetlands. Areas of beaver activity are common throughout. Notable communities within the wetland complex are a **mixed forb marsh community** and a large **alder-ninebark wetland**. For the most part, the marsh is inundated. The substrate is silty with a large amount of organic debris, forming vegetated mats in some areas. The marsh is dominated by grass-like plants and emergent vegetation with large beds of cow lily. The periphery of the marsh is lined with scattered shrubs, giving way to shrub swamps and palustrine forests. The alder-ninebark wetland contains more shrubs, including *Cornus amomum*, *Spiraea alba*, and *Salix nigra*, as well as *Carex* spp. and *Rubus* spp. Occurrences of **Clinton's wood fern** (*Dryopteris clintoniana*) and paper **pondshell** (*Utterbackia imbecillis*) were also found in this area.

The mixed forb marsh is dominated by cow lily, sedges (*Carex comosa*, and *C. crinita*), great bur-reed (*Sparganium eurycarpum*), smartweeds (*Polygonum* spp.), mild water pepper (*P. hydropiperoides*), common cattail (*Typha latifolia*), and duckweed. Scattered shrub patches are populated by meadowsweet (*Spiraea alba*), swamp rose (*Rosa palustris*), silky dogwood (*Cornus amomum*), speckled alder (*Alnus rugosa*) with widely scattered snags and trees including eastern hemlock (*Tsuga canadensis*), black ash (*Fraxinus nigra*), black willow (*Salix nigra*) and elms (*Ulmus* sp.). The herbaceous layer here contains common cattail, rice cutgrass (*Leersia oryzoides*), water pepper (*Polygonum hydropiper*), halberd-leaved tearthumb (*P. arifolium*), skunk cabbage (*Symplocarpus foetidus*), three-way sedge (*Dulichium arundinaceum*), and great bur-reed. An occurrence of **downy willow-herb** (*Epilobium strictum*) is also found near this marsh.

A second notable community within the wetland complex of Lake Creek valley is a circumneutral shrub swamp. This swamp was originally forested; however, beaver activity has noticeably affected the hydrology and vegetation of the riparian areas, thus creating a shrub swamp. This community exhibits exceptional floral diversity. Dominant species include meadowsweet, swamp rose, speckled alder, willows (*Salix* spp.), winterberry (*Ilex verticillata*), red maple (*Acer rubrum*), jewelweed (*Impatiens capensis*), rice cut-grass, spotted joepye weed (*Eupatorium maculatum*), smartweeds, mild water pepper, arrow-leaved tearthumb (*Polygonum sagittatum*), and water purslane (*Ludwigia palustris*). Other associates include various sedges (*Carex crinita*, *C. tribuloides*, *C. scoparia*, and *C. lurida*), great bur-reed, sensitive fern (*Onoclea sensibilis*), and common cattail. Silky dogwood, cow lily, skunk cabbage, boneset *(Eupatorium perfoliatum*), arrowhead (*Sagittaria* sp.), wild mint (*Mentha arvensis*), northern arrowwood (*Viburnum dentatum*), and halberd-leaved tearthumb are also common occurrences throughout the swamp.

A **red maple – black ash palustrine forest**, a community of special concern, is located along the northern section of Lake Creek. Skunk cabbage (*Symplocarpus foetidus*) and sedges (*Carex* spp.) are common in the herbaceous layer.

Just along the north bank of Lake Creek, upstream from Sugar Lake, **a mixed forb marsh**, a natural community of special concern is present. This community, dominated by broad-leaved plants, is commonly associated with wet meadows and a variety of other wetland types (Fike 1999). Distinctive vegetation includes three-way sedge (*Dulichium arundinaceum*), tearthumbs (*Polygonum* spp.), beggarticks (*Bidens* sp.), jewelweed (*Impatiens capensis*), sensitive fern (*Onoclea sensibilis*), arrowhead (*Sagittaria latifolia*), and rice cutgrass (*Leersia oryzoides*). Successional processes give way to a **hemlock- mixed hardwood palustrine forest** on the periphery of the marsh.

Hemlock-mixed hardwood palustrine forests are characterized by a pit and mound microtopography, with pools of standing groundwater. Fike describes this community as dominated by eastern hemlock (*Tsuga canadensis*), with white pine (*Pinus strobus*), red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*), ash (*Fraxinus* sp.), red oak (*Quercus rubra*), white oak (*Q. alba*), and American beech (*Fagus grandifolia*) present in smaller amounts (1999). A dense understory is formed by rhododendron (*Rhododendron maxima*), with occasional highbush blueberry (*Vaccinium corymbosum*) and winterberry (*Ilex verticillata*). The herbaceous layer, which grows from a well-developed layer of sphagnum moss (*Sphagnum* spp.), is sparse but includes several fern species (*Onoclea sensibilis, Osmunda cinnamomea, and O. claytonia*), violets (*Viola* sp.), Canada mayflower (*Maianthemum canadense*), and Indian cucumber-root (*Medeola virginiana*).

The rich plant diversity throughout this wetland complex creates a variety of habitats for numerous bird species, both common and rare. Specifically, this is ideal habitat for marsh birds, a group of birds that have experienced recent declines due to habitat fragmentation, elimination, and water pollution. Among the many birds that use this extensive wetland complex, several species of concern have been seen during the breeding season, including the **marsh wren** (*Cistothorus palustris*). Additional surveys may show that other wetland bird species are breeding in the wetland surrounding Lake Creek.

The hydrology of this wetland, which is linked to the surrounding uplands, is crucial to supporting the plants and communities that provide habitat to these bird species of concern. The immediate watershed that is being drained by Lake Creek is considered the supporting landscape for this BDA. The portion of the Lake Creek Valley watershed considered for this BDA includes portions of the Erie National Wildlife Refuge (ENWR), some larger forest blocks and a small amount of farmland which is common along the major roads within the watershed.

Threats and Stresses

The entire core area of this BDA falls within the limits of the ENWR and is therefore protected from inappropriate development. Invasive plant species within the wetland pose a threat to native plant species and the habitat they create for nesting birds. Reed canary grass (*Phalaris arundinacea*), which has become established near the intersection with Route 173, will become aggressive and spread rapidly throughout the wetland if not managed appropriately. Invasive species such as this are commonly dispersed via disturbed areas such as roadsides. Once established at a site, invasives typically colonize quickly and out-compete native plants for resources, therefore reducing native plant populations and diversity. Other invasives that could be problematic within this wetland are purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*). Furthermore, human disturbance to bird species of concern during the breeding season could lead to nest failure and would be highly detrimental to these bird populations.

At the landscape level, runoff from surrounding agricultural lands and major roads, such as Route 173, which bisects the wetland, could potentially alter the integrity of this habitat. Nutrient or chemical loading from these sources could drastically impact the water quality, thus changing plant and animal populations at the site. Any gross change in the hydrology of this creek would be detrimental to the species and communities of conservation concern located within this BDA.

Recommendations

Current management by the USFWS should afford protection to this wetland complex. Human disturbance should be minimized during breeding season, approximately April-June. Continued efforts should be allocated towards invasive plant species monitoring and removal throughout the wetland. Best management practices should continue to be applied to surrounding agricultural lands. Monitoring the wetland and roadside conditions for invasive species and erosion problems where Route 173 crosses would be advisable.

Lower French Creek BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under Fairfield Township.

Pine Knoll BDA – *Local Significance*

This site sits southeast of Pettis Corners, on the eastern side of Little Sugar Creek. This upland forested knoll was chosen as a locally significant site due to the exceptional plant diversity that is exhibited. Over twenty years ago, this area was an old growth beech-maple forest. A lumber company currently owns the land and practices selective cutting, but the forest has never been entirely logged. This forest type, referred to as a rich mesic hardwood forest, occurs commonly throughout the mid-Atlantic Appalachian states (Nature Serve 2006).

Sugar Lake Inlet
photo source: PHNP

The forest overstory is dominated by sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), red oak (*Quercus rubra*), and basswood (*Tilia americana*). This moist, nutrient rich forest supports high diversity, including spring ephemeral wildflowers (Swain and Kearsley 2001). Specifically, this BDA supports populations of five different orchids; yellow lady slipper (*Cypripedium parviflorum*), pink lady slipper (*C. acaule*), showy orchid (*Galearis spectabilis*), round leaved orchid (*Platanthera orbiculata*), and downy rattlesnake plantain (*Goodyera pubescens*). Other spring wildflowers include white clintonia (*Clintonia umbellata*), large-flowered trillium (*Trillium grandiflorum*), and perfoliate bellwort (*Uvularia perfoliata*). This forest also supports great songbird and amphibian diversity. A supporting landscape has not been designated for this core based on the natural division created by the geology of the knoll.

Threats and Stresses

Logging is the most imminent threat for this forest community. Forestry practices such as clear-cutting or diameter limit cutting, which removes most of the forest canopy, would greatly impact the plant diversity of Pine Knoll. Logging trucks, off-road vehicles, and logging roads would also destroy existing wildflower populations.

Recommendations

Sustainable forestry practices to limit habitat degradation are highly recommended. Land managers interested in timber harvesting should refer to *Best Management Practices for Pennsylvania Forests*, a brochure available online through Penn State for guidelines aimed at minimizing impacts from timber harvesting. Reduced road building and limited off road traffic would be advisable to limit destruction and trampling of wildflowers.

Sugar Lake BDA – *Exceptional Significance*

The core area of this site is designated around Sugar Lake, a naturally formed **glacial lake**. Sugar Lake is part of the larger French Creek watershed, one of the most intact streams in the eastern United States (Master et al 1998). The lake is fed and drained by Lake Creek, which eventually drains into French Creek via Sugar Creek. The inflow is largely protected by the extensive wetlands of the Lake Creek Valley which extend within a few hundred meters of the lake border

Residential development threatens the water quality of Sugar Lake
photo source: Steve Grund, PNHP

The supporting landscape includes the surrounding watershed that drains into the lake, this area supports a habitat containing a nesting pair of **marsh wrens** (*Cistothorus palustris*), a bird species of concern. This watershed has a variety of landscape uses including agriculture, residential, and commercial areas, as well as a portion of the Erie National Wildlife Refuge. Agriculture is fairly dominant throughout the immediate watershed supporting the lake. Residential and commercial development occurs along roads in the adjacent uplands to the northeast and southwest borders of the lake.

Threats and Stresses

The core area of Sugar Lake is protected from boat motors exceeding six horsepower, regulated by the Pennsylvania Fish and Boat Commission.

This protects aquatic organisms from recreational disturbance and reduces turbidity throughout the lake. Sugar Lake's native aquatic flora is threatened by an abundance of Eurasian water-milfoil (*Myriophyllum spicatum*), an invasive exotic plant that forms dense clumps, out-competing native plants for resources. Other exotic plants that might threaten native plants in this habitat and the surrounding wetlands include Japanese knotweed (*Polygonum cuspidatum*) and purple loosestrife (*Lythrum salicaria*).

Future residential and commercial development around the lake may pose a threat to the integrity of the lake ecosystem. The road to the northeast is close enough in proximity to cause problems such as runoff and deterioration of the shoreline. Erosion, bank stabilization, and lawn maintenance have already contributed to the loss and degradation of shoreline habitat. Agricultural and residential fertilizer and pesticide application within the immediate watershed are potential pollution sources in the entire watershed.

The wetlands contained within the ENWR are under the management of the U.S. Fish and Wildlife Service (USFWS) and are secure from development or other land use changes. The USFWS employs Adaptive Wildlife and Habitat Management on the refuge to provide nesting, breeding, brooding, and resting habitat for waterfowl and other migrating birds while supporting diversity of other wildlife. This process of wildlife and habitat management involves the manipulation of habitat to achieve a specific goal, monitoring changes, and then the determination of success based on the observations made (USFWS 2006).

Recommendations

Maintaining the water quality of the lake will afford protection to the aquatic organisms and native aquatic plant species of the lake. Continued management and regulation of recreational fishing by the PA Fish and Boat Commission will further protect population numbers. A management plan to remove and control invasive species within the lake is highly recommended. This includes removal of existing populations of Eurasian water-milfoil and monitoring for possible new invasions. Implementing boat wash stations near take outs and docks and requiring boat washing before and after lake use will help control the spread of Eurasian water milfoil.

High water quality is important for the health of both Sugar Lake and the larger watershed of French Creek. Runoff and nutrient loading in to the lake from surrounding agricultural lands could become a problem in the future. Restoring riparian corridors within the watershed and using Best Management Practices (BMPs) to reduce the amount of agricultural runoff into the watershed would be desirable.

Yoset Lake Palustrine Forests BDA – *High Significance*

This Natural Heritage Area is discussed under East Mead Township.

West Fallowfield Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			
NATURAL HERITAGE AREAS:					
McMillen Hollow BDA		High Significance			
see East Fallowfield Township					
Mud Lake BDA		*Exceptional Significance*			
Small beggar-ticks (*Bidens discoidea*) – Plant	G5	S3	-	1998	E
Broad-winged sedge (*Carex alata*) – Plant	G5	S2	PT	1997	E
Whorled water-milfoil (*Myriophyllum verticillatum*) – Plant	G5	S1	PE	1997	E
A swamp smartweed (*Polygonum setaceum* var. *interjectum*) – Plant	G5T4	S2	PE	1998	E
Bog-mat (*Wolffiella gladiata*) – Plant	G5	S2	PR	1997	B
Warmouth (*Lepomis gulosus*) – Fish	G5	S2	PE	1999	E
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Prothonotary warbler (*Protonotaria citrea*) – Bird	G5	S2S3B	-	1988	E
Sensitive species of concern***	-	-	-	2003	E
Pymatuning Wetland Complex-Central BDA		*Exceptional Significance*			
Small beggar-ticks (*Bidens discoidea*) – Plant	G5	S3	-	2002	E
Yellow sedge (*Carex flava*) – Plant	G5	S2	PT	2004	E
Prairie sedge (*Carex prairea*) – Plant	G5	S2	PT	1988	E
Cyperus-like sedge (*Carex pseudocyperus*) – Plant	G5	S1	PE	2004	E
Whorled water-milfoil (*Myriophyllum verticillatum*) – Plant	G5	S1	PE	2001	E
Flat-stem pondweed (*Potamogeton zosteriformis*) – Plant	G5	S2S3	PR	1988	E
Black tern (*Chlidonias niger*) – Bird	G4	S1B	PE	1997	B
Marsh wren (*Cistothorus palustris*) – Bird	G5	S2S3B	-	1996	A
Common moorhen (*Gallinula chloropus*) – Bird	G5	S3B	-	1988	E
Sensitive species of concern***	-	-	-	1983	E
Sensitive species of concern***	-	-	-	2003	E
Pymatuning Wetland Complex- South BDA		Exceptional Significance			
see East Fallowfield Township					
Pymatuning Marsh LCA					
see page 53 for descriptions of LCAs					

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

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

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

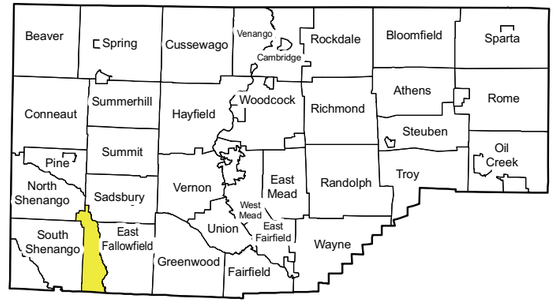
OTHER CONSERVATION AREAS: Pymatuning Wildlife Management Area/ SGL #214 Important Mammal Area and Pymatuning-Hartstown Complex Important Bird Area

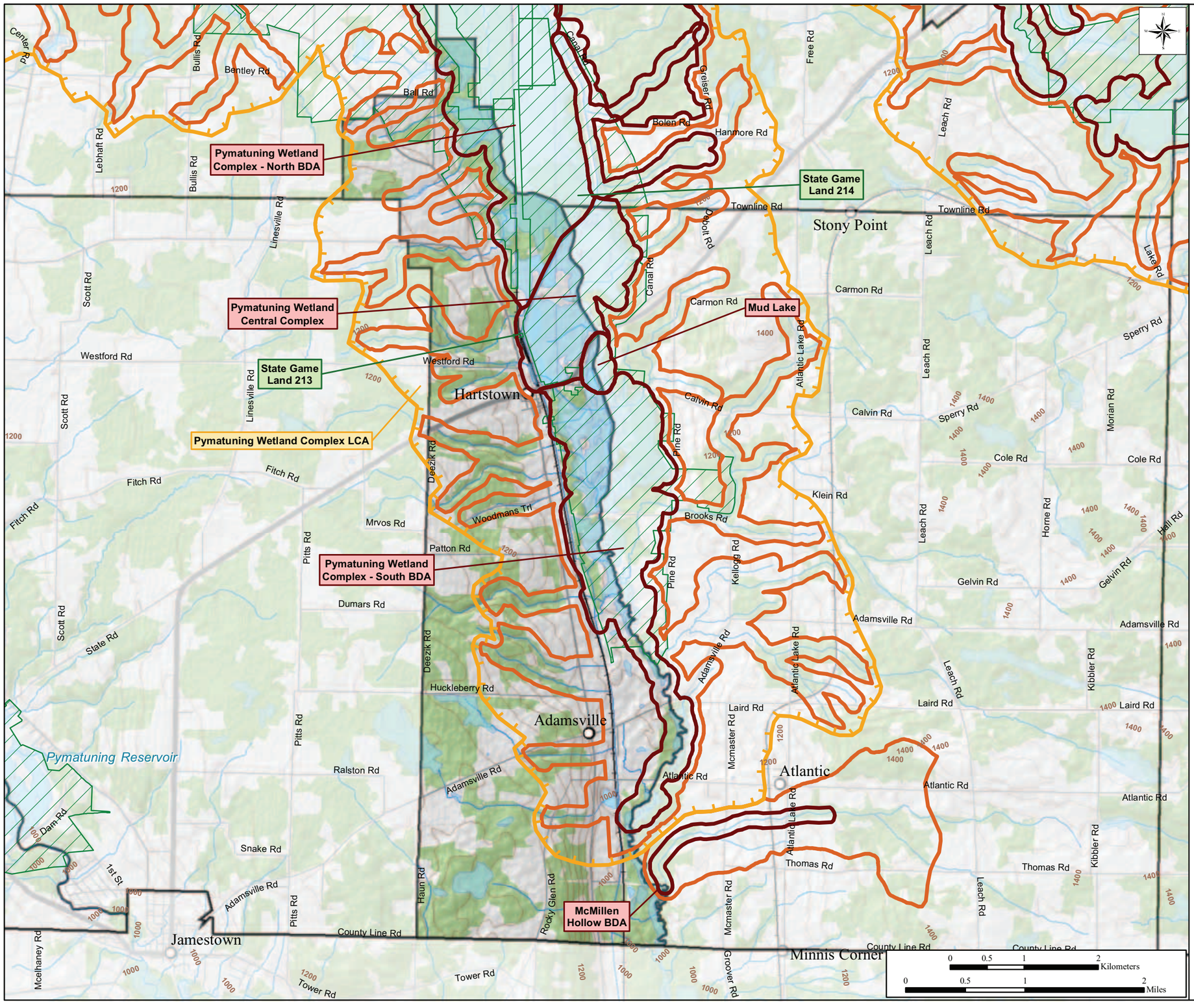
Crawford County
Natural Heritage Inventory
West Fallowfield Township

Biological Diversity Area:
- Mud Lake
- McMillen Hollow
- Pymatuning Wetland Complex - Central
- Pymatuning Wetland Complex - North
- Pymatuning Wetland Complex - South

Landscape Conservation Area:
- Pymatuning Wetland Complex

Public Land:
- State Game Land 213
- State Game Land 214





Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

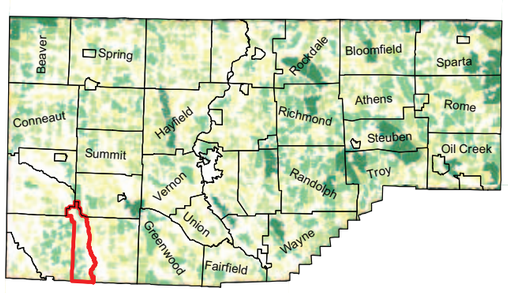
Crawford County Natural Heritage Inventory

West Fallowfield Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

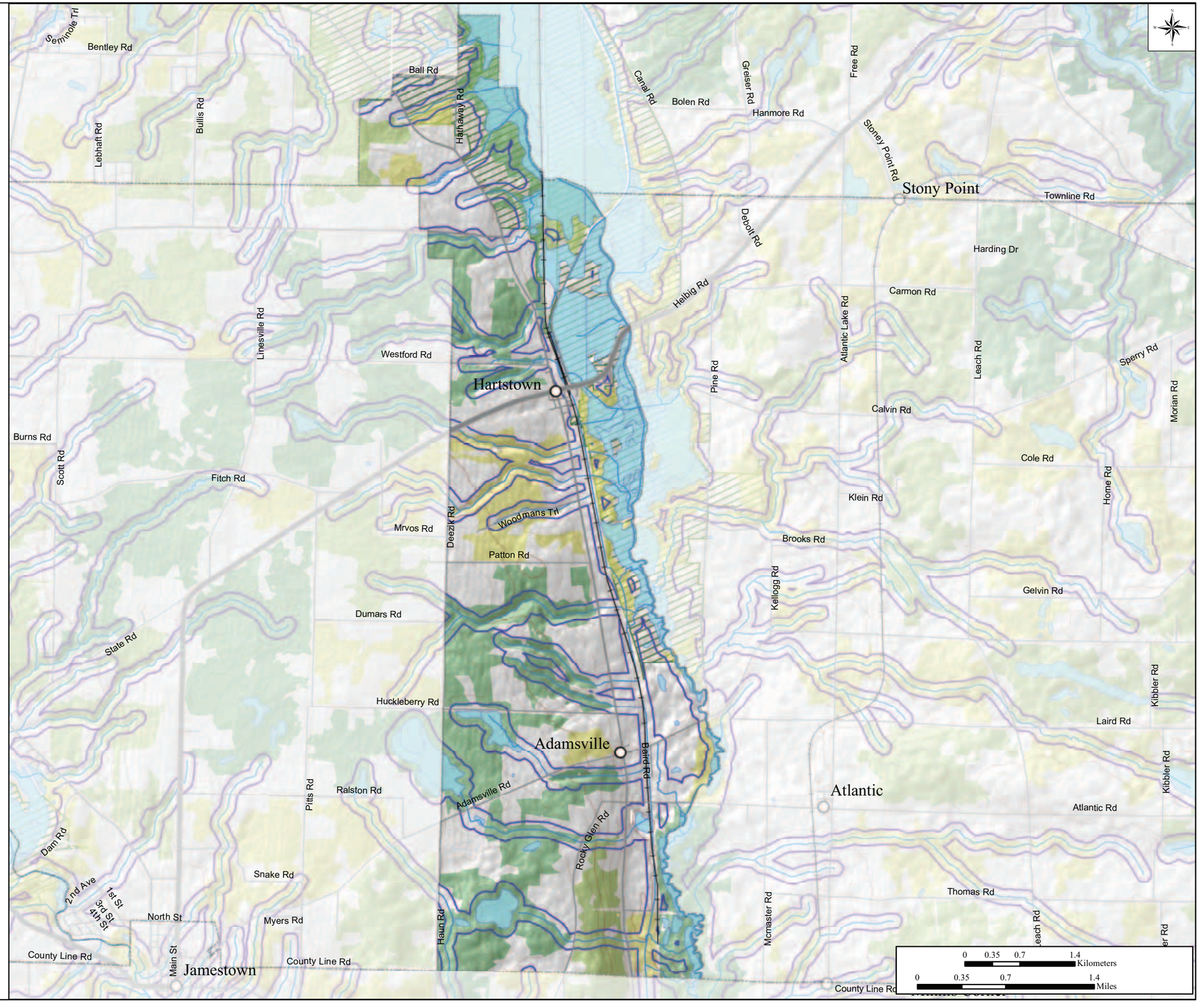
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land



West Fallowfield Township is located in southern Crawford County. It is bordered by Mercer County to the south, with Crooked Creek forming its eastern border, and is the second smallest township in the county. Agriculture is the prevalent land use, and much of the forested areas have been fragmented by roads. The woody wetlands around Crooked Creek, which cover 6% of the township, provide contiguous habitat for birds and other species. State Game Land #214 is located along the eastern edge of the township and protection of this publicly managed area is important to provide habitat to wildlife. This area includes wetlands, forests, and grasslands, which are used by a number of species. The Pymatuning, Hartstown Complex Important Bird Area (IBA) is located along the eastern side of the township, providing extensive habitat for waterfowl, shorebirds, and many other rare avian species. The Pymatuning Wildlife Management Area / SGL 214 Important Mammal Area (IMA) is also located along the eastern edge of West Fallowfield Township. This site was selected due to the available habitat for little brown bats, river otters, and a subspecies of red-backed vole, as well as other mammal species.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

McMillen Hollow BDA – *High Significance*
This Natural Heritage Area is discussed under East Fallowfield Township.

Mud Lake BDA – *Exceptional Significance*

This BDA is delineated around Mud Lake, sometimes called Crystal Lake and Dollar Lake. These glacial kettle lakes were formed during the last Ice Age, just east of Hartstown. The wetland areas surrounding these lakes are included in the core area, and they are hydrologically connected to the Pymatuning Marsh Complex. These lakes sit within State Game Lands #214 (SGL), southeast of where Route 322 crosses Pymatuning Marsh, between the central and south complex, as named in this report. This area supports a number of plant and animal species of concern.

Mud Lake
Photo source: Steve Grund, PNHP

A population of **warmouth sunfish** (*Lepomis gulosus*), a fish species of concern, is present in Mud Lake. Warmouths are secretive fish that prefer lakes and slow-moving water with rocky banks, stumps, and weeds for cover from direct sunlight. This species is native to the Great Lakes and Mississippi Basins and portions of the Gulf and Atlantic drainages. It is currently considered imperiled in Pennsylvania (NatureServe 2006). In Ohio, these fish are restricted to glaciated streams and lakes similar to the habitat found within Mud Lake (Ohio Department of Natural

Resources 2005). Predominant vegetation within the lake includes duckweeds (*Lemna minor*, *L. trisulca, Spirodela polyrhiza*), and Columbian watermeal (*Wolffia columbiana*). **Bog-mat** (*Wolffiella gladiata*), and **flat-leaved pondweed** (*Potamogeton robbinsii*), are two plant species of concern that are also documented from the open water of the lake.

Dollar Lake, to the north, is much smaller than Mud Lake, however it supports aquatic bed communities featuring a plant species of concern, **whorled water-milfoil** (*Myriophyllum verticillatum*). This species is found growing among common bladderwort (*Utricularia vulgaris*) and American waterweed (*Elodea canadensis*) within a large population of pond lily (*Nuphar* spp.) surrounded by swamp loosestrife and cattail (*Typha glauca*). Additionally, the south shore of Dollar Lake is an open meadow populated with false nettle (Boehmeria cylindrical), marsh fern (Thelypteris palustris), and giant bur-reed. This area also supports a relatively small population of **a swamp smartweed** (*Polygonum setaceum* var. *interjectum*), a plant species of concern.

The open, emergent marsh area surrounding both Mud and Dollar Lakes supports a variety of plant species of concern. Scattered along the shores of both lakes are populations of **broad-winged sedge** (*Carex alata*). These plants are growing on low-relief shores among giant bur-reed (*Sparganium eurycarpum*), green arrow arum (*Peltandra virginica*), swamp loosestrife (*Decodon verticillatus*), and various other sedges (*Carex* spp.). Numerous peat and mud flats surround the lakes and become exposed during periods of low water levels. These flats are sparsely vegetated by bald spike-rush (*Eleocharis erythropoda*), smartweed (*Polygonum* sp.), and nodding beggar-ticks (*Bidens cernua)*. **Small beggar-ticks** (*Bidens discoidea*), a plant species of concern, is also locally common on these flats. Additionally, a population of firm aster (*Symphyotrichum firmum*) is present throughout the wet meadow that surrounds this site. This species was once considered endangered in Pennsylvania and has recently been upgraded to rare status and remains on the PNHP Watch List.

The emergent marsh plants of Mud Lake BDA include fragrant water-lily (*Nymphaea odorata*).
Photo source: Steve Grund, PNHP.

This area is an important habitat for several bird species of concern. **Marsh wrens** (*Cistothorus palustris*) and **common moorhens** (*Gallinula chloropus*) use the emergent marsh vegetation for nesting material and cover from predators. The bottomland forests, which border the marsh, provide habitat to another species of concern, the **prothonotary warbler** (*Protonotaria citrea*). This species requires a very specific breeding habitat, forested areas near or over open water, which is becoming lost in the wake of human development. A **sensitive species of concern** is also known to nest here.

Threats and Stresses

This BDA lies entirely within SGL #214 and is largely protected from gross development. However, Route 322, which passes to the north, presents several threats to this site. Due to the nature of this wetland and its connection with Pymatuning Marsh, there is not much of a wooded border protecting the wetland from the road. Potential pollutants include runoff and salt spray, both of which would greatly alter the hydrology and viability of this site. Invasive exotic species, which tend to colonize along disturbed corridors such as roadways, could pose a major threat to native plant populations. Specifically, purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*) are two invasive wetland plants

that could establish here. These plants tend to form dense stands and crowd out native vegetation, reducing the diversity and structure of the wetlands, as well as eliminating habitat for species such as marsh wrens and common moorhens. Most species found in this wetland are extremely susceptible to human disturbance during the breeding season.

Common Moorhen
Photo source: Bob Moul

Recommendations

Any land management decisions regarding the watershed supporting this wetland complex should take into consideration the potential impacts to these lakes and the surrounding wetland areas. Insecticide spraying, salt application and mowing should be restricted on Route 322 where it crosses Pymatuning Marsh. Periodic monitoring of the wetland by the PA Game Commission for the presence or establishment of invasive species is highly recommended. A management plan for the removal of these species should be created if establishment and spread is observed. Furthermore, human access to bird nesting areas should be restricted during the spring breeding months.

Pymatuning Wetland Complex-Central BDA – *Exceptional Significance*

This BDA includes the primary wetland communities that together form the central portion of Pymatuning Swamp. The area now occupied by the swamp represents only a part of what once was one of the most extensive wetland complexes in the state. The damming of the headwaters of the Shenango River in the early 1930's resulted in the formation of Pymatuning Lake and the loss of a substantial portion of the swamp. The changes in the wetland communities are not fully known or understood but historic records of plant species that once occupied now flooded areas indicate that sections of the swamp supported a rich flora featuring species affiliated with calcareous conditions. The remaining swamp communities include open water, emergent, and palustrine wetland community types. The wetland as a whole extends for several miles from the lake edge upstream to where it narrows and eventually becomes discontinuous along the drainage. This BDA is delineated around the southern portion of the wetland that lies within the central portion of State Game Lands #214.

The central portion of this BDA is an open water emergent marsh with floating peat mats and pond lily (*Nuphar* spp.). During drawdown and low water levels, sparsely vegetated mud flats are common. The dominant plants of the peat mats and mud flats include nodding beggartick (*Bidens cernua*), bald spikerush (*Eleocharis erythropoda*) and *Polygonum* spp. These also support a population of **small beggar-ticks** (*Bidens discoidea*), a plant species of concern. Other emergent plants present at this site include swamp loosestrife (*Decodon verticillata*), swamp smartweed (*Polygonum hydropiperoides*), green arrow arum (*Peltandra virginica*), and bur-reeds (*Sparganium americanum*, *S. eurycarpum*). Several species of concern are found in the open water areas, such as **flat-stem pondweed** (*Potamogeton zosteriformis*), and **lesser bladderwort** (*Utricularia minor*). Engelmann's flatsedge (*Cyperus engelmannii*) and dotted water-meal (*Wolffia borealis*), both recently de-listed aquatic plants, are also present at this site.

This area currently and historically has supported a breeding colony of **black terns** (*Chlidonias niger*), a species of concern. Black terns prefer marshes and emergent wetlands with an even mix of open water and emergent vegetation. They tend to nest in small colonies along rivers, sloughs, wet meadows, and

impoundments dominated by cattails, bulrushes, water lily, grasses, and sedges. Black terns use the emergent vegetation to make cup-like nests that float on water. Recently, black terns have faced population declines due to habitat loss and destruction. In Pennsylvania breeding has only been confirmed in Erie and Crawford counties. The creation of Pymatuning Lake and the naturally occurring associated wetlands support several breeding populations.

Other wetlands birds of special concern such as the **marsh wren** (*Cistothorus palustris*) and the **common moorhen** (*Gallinula chloropus*) are known to nest in Pymatuning Swamp. These species also use the emergent aquatic vegetation to construct nests and provide cover. Additionally, the wetlands of Pymatuning Marsh are important breeding grounds for a species of concern, which prefers nesting in forests near large bodies of water.

Moving towards the perimeter of the swamp, there is less open water and the area is dominated by saturated peat and sphagnum moss (*Sphagnum* spp.) hummocks. A **sensitive species of concern** is locally common along the transition to the more heavily wooded wetland near Blair Road. This shrub swamp conifer wetland also supports many species of concern including **swampfly honeysuckle** (*Lonicera oblongifolia*), **whorled water milfoil** (*Myriophyllum verticillatum*), **flat-stem pondweed** (*Potamogeton zosteriformis*), **small beggar-ticks** (*Bidens discoidea*), and two formerly endangered plants: firm aster (*Symphyotrichum firmum*) and flat-leaved pondweed (*Potamogeton robbinsii*). Historically this swamp has supported numerous other species of concern. Common woody plants throughout this wetland include speckled alder (*Alnus rugosa*), willows (*Salix* spp.) dogwoods (*Cornus* spp.), red maple (*Acer rubrum*), white pine (*Pinus strobus*), and tamarack (*Larix laricina*). The mixed aquatic beds are populated by swollen bladderwort (*Utricularia vulgaris*), common waterweed (*Elodea canadensis*), floating pondweed (*Potamogeton natans*), and spineless hornwort (*Ceratophyllum echinatum*).

The supporting landscape for Pymatuning Swamp is represented by the immediate watershed of the wetland complex and includes a large percentage of agricultural lands and the borough of Hartstown to the southwest. Numerous small tributaries flow through these predominately agricultural areas directly into the swamp, which then drains to the Shenango River to the north and Crooked Creek to the south.

Threats and Stresses

Maintaining water quality is they key to the continued success of this wetland complex and the species of concern it supports. Changes in hydrology of this system such as flooding, damming, draining, loss of forest cover, and increased impervious surfaces within the watershed can impact this wetland. Periodic changes from natural processes, such as beaver and seasonal flooding events, have resulted in a dynamic mix of habitats and these natural processes will likely maintain the diversity of habitats at this site. Portions of this area are used for light recreation which may present a problem to nesting birds.

A relatively large vegetated riparian buffer surrounds this wetland, which serves to filter out pollutants that may enter the wetland from upland farms, roads, and municipalities. Loss of this vegetation may also cause changes in the canopy cover and temperature of this wetland. The introduction and spread of invasive exotic species, specifically common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*), is a threat to native plant and animal populations.

Recommendations

The sensitivity of the core area is high and any activities taking place within have the possibility of impacting the wetland and some or all species of concern occurring there. A good deal of protection is in place given that the swamp is almost entirely on public land and is considered an exceptional value (EV) wetland. Periodic monitoring of the presence or establishment of invasive species is necessary. Also, incorporating a policy and strategy for controlling invasive species into the management plans for the Game Commission lands will be essential in managing this threat.

It is highly recommended that best management practices be applied to agricultural lands within the supporting landscape to lessen the impacts farming may have on the watershed. Retaining riparian buffers along streams flowing through farmland is extremely important to prevent erosion and sedimentation, nutrient loading, and pollution from entering the streams feeding the wetland. Trees should also be planted in areas lacking such buffers. Any landscape level changes that would directly alter the current hydrology or water quality of this wetland should be carefully reviewed and measures should be taken to limit negative impacts.

Pymatuning Wetland Complex-South BDA – *Exceptional Significance*

This Natural Heritage Area is discussed under East Fallowfield Township.

West Mead Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			

NATURAL HERITAGE AREAS:

French Creek BDA	*Exceptional Significance*

see Woodcock Township

French Creek LCA

see page 53 for descriptions of LCAs

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Conneaut Marsh-Geneva Marsh Important Bird Area (IBA) and Cussewago Bottom IBA

West Mead Township is located on the eastern bank of French Creek, bordered by Woodcock Township to the north and East Fairfield to the south. The tributary streams of French Creek drain most of the township. Mud Run, the outlet of Tamarack Lake, is a headwater tributary that drains into Little Sugar Creek, which eventually meets French Creek at Cochranton in East Fairfield Township. Tamarack Lake is an artificial lake which is owned by the Commonwealth and operated by the PA Fish and Boat Commission. West Mead township is comprised of equal parts agriculture and forested lands. About 15% of the township is urbanized most of which is development around the City of Meadville. There are two city parks in Meadville and Crawford County Farm and CA lies just outside of the city.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county.

French Creek BDA

This Natural Heritage Area is discussed under Woodcock Township.

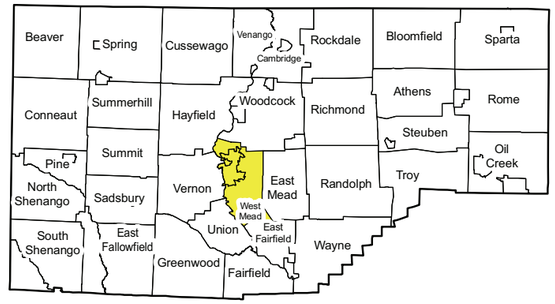
Crawford County
Natural Heritage Inventory

West Mead Township
&
City of Meadville

Biological Diversity Area:
French Creek

Landscape Conservation Area:
French Creek

Public Land:
None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

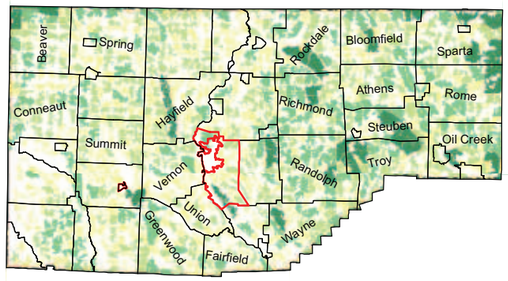
Crawford County
Natural Heritage Inventory

West Mead Township
&
City of Meadville

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



Legend

PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000

- 40 Ft. Contour Line
- Managed Land

West Shenango Township

	PNHP Rank*		State Status	Last Seen	Quality**
	Global	State			

NATURAL HERITAGE AREAS:
None

* Please refer to Appendix IV for an explanation of PNHP ranks and legal status
** Please refer to Appendix V for an explanation of quality ranks

OTHER CONSERVATION AREAS: Pymatuning-Hartstown Complex Important Bird Area

West Shenango Township, the smallest township in Crawford County, is located in the southwest corner of the county. It is bordered by Mercer County to the south and Ohio to the west. Almost a third of West Shenango Township is water, due to Pymatuning Lake, which lies within Pymatuning State Park, Pennsylvania's largest state park. This park has been designated an Important Bird Area (IBA) because of the excellent habitat it provides to a diversity of avian species. About 15% of the township contains residential and recreational development with approximately equal amounts of forest and agriculture that account for the rest of West Shenango Township.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county.

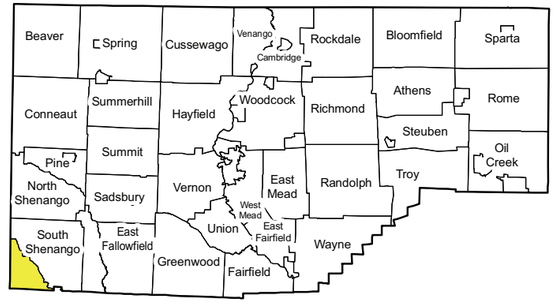
Crawford County Natural Heritage Inventory

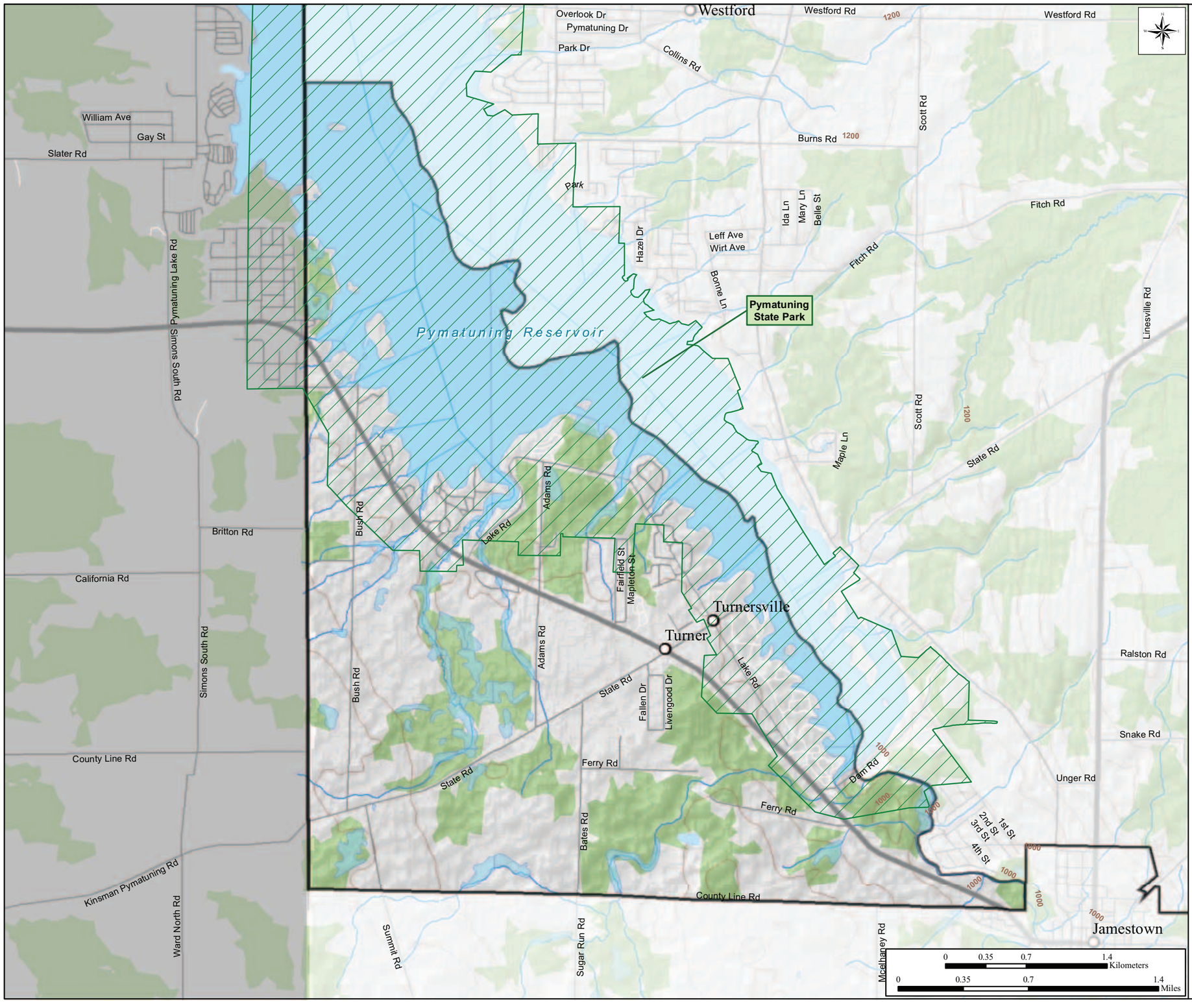
West Shenango Township

Biological Diversity Area:
None

Landscape Conservation Area:
None

Public Land:
Pymatuning State Park





Legend

Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

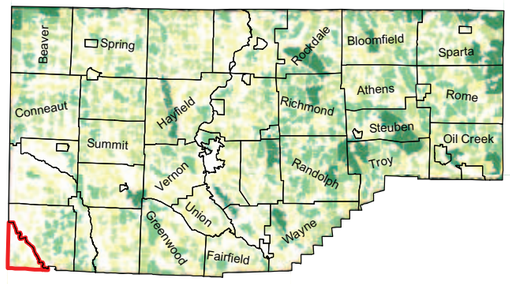
Crawford County Natural Heritage Inventory

West Shenango Township

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

Riparian buffers through forested areas should be considered priorities for conservation. Riparian buffers through non-forested habitats should be considered priorities for restoration.

Distribution of forest blocks in Crawford County



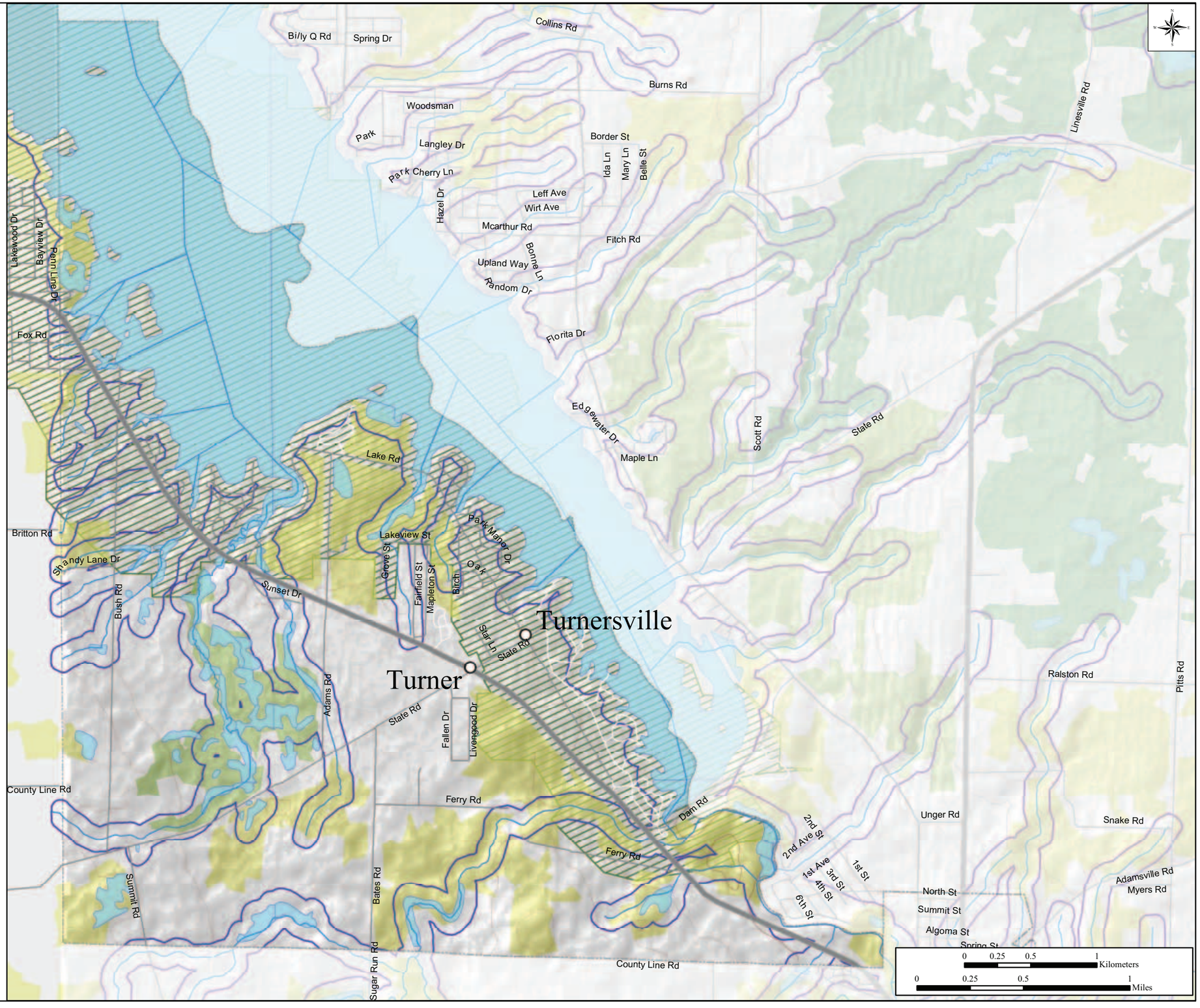
Legend

Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

- < 250
- 251-500
- 501-1000
- >1000
- 40 Ft. Contour Line
- Managed Land



Woodcock Township, Blooming Valley, Saegertown, and Woodcock Boroughs

	PNHP Rank* Global	PNHP Rank* State	State Status	Last Seen	Quality**
NATURAL HERITAGE AREAS:					
French Creek BDA		*Exceptional Significance*			
Redhead pondweed (*Potamogeton richardsonii*) – Plant	G5	S3	PT	2002	E
Three-ridge (*Amblema plicata*) – Mussel	G5	S2S3	-	1993	E
Cylindrical papershell (*Anodontoides ferussacianus*) – Mussel	G5	S2S3	-	1993	E
Long solid (*Fusconaia subrotunda*) – Mussel	G3	S1	-	1993	E
White heelsplitter (*Lasmigona complanata*) – Mussel	G5	S1	-	1986	BC
Creek heelsplitter (*Lasmigona compressa*) – Mussel	G5	S2S3	-	1993	E
Round pigtoe (*Pleurobema sintoxia*) – Mussel	G4	S2	-	1993	E
Paper pondshell (*Utterbackia imbecillis*) – Mussel	G5	S3S4	-	1993	E
Rainbow mussel (*Villosa iris*) – Mussel	G5	S1	-	1991	E
Bowfin (*Amia clava*) – Fish	G5	S2S3	PC	2003	E
Ohio lamprey (*Ichthyomyzon bdellium*) – Fish	G3	S1	PC	1993	E
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1986	AB
Sensitive species of concern***	-	-	-	1993	E
Sensitive species of concern***	-	-	-	1986	C
Sensitive species of concern***	-	-	-	1991	B
Sensitive species of concern***	-	-	-	1987	C
Sensitive species of concern***	-	-	-	1985	E
Sensitive species of concern***	-	-	-	1987	E
Sensitive species of concern***	-	-	-	1991	B
Sensitive species of concern***	-	-	-	1991	E
Sensitive species of concern***	-	-	-	1985	C
Sensitive species of concern***	-	-	-	1993	C
Sensitive species of concern***	-	-	-	1993	B
Sensitive species of concern***	-	-	-	1985	E
Hemlock Natural Area BDA		*High Significance*			
Rich hemlock mesic hardwoods forest – Natural Community	GNR	S2S3	-		E
Woodcock Creek BDA		*High Significance*			
see Richmond Township					
Woodcock Lake BDA		*Notable Significance*			
Sensitive species of concern***	-	-	-	2007	E
French Creek LCA					
see page 53 for descriptions of LCAs					

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

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

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

OTHER CONSERVATION AREAS: Erie National Wildlife Refuge Important Bird Area

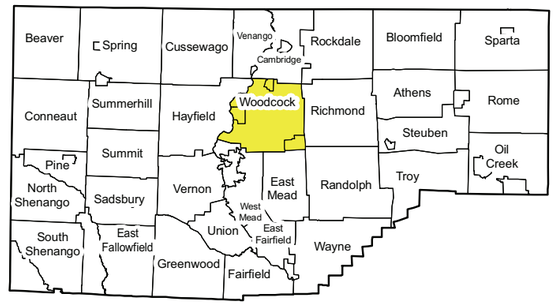
Crawford County
Natural Heritage Inventory

Woodcock Township
Woodcock Borough
Saegertown Borough
&
Blooming Valley Borough

Biological Diversity Area:
- French Creek
- Hemlock Natural Area
- Woodcock Creek
- Woodcock Lake

Landscape Conservation Area:
- French Creek

Public Land:
- None



Legend

PNHP
Pennsylvania Natural Heritage Program

Biological Diversity Area (BDA)
- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

State Land

Federal Land

National Wetland Inventory

Streams

40 Ft. Contour Line

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

Crawford County
Natural Heritage Inventory

Woodcock Township
&
Woodcock Borough
Saegertown Borough
Blooming Valley Borough

Much of the native biodiversity of the township can be maintained by providing undisturbed forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads or utility infrastructure. These general landscape features help provide the habitat necessary to keep common species common. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as natural wildlife corridors while significantly improving regional water quality.

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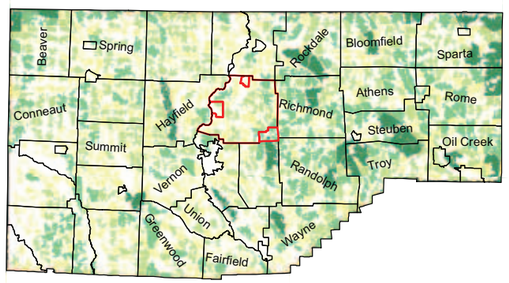
Distribution of forest blocks in Crawford County



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PNHP
Pennsylvania Natural Heritage Program

- National Wetland Inventory
- Riparian Buffer

Forest Block by Acres

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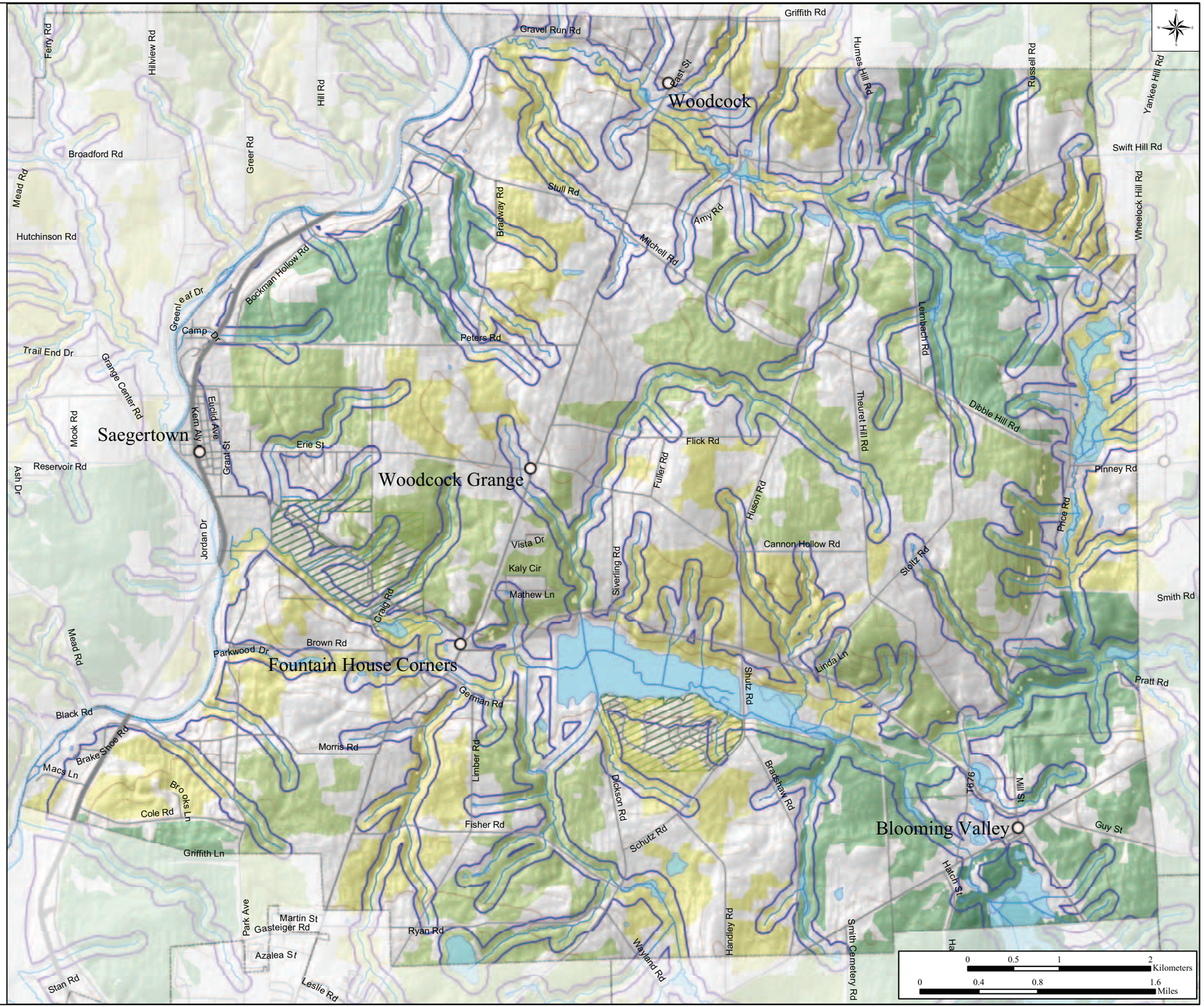


Woodcock Township lies on the eastern bank of French Creek in the center of Crawford County. Woodcock Creek flowing into French Creek drains much of the southeastern portion of the township. At one point, the creek was dammed by the United States Army Corps of Engineers to form Woodcock Creek Lake. The Crawford County Fairground sits on the southern shore of the lake. Colonel Crawford Park lies on the northern shore farther downstream. Both parks offer numerous recreational opportunities. Agriculture and forests each account for almost half of the land use in Woodcock Township. Many of the tributaries to French Creek flow through forested ravines across farmland. The borough of Saegertown is located along French Creek. It contains a mix of urban, agricultural, and forested land. The boroughs of Woodcock and Blooming Valley are also located within this township. Both are predominantly agricultural towns.

As is true in the rest of the county, much of the native biodiversity of the township can be maintained by providing forested buffers along streams, and avoiding fragmentation of the largest forest blocks with additional roads. These general landscape features provide the habitat necessary to keep common species common. Protection of these forest blocks will additionally protect the water quality of the many headwater streams originating within them. The streams that flow through open agricultural areas should be restored with native trees to buffer the stream and improve water quality. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways, protecting water quality in the township. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. This coarse filter or landscape level approach will help provide habitat for most of the common native species found throughout the county. In addition to the coarse filter outlined above, a fine filter approach applied to the following sites will help keep these uncommon species of plants and animals from disappearing from Crawford County and Pennsylvania.

French Creek BDA – *Exceptional Significance*

French Creek, considered one of the most ecologically diverse streams east of the Mississippi, stretches 117 miles from Chautauqua, New York to the Allegheny River in Mercer County, Pennsylvania. Along with its nine major tributaries, French Creek drains the northwestern Pennsylvanian counties of Erie, Crawford, and Mercer. About half of Crawford County lies within the French Creek watershed, which totals 1270 square miles in area (Crawford County Conservation District 2007). Once used by explorers and Native Americans as a link between Lake Erie and the Ohio River, this river retains few dams, making it valuable for recreation and wildlife. The river itself is home to approximately 80 species of fish and 25 species of mussels. Due to the size of French Creek, the amount of species of conservation concern and their habitat requirements, French Creek has been identified as a Landscape Conservation Area (LCA) to promote conservation of this working landscape.

A total of 26 species of concern were found within French Creek. This BDA begins in the northern part of the county and is designated around Conneauttee Creek upstream from the confluence with French Creek. A series of riffles and runs near Drakes Mills supports a mussel species of concern, the **creek heelsplitter** (*Lasmigona compressa*). As Conneauttee Creek meanders through its broad glacial valley, the natural river course creates deeper, slower moving pools in between the fast-moving riffles. Sluggish pools with a fine substrate, such as the silty stream bottom near Drake's Mills are ideal habitat for the **white heelsplitter** (*Lasmigona complanata*), a critically imperiled mussel species.

Conneauttee Creek flows into French Creek just south of Cambridge Springs. This BDA includes French Creek downstream past Meadville to Wilson Chutes Bridge at Buchanan Station. The natural flow of French Creek has created a series of riffles and runs that provides habitat to a number of species. The typical pattern of the stream consists of clear, swift cobbles or riffles followed by deeper, slower moving pools. Several riffles form at the mouth of the small tributaries that drain into French Creek. Turbidity and pollution are low in the creek, providing habitat to a number of species of concern. Localized areas throughout the creek support assemblages of different species. Eight mussel species of concern were located in French Creek during field surveys, **three ridge** (*Amblema plicata*), **cylindrical papershell** (*Anodontoides ferussacianus*), **long solid** (*Fusconaia subrotunda*), **creek heelsplitter** (*Lasmigona compressa*), **white heelsplitter** (*Lasmigona complanata*), **round pigtoe**

(*Pleurobema sintoxia*), and **paper pondshell** (*Utterbackia imbecillis*), and rainbow mussel (*Villosa iris*). These species occupy different habitats, including headwater creeks, gravelly rivers, and slow moving pools. **Bowfins** (*Amia calva*) and **Ohio lampreys** (*Ichthyomyzon bdellium*), both fish species of concern, were also found in French Creek. Fifteen other aquatic **sensitive species of concern** were also found in French Creek.

The diversity of aquatic species present in this stream is quite significant and it is dependent on the water quality and hydrology of the stream and the quality of the uplands. The lack of impoundments and dams provides adequate stream length for locally migratory fish species that utilize different habitats during different stages of their life cycle. The high diversity of fish species provides mussel populations the ability to disperse throughout the stream. Although the surrounding landscape is principally agriculture, French Creek remains largely unpolluted and clear, thus affording habitat for this species. The supporting landscape includes the watershed of the main French Creek channel. This includes several road crossings near the towns of Cambridge Springs, Venango, Saegertown, and Meadville. **Redhead pondweed** (*Potamogeton richardsonii*), an aquatic plant species of concern is found in several locations throughout the stream. This species grows submerged in the lakes, rivers, and creeks.

Threats and Stresses

Maintaining high water quality and suitable stream habitat is the key to sustaining healthy fish and mussel populations in French Creek. Loss of forested riparian zones would likely result in increased water temperature, erosion, and sedimentation pollution in the river and disruption of natural nutrient cycling linked to the stream. Removal of forest cover on valley walls is especially detrimental due to the potential for increased runoff and erosion following storm events.

Pollution of French Creek is most likely linked to non-point sources such as agriculture and wastewater discharge from residential and industrial property. Agriculture contributes to erosion and pollution via clearing of riparian vegetation and farming too close to streams, chemical runoff from pesticides and fertilizers, and nutrient loading due to animal waste. Allowing livestock to cross streams is extremely damaging for mussels that bury themselves in the shallow cobbles and riffles where livestock tend to cross. Stream dredging, the removal of sand and gravel from river bottoms, destroys mussel and fish habitat and alters stream flow. Finally, runoff from impervious surfaces such as roads and bridges can result in the addition of oil, salt, and chemicals into the system. Organisms like mussels and some fish that filter-feed directly from the water are extremely susceptible to polluted water.

Recommendations

Maintaining a forested riparian buffer is essential to protect the water quality of French Creek. A minimum of a 100-meter buffer is recommended. Landowners within the floodplain and watershed of French Creek should consult best management practices to reduce impacts from agriculture and septic systems. Restrict livestock from entering or crossing streams. Dredging, although not currently practiced here, should be prohibited due to the amount of mussel species in the stream. Road maintenance or city workers should avoid excessive application of road salt during the winter.

Hemlock Natural Area BDA – *High Significance*

This site is a steep ravine along Woodcock Creek southeast of the dam that creates Woodcock Creek Lake, owned and managed by the U.S. Army Corps of Engineers. This area is an excellent example of a **rich hemlock mesic hardwoods forest**.

The maturing hemlock-hardwoods forest is dominated by eastern hemlock (*Tsuga canadensis*), sugar maple (*Acer saccharum*), yellow birch (*Betula allegheniensis*), and American beech (*Fagus grandifolia*). Other woody species include red maple (*Acer rubrum*), musclewood (*Carpinus caroliniana*), bitternut hickory (*Carya cordiformis*), shagbark hickory (*C. ovata*), American basswood (*Tilia americana*), and flowering raspberry (*Rubus odoratus*). The herbaceous layer is dominated by red baneberry (*Actaea rubra*), pearly everlasting (*Anaphalis margaritacea*), red trillium (*Trillium erectum*), club mosses (*Lycopodium* spp.), and wood ferns (*Dryopteris* spp.). The supporting landscape consists of the subwatershed feeding into this portion of Woodcock Creek and contains approximately 1 km of similar streamside habitat.

Threats and Stresses

This area is currently managed by the Army Corps of Engineers which likely affords it appropriate protection from major development. Westward migration of the hemlock wooly adelgid (*Adelges tsugae*), an exotic, invasive insect currently documented in 42 counties in the eastern two-thirds of Pennsylvania (PA Bureau of Forestry 2006), is a possible threat to the hemlock trees in the region. The hemlock wooly adelgid, native to Asia, is a sap-feeding insect that attacks the eastern hemlock. This insect pest can result in high levels of hemlock mortality, opening up the forest canopy and illuminating the forest floor to full sunlight.

Recommendations

Any land management decisions regarding the watershed supporting this natural area should take into consideration potential impacts to this community, including alterations to the light, temperature, and hydrologic regimes. Periodic monitoring for the hemlock wooly adelgid is recommended.

Woodcock Creek BDA – *High Significance*

This Natural Heritage Area is discussed under Richmond Township.

Woodcock Lake BDA – *Notable Significance*

Woodcock Lake is a two mile long Army Corps of Engineers project formed by the damming of Woodcock Creek. This dam was created to provide flood control along French Creek. A portion of the Crawford County Fairgrounds is located on the southern shore of the lake. A **sensitive species of concern** was observed nesting at this site in 2007. The core habitat for this species includes the nesting site and feeding areas along the lake.

Threats and Stresses

The Army Corps of Engineers provides some protection from development and other modifications to the landscape. Recreational activities are the biggest threat to this species, especially those occurring during the breeding season. Disturbance from boating and hiking may threatened the success of this species, especially activities close to the nest site.

Recommendations

Disturbance to this species during the breeding season should be minimized. Boating restrictions should be put in place to limit boat speed and the access to the nesting site. Trails close to this nest should be closed during the breeding season.

General Recommendations

The following are general recommendations for protection of natural heritage areas (NHAs) within a county. Approaches to protecting a NHA 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 when incorporated into a long-term, large-scale plan, 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 NHAs on private land.**
   Conservation easements protect land while leaving it in private ownership. An 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 and will not be extinguished with new ownership. Tax incentives may apply to easements donated for conservation purposes.

   Lease and management agreements also allow the landowner to retain ownership and temporarily ensure protection of land. There are no tax incentives 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, protection of a watershed, forest or agricultural land with land trust offering technical expertise.

   Land acquisition by a conservation organization can be at fair market value 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. Identify 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 lands should be examined for acquisition when a NHA is present on either property and there is a need of additional land to complete protection of the associated natural features.

   Fee simple acquisition is when a buyer purchases land outright and has 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.

   Unrestricted donations of land are welcomed by land trusts. The donation of land entitles the donor to a charitable deduction for the full market value, as well as a release from the responsibility of managing the land. If the land is donated because of its conservation value, the land will be permanently protected. A donation of land that is not of high biological significance may be sold, with or without restrictions, to a conservation buyer and the funds used to further the land trust's conservation mission.

   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 concern and natural communities.**
   Many of the already-protected NHAs are in need of additional management recommendations to ensure the continued existence of the associated natural elements. Incorporate site-specific recommendations into existing management plans or prepare new plans. Recommendations 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, and agriculture, and implementing sustainable forestry practices. For example, some species simply require continued availability of a natural community while others may need specific management practices such as canopy thinning, mowing, or burning to maintain their habitat requirements.

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 habitat value, especially for species of concern, and agreements should be worked out to minimize activities that may threaten native flora and fauna.

3. Protect bodies of water.

Protection of reservoirs, wetlands, rivers, and creeks is vital for ensuring the health of human communities and natural ecosystems, especially those that protect biodiversity, supply drinking water, and are attractive recreational resources. Many rare species, unique natural communities, or locally significant habitats occur in wetlands and water bodies and are directly dependent on natural hydrological patterns and water quality for their continued existence. Ecosystem processes also provide clean water supplies for human communities and do so at significant cost savings in comparison to water treatment facilities. Hence, protection of high quality watersheds is the only way to ensure the viability of natural habitats and water quality. 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 NHAs.**

Development plans should provide for natural buffers between disturbances and NHAs. Disturbances may include construction of new roads and utility corridors, non-sustainable timber harvesting, and fragmentation of large pieces of land. Storm runoff from these activities results in the transport of nutrients and sediments into aquatic ecosystems (Trombulak and Frissell 2000). County and township officials can encourage landowners to maintain vegetated buffer zones within riparian zones. Vegetated buffers (preferably 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. Staff at the Pennsylvania Natural Heritage Program (PNHP) or natural resources agencies can provide further guidance regarding buffer considerations appropriate for various kinds of natural resources within NHAs, e.g., barren community, wetland, water body, or forest.

Watersheds or subwatersheds where natural communities and species of concern occur (outlined on the Township maps in this report) should be viewed as areas of sensitivity, although not all portions of the watershed may be zones of potential impact. As an example, conserving natural areas around municipal water supply watersheds provide 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.**

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 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 brownfield development, for commercial and industrial projects presents one way to encourage economic growth while allowing ecologically sensitive areas to remain undisturbed. For example, reclaimed surface mines can be used for wind development when feasible. Cluster development can 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 ROW's), 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, and 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 invasive species.

Invasive species threaten native diversity by dominating habitat used by native species and disrupting the integrity of the ecosystems they occupy. Management for invasives depends upon the extent of establishment of the species. Small infestations may be easily controlled or eliminated but more well established populations might present difficult management challenges. Below is a list of sources for invasive species information.

- The ***Mid-Atlantic Exotic Plant Pest 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 by providing leadership, representing the mid-Atlantic region at national meetings and conferences, monitoring and disseminating research on impacts and controls, facilitating information development and exchange, and coordinating on-the-ground removal and training. A membership brochure is available as a pdf file at http://www.ma-eppc.org .

- Several excellent Web sites exist to provide information about invasive exotic species. The following sources provide individual species profiles for the most troublesome invaders, with information such as the species' country of origin, ecological impact, geographic distribution, as well as an evaluation of possible control techniques.
  - The 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/
  - U.S. Department of the Interior, National Park Service invasive species monitoring resources at: http://science.nature.nps.gov/im/monitor/invasives.htm (under construction).

- 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. Incorporate CNHI information into planning efforts.

Through internal planning, decision-making related to land-use development, and participation in regional planning initiatives, counties, and municipalities could profoundly shape the land and landscapes of Pennsylvania. Natural Heritage Areas 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

Alluvium: detrital deposits made by streams on riverbeds, flood plains, and alluvial fans, especially a deposit of silt or silty clay laid down during time of flood.

Ambystomid: a small to moderate-sized terrestrial or semi-aquatic New World salamander. Ambystomid salamanders possess lungs, as compared to plethodontid salamanders, which do not.

Anthropogenic: human caused.

Bedrock: the solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Biocide: a natural or synthetic substance toxic to living organisms. Some ecologists advocate the use of this term instead of 'pesticides', since most pesticides are also toxic to species other than the target pest species. Indirectly, pesticides may also affect non-target organisms detrimentally in many other ways (e.g. by loss of food species or loss of shelter) so that the effects of pesticides may also be felt throughout a whole ecosystem. The term 'biocide' indicates this property more clearly than 'pesticide'.

Biological Diversity Area (BDA): An area containing and important in the support of plants or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity.

Bog: a low-nutrient, highly acidic wetland where sphagnum peat accumulates to the point where plant roots have minimal contact with either surface water or groundwater.

Calcareous: containing calcium carbonate. When the term is used to describe a type of rock, it implies that as much as 50% of the rock is calcium carbonate. Limestone is the most important and widely distributed of the carbonate rocks.

Calciphilic: thriving in environments rich in calcium salts.

Colluvium: weathered rock debris that has moved down a hill slope chiefly by gravity; includes talus and cliff debris.

Ecology: the study of relations between organisms and their natural environment, living and nonliving.

Ecosystem: The biotic (living) community and its abiotic (nonliving) environment functioning as a system.

Endemic: a species or other taxonomic group that is restricted to a particular geographic region, owing to such factors as isolation or response to soil or climatic conditions.

Esker: A deposit of sand and gravel formed by streams flowing within and under glaciers.

Eutrophication: the process of nutrient enrichment (usually by nitrates and phosphates) in aquatic ecosystems, such that the productivity of the system ceases to be limited by the availability of nutrients. It occurs naturally over geologic time, but may be accelerated by human activities (e.g., sewage disposal or agricultural run-off).

Extirpated: species that have become locally extinct since the settlement of this area by people of European descent.

Food-web: a conceptual diagram that represents the feeding relationships of organisms within an ecosystem. It consists of a series of interconnecting food-chains, and shows the transfer of energy from primary producers (green plants) through a series of organisms that eat and are eaten. Only some of the many possible relationships can be shown in such a diagram and it is usual to include only one or two carnivores at the highest trophic levels.

Geomorphic: pertaining to the form of the earth or of its surface features.

Graminoid: Grass or grass-like plant, including grasses (*Poaceae*), sedges (*Cyperaceae*), rushes (*Juncaceae*), arrow-grasses (*Juncaginaceae*), and quillworts (*Isoetes*).

Instar: an insect larva that is between one moult (ecdysis) of its exoskeleton and another, or between the final ecdysis and its emergence in the adult form. Instars are numbered and there are usually several during larval development.

Kame: A ridge of sand and gravel deposited in contact with a glacier by melting glacial ice.

Kettle: A depression left in glacial drift by pieces of glacial ice that generally fills with water, sediment, or vegetation.

Landscape Conservation Area (LCA): A large contiguous area important because of its size, contiguous forest, open space, habitats, and/or inclusion of one or more Biological Diversity Areas, and although including a variety of land uses, has not been heavily disturbed and thus retains much of its natural character.

Mast: a fruit, especially of beech, but also of oak, elm, and other forest trees.

Mesic: refers to an environment that is neither extremely wet (hydric) nor extremely dry (xeric).

Mineral soil: a soil composed predominantly of, and having its properties determined predominantly by, mineral matter. Usually contains < 20% organic matter, but may contain an organic surface layer up to 30 centimeters thick.

Mycorrhiza: a close physical association between a fungus and the roots of a plant, from which both fungus and plant appear to benefit; a mycorrhizal root takes up nutrients more efficiently than does an uninfected root. A very wide range of plants can form mycorrhizas of one form or another and some plants appear incapable of normal development in the absence of their mycorrhizal fungi.

Old-field ecosystem: develops on abandoned farmland as the land gradually reverts to forest.

Physiographic Province: A region of which all parts are similar in geologic structure and Climate and which has consequently had a unified geomorphic history; a region whose relief features and landforms differ significantly from that of adjacent regions.

Riparian: pertaining to or situated on the bank of a body of water, especially of a river.

Toe slope: The lowest part of a slope or cliff; the downslope end of an alluvial fan.

Trophic level: A step in the transfer of energy within a food-web. There may be several trophic levels within a system, for example: producers (autotrophs), primary consumers (herbivores), and secondary consumers (carnivores); further carnivores may form fourth and fifth levels.

Vernal: occurring in the spring.

Xeric: a dry, as opposed to a wet (hydric) or intermediate (mesic) environment.

Literature Cited

Anonymous. 1985. A preliminary inventory of natural areas of the Hoosier National Forest. Indiana Department of Natural Resources, Indianapolis, Indiana. Unpublished report. 197 p.

Bedford, B.L. and K.S. Godwin. 2003. Fens of the United States: distribution, characteristics, and scientific connection versus legal isolation. Wetlands 23(3): 608-629.

Blaustein, A. R., D. B. Wake, and W. P. Sousa. 1994. Amphibian declines: judging stability, persistence, and susceptibility of populations to local and global extinctions. Conservation Biology 8:60-71.

Brauning, D.W. 1992. Atlas of breeding birds in Pennsylvania. University of Pittsburgh Press, Pittsburgh, PA. 484 p.

Brennan, L.A. and W.P. Kuvlesky. 2005. North American grassland birds: an unfolding conservation Crisis? Journal of Wildlife Management 69(1): 1-13.

Brody, A. J., and M. R. Pelton. 1989. Effects of roads on black bear movements in western North Carolina. Wildlife Society Bulletin 17: 5-10.

Burns, R.M. and B.H. Honkala, tech coords. 1990. Silvics of North America: 1.Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington D.C. Volume 2, 877 p.

Butler, R.W. 1992. Great Blue Heron *In* The Birds of North America, No. 25 (A. Poole, P. Steenheim, and F. Gill, Eds.) Philadelphia: The Academy of Natural Sciences; Washington D.C.: The American Ornithologists' Union.

Ciszek, D. 2002. "Lynx rufus" Animal Diversity Web. [web application] http://animaldiversity.ummz.umich.edu/site/accounts/information/Lynx_rufus.html. Accessed: 19 March 2005.

Cote, S.D., T.P. Rooney, J. Trembley, J.P. Dussault, and D.M. Waller. 2004. The ecological impacts of deer overabundance. Annual Review of Ecology, Evolution and Systematics 35: 113-147.

Cummings, K.S. and C.A. Mayar. 1992. Field guide to freshwater mussels of the midwest. Illinois Natural History Survey Manual 5. Champaign, IL.194 p.

Curtis, P.D. and K.L. Sullivan. 2001. White-tailed deer, Wildlife Management Fact Sheet Series, Cornell Cooperative Extension, Cornell University, Ithaca, NY. 6 p.

Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. [Web application] http://www.npwrc.usgs.gov/resource/othrdata/wetloss/wetloss.htm (Version 16 July 97).

Davis, A.F., T.L. Smith, A.M. Wilkinson, E.B. Drayton, and G.J. Edinger. 1990. A natural areas inventory of Lancaster County, Pennsylvania. Pennsylvania Science Office of the Nature Conservancy, Middletown, Pennsylvania. 165 p.

Eastmen, J. 2000. Birds of Field and Shore: Grassland and Shoreline Birds of Eastern North America. Stackpole Books, Mechanicsburg, PA.

Environmental Protection Agency (EPA). 2001. Threats to Wetlands from Wetlands Fact Sheet Series. [Online]. http://www.epa.gov/owow/wetlands/
facts/threats.pdf. Accessed on 3 November 2006.

-------. 2006. Fens factsheet. [Online].http://www.epa.gov/owow/wetlands/types/fen.html. Accessed on 2 November 2006.

Fike, J. 1999. Terrestrial and Palustrine Plant Communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Natural Resources. Harrisburg, PA. 87pp.

Forman, R. T., and L. E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207-231.

Forman, R. T., and D. R. Deblinger. 2000. The Ecological Road-Effect Zone of a Massachusetts (U.S.A.) Suburban Highway. Conservation Biology 14:36-46.

Getz, L.L., L. Verner, and M. Prather. 1977. Lead concentrations in small mammals living near highways. Environmental Pollution 13: 151-157.

Goodrich, L. J., M. Brittingham, J.A. Bishop, and P. Barber. 2003. Wildlife habitat in Pennsylvania: past, present, and future. Pennsylvania Department of Conservation and Natural Resources. Harrisburg, PA. http://www.dcnr.state.pa.us/wlhabitat/.

Grund, S.P. and J.K. Bissell. 2006. Documenting the Flora Associated with the Glacial Lakes of Northwestern Pennsylvania. The Western Pennsylvania Conservancy. Pittsburgh, PA : 133 pages.

Haskell, D. G. 2000. Effects of forest roads on macroinvertebrate soil fauna of the southern Appalachian Mountains. Conservation Biology 14:57-63.

Heimlich, R.E., K.D. Wiebe, R. Classen, D. Gadsby, and R.M. House. 1998. Wetlands and agriculture: private interests and public benefits. Agriculture Economics Report No. (AER 765). United States Department of Agriculture(USDA):104 pp.

Jones, C., J. McCann and S. McConville. 2000. A Guide to the Conservation of Forest Dwelling Interior Birds In the Chesapeake Bay Critical Area. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays, Maryland Department of Natural Resources, Annapolis, MD.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler,and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, D.C., U.S.A.

Latham, R. E., J. Beyea, M. Benner, C. A. Dunn, M. A. Fajvan, R. R. Freed, M. Grund, S. B. Horsley, A. F. Rhoads and B. P. Shissler. 2005. *Managing White-tailed Deer in Forest Habitat From an Ecosystem Perspective: Pennsylvania Case Study*. Report by the Deer Management Forum for Audubon Pennsylvania and Pennsylvania Habitat Alliance, Harrisburg. xix + 340 pp.

Lynch, J. F., and D. F. Whigham. 1984. Effects of forest fragmentation on breeding bird communities in Maryland, USA. Biological Conservation 28:287-324.

Massachusetts Audubon Society. 2006. History of Grassland birds in the Northeast[Web application] http://www.massaudubon.org/Birds_&_Beyond/grassland/index.php. Accessed on 20 July 2006.

Master, L.L., S.R. Flack, and B.A. Stein, eds. 1998. *Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity.* The Nature Conservancy, Arlington, Virginia.

Matlack, G. R. 993. Microenvironment variation within and among forest edge sites in the eastern United States. Biological Conservation 66:185-194.

Mattice, J.A., D.W. Brauning, and D.R. Diefenbach. 2005. Abundance of Grassland Sparrows on Reclaimed Surface Mines in Western Pennsylvania. USDA Forest Service Gen. Tech. PSW-GTR-191: 504-510.

Mazur, K. M., and P. C. James. 2000. Barred Owl (*Strix varia*). *In* The Birds of North America,

No. 508 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

McCullough, D.G. and S.A. Katovich. 2004. Pest alert: Emerald Ash Borer Fact Sheet prepared for the U.S.D.A. Forest Service, Northeastern Area. Newton Square, Pa [Web application] http://www.na.fs.fed.us/spfo/pubs/pest_al/eab/eab.pdf. Accessed on 27 November 2006.

McKillen, M. 2001. When marl meant money: budding businesses gambled and lost mining a little-remembered marsh mineral. Wisconsin Natural Resources Magazine. Wisconsin Department of Natural Resources. [Online]. http://www.wnrmag.com/stories/2001/aug01/marl.htm. Accessed 13 November 2006.

McWilliams, G.M. and D.W. Brauning. 2000. The Birds of Pennsylvania. Cornell University Press. Ithaca, NY:

Miller, S.G., S.P. Bratton, and J. Hadidian. 1992. Impacts of white-tailed deer on endangered and threatened vascular plants. Natural Areas Journal 12(2): 67-74.

Mundahl, N.D. 1999. Population status and habitat requirements of the American brook lamprey in southeastern Minnesota. Report to the Minnesota Department of Natural Resources, Division of Wildlife and Fisheries, Natural Heritage and Non-game Research Program: 28 pp.

Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. Trends in Ecology & Evolution 10:58-62.

Myers, W., J. Bishop, R. Brooks, T. O'Connell, D. Argent, G. Storm, J. Stauffer, and R. Carline. 2000.The Pennsylvania Gap Analysis Project Final Report. The Pennsylvania State University and U.S. Geological Survey, University Park, PA. 142 p.

Naeem, S. (Chair), F.S. Chapin III., R. Costanza, P.R. Ehrlich, F.B. Golley, D.U. Hooper, J.H. Lawton, R.V. O'Neill, H.A. Mooney, O.E. Sala, A.J. Symstad, and D. Tilman. 1999. Biodiversity and ecosystem functioning: maintaining natural life support processes. Issues In Ecology #4. 11p.

Nash, B.L., D.D. Davis and J.M. Skelly. 1992. Forest health along a wet sulfate/pH deposition gradient in north-central Pennsylvania. Environmental Toxicology and Chemistry 11: 1095-1104.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Naugle, D.E. 2004. Black tern (*Chlidonias niger surinamiensis):* a technical conservation assessment. [web application]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/blacktern.pdf. Accessed on 2 November 2006.

Ohio Department of Agriculture. 2006. Ohio's EAB quarantine and Regulations. [Online] http://www.ohoagriculture.gov/eab/plnt-eab-regulations.stm. Accessed: 18 December 2006.

Ohio Department of Natural Resources. 2005. Life history notes: warmouth sunfish/ [Online] http://www.ohiodnr.com/WILDLIFE/fishing/aquanotes-fishid/warmouth.htm. Accessed on 23 Jan 2007.

--------. 2002. Central mudminnow Fact Sheet. [Online] http://www.odnr.com/dnap/rivfish/mudmin.html. Accessed on 18 January 2007.

Ostrofsky, M.L., B.L. Bodamer, A.D. McMillen. 2004. A trophic assessment and phosphorus budget for Sugar Lake in Crawford County, Pennsylvania. Crawford County Conservation District.

Ostrofsky, M.L., B.L. Bodamer, K.J. Butkas, A.D. McMillen. 2004. A Trophic Assessment and Phosphorus Budget for Sugar Lake in Crawford County, Pennsylvania. Crawford County Conservation District.

Ostroumov, S.A. 2002. New definitions of the concepts and terms ecosystem and biogeocenosis. Doklady Biological Sciences 383: 141-143(3).

Oxley, D. J., M. B. Fenton, and G. R. Carmody. 1974. The effects of roads of populations of small mammals. Journal of Applied Ecology 11:51-59.

PA CREP.(2006) http://www.pgc.state.pa.us/crep. Accessed: 24 July 2006.

PA DEP. Forest Quality and Current Threats. [Web application] http://dcnr.state.pa.us/wlhabitat/forest/forest_quality.htm. Accessed: 26 June 2006.

----------. 2006. Wetland Quality. [Web application]. http://www.dcnr.state.pa.us/wlhabitat/aquatic/wlqual.htm. Accessed: 22 November 2006.

----------. 2004. "Pennsylvania Integrated Water Quality Monitoring and Assessment Report." PA Department of Environmental Protection, Bureau of Watershed Conservation. Harrisburg, PA

Parendes, L. A., and J. A. Jones. 2000. Role of light availability and dispersal in exotic plant invasion along roads and streams in the H. J. Andrews Experimental Forest, Oregon. Conservation Biology 14:64-75.

Pennsylvania Bureau of Forestry. 2006. "Hemlock wooly adelgid." Document published online by DCNR. Available online: http://www.dcnr.state.pa.us/forestry/leaflets/wooley.htm

Pennsylvania Game Commission. 2006. Bald Eagle Threatened Species Factsheet. [Online] http://www.pgc.state.pa.us/pgc/cwp/view.asp?a=458&q=152498 .Accessed on 3 January 2007.

Pennsylvania 21st Century Environment Commission. 1998. Report of the 21st Century Environment Commission. http://www.21stcentury.state.pa.us/2001/final.htm.

Peterjohn, B.G. and D.L. Rice. 1991. The Ohio breeding bird atlas. Ohio Department of Natural Resources. Division of Natural Areas and Preserves. Columbus, Ohio: 416 pp.

Peterjohn, B.G. and J.R. Saur. 1999. Population status of North American grassland birds from the north American breeding bird survey (1966-1996). Studies in Avian Biology 19 (1): 27-44.

Reese, G.A., D.A. Albert, S.R. Crispin, L.A. Wilsmann, and S.J. Ouwinga. 1988. A natural heritage inventory of Oakland County, Michigan. Volume I: Technical Report: Michigan Natural Features Inventory, Lansing, Michigan. 242 p.

Reschke, C. 1990. Techniques used for the inventory of rare ecological communities in New York State. pp. 102 –105. In R.S. Mitchell, C.J. Sheviak and D.J. Leopold (eds.), Ecosystem management: rare species and significant habitats. New York State Museum Bulletin 471. 314 p.

Rhoads, A.F. and T. Block. 2000. The Plants of Pennsylvania. University of Pennsylvania Press.

Rhoads, A.F. and W.M. Klein Jr. 1993. The vascular flora of Pennsylvania, annotated checklist and atlas. American Philosophical Society Memoirs Vol. 207. Philadelphia, Pa: 636 p.

Robbins, C.S. 1980. Effects of forest fragmentation on breeding bird populations in the piedmont of the Mid-Atlantic Region. Atlantic Naturalist 33: 31-36.

Robertson, R.J. and R.F. Norman. 1976. Behavioral defenses to brood parasitism by potential hosts of the brown-headed cowbird. Condor 78(2): 166-173.

Robinson, W. D. 1995. Louisiana Waterthrush (*Seiurus motacilla*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 151. The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Rodewald, A. D. 2001. Ohio State University Extension Fact Sheet. Managing for Forest Songbirds. http://ohioline.osu.edu/w-fact/0006.html.

Rosenberg, K.V. and B. Robertson. 2003. Allegheny Plateau (Area 24) PIF Landbird Conservation Plan. American Bird Conservancy, The Plains, VA.

Rosenberg, K.V., R.W. Rohrbaugh, Jr., S.E. Barker, J.D. Lowe, R.S. Hames, and A.A. Dhondt. 1999. A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other Forest-Interior Birds. Cornell Lab of Ornithology.

Seiler, A. 2001. Ecological effects of roads: a review. Introductory Research Essay No. 9, Swedish University of Agricultural Sciences, Upsala, Sweden.

Schmidt, W. 1998. Plant dispersal by motor cars. Vegetatio 80: 147-152.

Shepps, V.C., G.W. White, J.B. Droste, and R.F. Stilter. 1959. Glacial geology of northwestern Pennsylvania. Bulletin G-32. Pennsylvania Department of Internal Affairs, Topographic and Geologic Survey, Harrisburg, PA. Bull G-32.

Shuford, W. D. 1999. Status assessment and conservation plan for the black tern (*Chlidonias niger surinamensis*) in North America. U.S. Department of Interior, Fish and Wildlife Service, Denver, CO.

Sloey, W.E., F.L. Spamgler, and C.W. Fetter. 1978. Management of freshwater wetlands for nutrient assimilation. Pages 323-324 *In* Good, R.E., Whigham, D.F., Simpson. 1978. Freshwater Wetlands: Ecological Processes and Management Potential. Proceedings of the Symposium Freshwater Marshes: Present Status, Future Needs at Rutgers University, New Brunswick, New Jersey. Academic Press, New York, NY: 378 p.

Smith, T.L. 1991. Natural Ecological Communities of Pennsylvania. Pennsylvania Natural Heritage Inventory. Department of Environmental Resources: 112 p.

Squires, J. R., and R. T. Reynolds. 1997. Northern Goshawk (*Accipiter gentilis*). *In* The Birds of North America, No. 298 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Steidl, R.J. and R.G. Anthony. 2000. Experimental effects of human activity on breeding bald eagles. Ecological Applications 10(1): 258-268.

Steiner, L. 2000. Pennsylvania Fishes. Pennsylvania Fish and Boat Commission. Harrisburg, PA: 170 p.

Stewart, R.E. 2001. Technical Aspects of Wetlands: Wetlands as Bird Habitat. National Summary on Wetland Resources, United States Geological Survey Water Supply Paper 2425. USGS. http://water.usgs.gov/nwsum/WSP2425/birdhabitat.html. Accessed on 10 June 2006.

Swain, P.C. and J.B. Kearsley. 2001. Classification of the Natural Communities of Massachusetts. Version 1.3. Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife. Westborough, MA.

Tautin, J. 2004. Pennsylvania Important Bird Area #4 Cussewago Bottom Phase I Conservation Plan. Prepared for the Pennsylvania Audubon Society.

----------.2004. Pennsylvania Important Bird Area #7 Conneaut Marsh-Geneva Marsh Phase I Conservation Plan. Prepared for the Pennsylvania Audubon Society.

Thompson, E.H. and E.R Sorenson. 2000. Wetland, woodland, wildland: a guide to the natural communities of Vermont. The Nature Conservancy and the Vermont Department of Fish and Wildlife. University Press of New England. Hanover, NH: 456 p

Thorne, S. G., K. C. Kim and K. C. Steiner, Eds. (1996). A Heritage for the 21st Century: Conserving Pennsylvania's Native Biological Diversity. Pennsylvania Fish and Boat Commission. Harrisburg, PA. 60 p.

Tomelleri, J.R. and M.E. Eberle. 1990. Fishes of the central United States. University Press of Kansas. 226 p.

Trombulak, S. C., and C. A. Frissell. 2000. Review of the ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

Upper St. Clair Township, Department of Deer Management. 2005. Deer Management Updates. http://www.twpusc.org/admin/deer/updates.htm

U.S. Fish and Wildlife Service. 2006. Erie National Wildlife Refuge Fact Sheet. U.S. Department of the Interior. [Web application] http://library.fws.gov/refuges. Accessed: 23 October 2006

-------. 2006. Great Blue Heron Fact Sheet. U.S. Department of the Interior, Chesapeake Bay Field Office. [Web application] http://www.fws.gov/chesapeakebay/heron.htm. Accessed 21 November 2006.

-------. 2001. Urban conservation treaty for migrating birds. U.S. Department of the Interior. [Web application] http://www.fws.gov/birds/uctmbga/index.html. Accessed on 22 November 2006.

-------. 1997. Clubshell (*Pleurobema clava*), Endangered Species Fact Sheet. U.S. Department of the Interior, Region 3. [Web application] http://www.fws.gov/Midwest/Endangered/clams/clubs_fc.html. Accessed on 30 November 2006.

U.S. NABCI Committee. 2000. The North American Bird Conservation Initiative in the United States: A Vision of American Bird Conservation. U.S. Fish and Wildlife Service: Arlington, VA.

Vellidis, G., M. Smith, and R. Lowrance. 2003. Impact and Control of Agricultural Runoff: Riparian forest buffer systems slow the flow of sediment and nutrients from cultivated lands. Stormwater: The Journal for Surface Water quality Professionals. [web application] http://www.forester.net/sw_0305_impact.html. Accessed on 24 October 2006.

Watkins, R. Z., J. Chen, J. Pickens, and K. D. Brosofske. 2003. Effects of forest roads on understory plants in a managed hardwood landscape. Conservation Biology 17:411-419.

Weseloh, D.V.C., J., Rodrigue, H. Blokpoel, and P.J. Ewins. 1997. Contaminant concentrations in eggs of black terns (*Chlidonias nigra*) from southern Ontario and southern Quebec, 1989-1996.Colonial Waterbirds 20(3): 606-616.

Western Pennsylvania Conservancy. 1995. Erie National Wildlife Refuge Natural Heritage Inventory Report.

Williams, C. E. 1995. Effects of powerline corridors on forest ecosystem integrity. Pages 76-86 *in* S. K. Majumdar, E. W. Miller, and F. J. Brenner, editors. Environmental Contaminants, Ecosystems and Human Health. Pennsylvania Academy of Science, Easton, PA.

Williams, J.D., M.L. Warren, K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9): 6-22.

Wilson, M. and E. Rebek. 2005. Signs and symptoms of the emerald ash borer. Fact Sheet. [Online] http://www.emeraldashborer.inof/files/E-2983.pdf. Michigan State University Extension, Lansing, MI and The Ohio State University Extension OARDC, Wooster, OH. Accessed on 18January 2007.

Yahner, R.H. 2000. Eastern Deciduous Forest: Ecology and wildlife Conservation. University of Minnesota Press: Minneapolis, MN.

Appendices

Appendix I: Significance Ranks

The Natural Heritage Areas that have qualified for inclusion in this report are ranked according to their significance as areas of importance to the biological diversity and ecological integrity of Crawford County. 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 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 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 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: Sites that have great potential for protecting biodiversity in the county but are not, as of yet, known to contain species of 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.

Appendix II: Pennsylvania Natural Heritage Program Data System

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

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

PNHP has recorded over 15,000-detailed occurrences of species and communities of special concern, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps. Additional data are stored in extensive manual and digital files set up for over 200 natural community types, 1400 animals, and 3500 plants. These files are organized by each of Pennsylvania's 881 7½ USGS topographic quadrangle maps using a geographic information system (GIS).

In order to conduct an inventory of significant flora, fauna, and natural communities in the county, scientists from the Middletown office of the Western Pennsylvania Conservancy first consulted the database maintained by the PNHP. They then used this systematic inventory approach to identify the areas of highest natural integrity in Mifflin 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 of the County's natural communities, and viable populations of sensitive plant and animal species can help to insure that a full range of biological diversity in Crawford County is preserved for the future.

Appendix III: County Natural Heritage Inventory Site Survey Form

County: _____ Quad: _____ Date: _____ GPS'd?_____

Site #: _____ Site Name: _____ Photo? _____

Source Code: _____ Field Crew: _____

Site Description (incl snags, woody debris, scat, etc.):

Wildlife Observations:

Overstory Dominant(s): _____

Understory Dominant(s): _____

Herb Layer Dominant(s): _____

Impacts/Threats: _____

	Cover Class						
Woody spp.	SE	SA	U	O	SH	**Herbs**	**Ferns & Fern Allies**
							Graminoids

Appendix IV: 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 Vc lists 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 TYPE (**Fike 1999**)	GLOBAL RANK	STATE RANK
TERRESTRIAL FORESTS:		
Hemlock (white pine) forest	G5	S4
Serpentine pitch pine – oak forest	G2	S1
Serpentine Virginia pine – oak forest	G2	S1
Pitch Pine – mixed oak forest	G?	S4
Virginia pine – mixed hardwood forest	G?	S5
Dry white pine (hemlock) – oak forest	G?	S4
Hemlock (white pine) – northern hardwood forest	G?	S5
Hemlock (white pine) – red oak – mixed hardwood forest	G?	S4
Hemlock – tuliptree – birch forest	G?	S4
Rich hemlock – mesic hardwoods forest	G?	S2S3
Dry oak –heath forest	G?	S4S5
Dry oak – mixed hardwood forest	G?	S3
Red oak – mixed hardwood forest	G?	S5
Northern hardwood forest	G?	S4
Black cherry – northern hardwood forest	G?	S4
Tuliptree – beech – maple forest	G?	S4
Sugar maple – basswood forest	G?	S4
Mixed mesophytic forest	G?	S1S2
Sweet gum – oak coastal plain forest	G?	S1
Red maple (terrestrial) forest	G?	S5
Black-gum ridgetop forest	G?	S3
Aspen/gray (paper) birch forest	G?	S?
Black locust forest	G?	S5
Black Spruce- tamarack peatland forest	G?	S3
Red Spruce palustrine forest	G?	S3

COMMUNITY TYPE (**Fike 1999**)	GLOBAL RANK	STATE RANK
PALUSTRINE FORESTS:		
Hemlock palustrine forest	G5	S3
Hemlock – mixed hardwood palustrine forest	G?	S3S4
Red spruce – mixed hardwood palustrine forest	G?	S3
Bottomland oak – hardwood palustrine forest	G5	S2
Red maple – black-gum palustrine forest	G5	S3S4
Red maple – black ash palustrine forest	G?	S2S3
Red maple – magnolia Coastal Plain palustrine forest	G?	S1
Great Lakes Region lakeplain palustrine forest	G?	S1
Sycamore – (river birch)- box elder floodplain forest	G?	S3
Silver maple floodplain forest	G?	S3
Red maple – elm – willow floodplain swamp	G?	S2
TERRESTRIAL WOODLANDS:		
Pitch pine – heath woodland	G4	S2
Pitch pine – scrub oak woodland	G4	S2
Red spruce rocky summit	G?	S1
Pitch pine – rhodora – scrub oak woodland	G?	S1
Pitch pine – mixed hardwood woodland	G4	S2S3
Virginia pine – mixed hardwood shale woodland	G?	S2
Red-cedar – mixed hardwood rich shale woodland	G?	S1S2
Dry oak – heath woodland	G4	S3
Birch (black-gum) rocky slope woodland	G?	S2
Yellow oak – redbud woodland	G?	S2
Great Lakes Region scarp woodland	G?	S1S2
Great Lakes Region bayberry – cottonwood community	G?	S1
PALUSTRINE WOODLANDS:		
Pitch pine – leatherleaf woodland	G?	S2
Black spruce – tamarack palustrine woodland	G?	S2
Red spruce palustrine woodland	G?	S2S3
Red maple – highbush blueberry palustrine woodland	G5	S4
Red maple – sedge palustrine woodland	G5	S4
Red maple – mixed shrub palustrine woodland	G?	S4
TERRESTRIAL SHRUBLANDS:		
Red-cedar – prickly pear shale shrubland	G?	S2
Red-cedar – pine serpentine shrubland	G2	S1
Red-cedar – redbud shrubland	G?	S2
Low heath shrubland	G4	S1
Low heath – mountain ash shrubland	G?	S2
Scrub oak shrubland	G4	S3
Rhodora – mixed heath – scrub oak shrubland	G?	S1
PALUSTRINE SHRUBLANDS:		
Buttonbush wetland	G?	S4
Alder – ninebark wetland	G?	S3
Alder – sphagnum wetland	G5	S4
Highbush blueberry – meadow-sweet wetland	G5	S5
Highbush blueberry – sphagnum wetland	G?	S5
Leatherleaf – sedge wetland	G?	S3

COMMUNITY TYPE (**Fike 1999**)	GLOBAL RANK	STATE RANK
Leatherleaf – bog rosemary	G?	S2
Leatherleaf – cranberry peatland	G?	S2S3
Water-willow (*Decodon verticillatus*) shrub wetland	G?	S3
River birch – sycamore floodplain scrub	G?	S4
Poison sumac – red-cedar – bayberry fen	G2	S1
Buckthorn – sedge (*Carex interior*) – golden ragwort fen	G2G3	S1
Great Lakes Region scarp seep	G?	S1
Great Lakes Region bayberry – mixed shrub palustrine shrubland	G?	S1
TERRESTRIAL HERBACEOUS OPENINGS:		
Side-oats gramma calcareous grassland	G2	S1
Calcareous opening/cliff	G?	S2
Serpentine grassland	G?	S1
Serpentine gravel forb community	G?	S1
Great Lakes Region dry sandplain	G?	S1
HERBACEOUS WETLANDS:		
Bluejoint – reed canary grass marsh	G?	S5
Cat-tail marsh	G?	S5
Tussock sedge marsh	G?	S3
Mixed forb marsh	G3G4	S3
Herbaceous vernal pond	G?	S3S4
Wet meadow	G?	S5
Bulrush marsh	G?	S3
Great Lakes Region palustrine sandplain	G?	S1
Prairie sedge – spotted joe – pye – weed marsh	G?	S1S2
Open sedge (*Carex stricta*, *C. prairea*, *C. lacustris*) fen	G?	S1
Golden Saxifrage – sedge rich seep	G?	S2
Skunk cabbage – golden saxifrage forest seep	G?	S4S5
Serpentine seepage wetland	G?	S1
Golden saxifrage – Pennsylvania bitter-cress spring run	G?	S3S4
Sphagnum – beaked rush peatland	G?	S3
Many fruited sedge – bladderwort peatland	G?	S2
Water-willow (*Justicia americana*) – smartweed riverbed community	G?	S4
Riverside ice scour community	G?	S1S2
Big bluestem – Indian grass river grassland	G?	S3
Pickerel-weed – arrow-arum – arrowhead wetland	G3G4	S4
Spatterdock – water lily wetland	G?	S4

COMMUNITY TYPE (**Fike 1999**)	GLOBAL RANK	STATE RANK
COMMUNITY COMPLEXES:	Complexes not ranked	
Acidic Glacial Peatland Complex		
Great Lakes Region Scarp Complex		
Erie Lakeshore Beach-Dune-Sandplain Complex		
Mesic Till Barrens Complex		
Serpentine Barrens Complex		
Ridgetop Acidic Barrens Complex		
River Bed-Bank-Floodplain Complex		

COMMUNITY TYPES (**Smith 1991**)	GLOBAL RANK	STATE RANK
SUBTERRANEAN COMMUNITIES:		
Solution Cave Terrestrial Community	G?	S3
Solution Cave Aquatic Community	G?	S3
Tectonic Cave Community	G?	S3S4
Talus Cave Community	G?	S2S4
DISTURBED COMMUNITIES:		
Bare Soil	G?	S?
Meadow/Pastureland	G?	S?
Cultivated Land	G?	S?
Successional Field	G?	S?
Young Miscellaneous Forest	G?	S?
Conifer Plantation	G?	S?
ESTUARINE COMMUNITIES:		
Deepwater Subtidal Community	G?	S1
Shallow-Water Subtidal Community	G?	S1
Freshwater Intertidal Mudflat	G3G4	S1
Freshwater Intertidal Marsh	G3G4	S1
RIVERINE COMMUNITIES:		
Low-Gradient Ephemeral/Intermittent Creek	G?	S5
Low-Gradient Clearwater Creek	G?	S3S4
Low-Gradient Clearwater River	G?	S2S3
Low-Gradient Brownwater Creek	G?	S2S3
Medium-Gradient Ephemeral/Intermittent Creek	G?	S5
Medium-Gradient Clearwater Creek	G?	S3
Medium-Gradient Clearwater River	G?	S?
Medium-Gradient Brownwater Creek	G?	S3
High-Gradient Ephemeral /Intermittent Creek	G?	S5
High-Gradient Clearwater Creek	G?	S3
High-Gradient Clearwater River	G?	S?
High-Gradient Brownwater Creek	G?	S?
Waterfall and Plungepool	G?	S3S4
Spring Community	G?	S1S2
Spring Run Community	G?	S1S2

COMMUNITY TYPES (**Smith 1991**)	GLOBAL RANK	STATE RANK
LACUSTRINE COMMUNITIES:		
Glacial Lake	G?	S1
Nonglacial Lake	G?	S2
Artificial Lake	---	---
Natural Pond	G?	S2S3
Artificial Pond	---	---
Stable Natural Pool	G?	S?
Ephemeral/Fluctuating Natural Pool	G?	S3
Artificial Pool	---	---
Ephemeral/Fluctuating Limestone Sinkhole	G?	S1

Appendix V: Federal and State Endangered Species Categories

Several federal and state legislative acts have provided the authority and means for the designation of endangered, threatened, rare, etc. species lists. Those acts and status summaries follow. However, not all of the species or natural communities considered by conservation biologists (e.g., Pennsylvania Biological Survey) as "special concern resources" are included on the state or federal lists. In this county inventory report, "N" denotes those special concern species that are not officially recognized by state or federal agencies. Therefore: N = No current legal status, but is considered to be of special concern in Pennsylvania, or is under review for such consideration, by conservation biologists. Contact the Pennsylvania Natural Heritage Program for more information.

Appendix Va: Federal Status

All Plants and Animals: Legislative Authority: U.S. Endangered Species Act (1973), U.S. Fish and Wildlife Service, February 21, 1990, 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 throughout all or a significant portion of their ranges.

PE = Proposed Endangered - Taxa already proposed to be listed as endangered.

PT = Proposed Threatened - Taxa already proposed to be listed as threatened.

Appendix Vb: Pennsylvania Status

Native Plant Species: Legislative Authority: Title 25 Chapter 82, Conservation of Native Wild Plants, January 1, 1988; 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 are 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 their future decline, or if the species is greatly exploited by man.

PR = Pennsylvania Rare - Plant species which are uncommon within this Commonwealth because they may be found in restricted geographic areas or in low numbers throughout this Commonwealth.

PX = Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plants may or may not be in existence outside the Commonwealth.

PV = Pennsylvania Vulnerable - Plant species which are in danger of population decline within this Commonwealth 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 - A classification of 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.

Animals - The following state statuses are used by the Pennsylvania Game Commission (Legislative Authority: Title 34, Chapter 133 pertaining to wild birds and mammals, Game and Wildlife Code, revised Dec. 1, 1990) and by the Pennsylvania Fish and Boat Commission (Legislative Authority: Title 30 Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms, Fish and Boat Code, revised February 9, 1991):

PE = Pennsylvania Endangered

Birds & mammals - 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 is 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 are 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, amphibians, reptiles & aquatic organisms - All species declared by: 1) 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) are declared by the Pennsylvania Fish and Boat Commission, Executive Director to be threatened with extinction and appear on the Pennsylvania Endangered Species List published by the Pennsylvania Bulletin.

PT = Pennsylvania Threatened

Birds & mammals - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the casual factors affecting the organism are abated. These are: 1) species whose population within the Commonwealth are decreasing or are heavily depleted by adverse factors and while not actually endangered, are still in critical condition; 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that are 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, amphibians, reptiles & aquatic organisms - All species declared by: 1) 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) are declared by the Pennsylvania Fish and Boat Commission Executive Director 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.

Internal Fish and Boat Commission Status Category:

PC = Pennsylvania Candidate

Species that exhibit the potential to become Endangered or Threatened in the future. Pennsylvania populations of these taxa are: 1) "rare" due to their decline, distribution, restricted habitat, etc.; 2) are "at risk" due to aspects of their biology, certain types of human exploitation, or environmental modification; or, 3) are considered "undetermined" because adequate data is not available to assign an accurate status. This category is unofficial and has no basis in any law (i. e., Chapter 75, Fish and Boat Code), as do the Endangered and Threatened categories.

Invertebrates - Pennsylvania Status: No state agency is assigned to develop regulations to protect terrestrial invertebrates, although a federal status may exist for some species. Aquatic invertebrates are regulated by the Pennsylvania Fish And Boat Commission, but have not been listed to date. Although no invertebrate species are presently state listed, conservation biologists unofficially assign numerous state status and/or state rank designations. NOTE: Invertebrate species are regularly considered under the U.S. Endangered Species Act for federal status assignments.

Appendix Vc: Global and State Ranking

Global and State Ranking is a system utilized by the network of 50 state natural heritage programs in the United States. Although similar to the federal and state status designations, the ranking scheme allows the use of one comparative system to "rank" all species in a relative format. Unlike state or federal status designation guidelines, the heritage ranking procedures are also applied to natural community resources. Global ranks consider the imperilment of a species or community throughout its range, while state ranks provide the same assessment within each state. Although there is only one global rank used by the heritage network, state ranks are developed by each state and allow a "one-system" comparison of a species or communities imperilment state by state. For more information, contact the Pennsylvania Natural Heritage Program.

Global Element Ranks

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres)or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

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.

G? = Not ranked to date.

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 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 (occurring only once or a few times) or casual (occurring more regularly but not every year) 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 or catalpa in eastern states).

SH = Of historical occurrence in the state, perhaps having not been verified in the past 20 years, and suspected to be still extant.

SN = Regularly occurring, usually migratory and typically nonbreeding 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.

SU = Possibly in peril in state but status uncertain; need more information.

SX = Apparently extirpated from the state.

SZ = Not of significant conservation concern in the state, invariably because there are no (zero) definable element occurrences in the state, although the taxon is native and appears regularly in the state.

S? = Not ranked to date.

NOTE: The study of naturally occurring biological communities is complex and natural community classification is unresolved both regionally and within Pennsylvania. The Global and State Ranking of natural communities also remains difficult and incomplete. Although many natural community types are clearly identifiable and are ranked, others are still under review and appear as G? and/or S?

Appendix VI: Animals, Plants, and Natural Communities of Special Concern in Crawford County

Table 11. Animals of Special Concern in Crawford County documented in the Pennsylvania Natural Heritage Program database since 1980.

Scientific Name	Common Name
Birds	
Ardea herodias	Great Blue Heron
Botaurus lentiginosus	American Bittern
Chlidonias niger	Black Tern
Cistothorus palustris	Marsh Wren
Cistothorus platensis	Sedge Wren
Fulica americana	American Coot
Gallinula chloropus	Common Moorhen
Haliaeetus leucocephalus	Bald Eagle
Ixobrychus exilis	Least Bittern
Podilymbus podiceps	Pied billed Grebe
Porzana carolina	Sora
Protonotaria citrea	Prothonotary Warbler
Fish	
Amia calva	bowfin
Ammocrypta pellucida	eastern sand darter
Culaea inconstans	brook stickleback
Erimystax dissimilis	streamline chub
Etheostoma camurum	bluebreast darter
Etheostoma maculatum	spotted darter
Etheostoma tippecanoe	Tippecanoe darter
Ichthyomyzon bdellium	Ohio lamprey
Ichthyomyzon greeleyi	mountain brook lamprey
Lampetra appendix	American brook lamprey
Lepomis gulosus	warmouth
Lythrurus umbratilis	redfin shiner
Moxostoma carinatum	river redhorse
Nocomis biguttatus	hornyhead chub
Notropis dorsalis	bigmouth shiner
Noturus eleutherus	mountain madtom
Noturus gyrinus	tadpole madtom
Noturus miurus	brindled madtom
Noturus stigmosus	northern madtom
Percina evides	gilt darter
Percina macrocephala	longhead darter
Phoxinus erythrogaster	southern redbelly dace
Amphibians	
Rana pipiens	Northern Leopard Frog
Mussels	
Alasmidonta marginata	elktoe
Amblema plicata	three ridge
Anodontoides ferussacianus	cylindrical papershell

Epioblasma torulosa rangiana	northern riffleshell
Epioblasma triquetra	snuffbox
Fusconaia subrotunda	long solid
Lampsilis fasciola	wavy-rayed lampmussel
Lasmigona complanata	white heelsplitter
Lasmigona compressa	creek heelsplitter
Ligumia nasuta	eastern pondmussel
Pleurobema clava	clubshell
Pleurobema sintoxia	round pigtoe
Quadrula cylindrica	rabbitsfoot
Simpsonaias ambigua	salamander mussel
Umbra limi	central mudminnow
Utterbackia imbecillis	paper pondshell
Villosa fabalis	rayed bean mussel
Villosa iris	rainbow mussel
Butterflies	
Chlosyne harrisii	Harris's checkerspot
Euphyes conspicuus	black dash
Dragonflies	
Aeshna verticalis	green-striped darner
Argia tibialis	blue-tipped dancer
Arigomphus furcifer	lilypad clubtail
Cordulia shurtleffi	American emerald
Gomphus fraternus	midland clubtail
Gomphus quadricolor	rapids clubtail
Libellula incesta	slaty skimmer
Nasiaeschna pentacantha	Cyrano darner
Sympetrum obtrusum	white-faced meadowhawk
Rhionaeschna mutata	spatterdock darner

Table 12. Plants of Special Concern in Crawford County documented in the Pennsylvania Natural Heritage Program database since 1980

Scientific Name	**Common Name**
Plants	
Acorus americanus	sweet flag
Alopecurus aequalis	short-awn foxtail
Bidens discoidea	small beggar-ticks
Cardamine pratensis var. palustris	cuckooflower
Carex alata	broad-winged sedge
Carex bebbii	Bebb's sedge
Carex buxbaumii	brown sedge
Carex cryptolepis	Northeastern sedge
Carex diandra	lesser panicled sedge
Carex disperma	soft-leaved sedge
Carex flava	yellow sedge

Carex lasiocarpa	slender sedge
Carex lupuliformis	false hop sedge
Carex mitchelliana	Mitchell's sedge
Carex prairea	prairie sedge
Carex pseudocyperus	cyperus-like sedge
Carex typhina	cattail sedge
Cladium mariscoides	twig rush
Cuscuta cephalanthi	button-bush dodder
Cyperus engelmannii	Engelmann's flatsedge
Cypripedium calceolus var. parviflorum	small yellow lady's slipper
Cypripedium reginae	showy lady's-slipper
Dryopteris clintoniana	Clinton's wood fern
Eleocharis elliptica	slender spike
Eleocharis intermedia	matted spike-rush
Epilobium strictum	downy willow-herb
Erigenia bulbosa	harbinger-of-spring
Eriophorum viridicarinatum	thin-leaved cotton-grass
Erythronium albidum	white trout-lily
Filipendula rubra	queen-of-the-prairie
Fraxinus profunda	pumpkin ash
Galium labradoricum	labrador marsh bedstraw
Galium trifidum	marsh bedstraw
Helianthus microcephalus	small wood sunflower
Iris virginica	Virginia blue flag
Lonicera oblongifolia	swamp fly honeysuckle
Megalodonta beckii	Beck's water-marigold
Myriophyllum sibiricum	northern water-milfoil
Myriophyllum verticillatum	whorled water-milfoil
Pedicularis lanceolata	swamp lousewort
Platanthera dilatata	leafy white orchid
Platanthera hyperborea	leafy northern green orchid
Poa languida	drooping bluegrass
Poa paludigena	bog bluegrass
Polygala polygama	racemed milkwort
Polygonum setaceum var. interjectum	a swamp smartweed
Potamogeton friesii	Fries' pondweed
Potamogeton praelongus	white-stemmed pondweed
Potamogeton richardsonii	red-head pondweed
Potamogeton vaseyi	Vasey's pondweed
Potamogeton zosteriformis	flat-stem pondweed
Quercus shumardii	Shumard's oak
Ranunculus aquatilis var. diffusus	white water-crowfoot
Ribes triste	red currant
Salix myricoides	broad-leaved willow
Salix serissima	autumn willow
Samolus parviflorus	pineland pimpernel
Schoenoplectus acutus	hard-stemmed bulrush
Schoenoplectus fluviatilis	river bulrush
Sorbus decora	showy mountain-ash

Spiranthes romanzoffiana	hooded ladies'-tresses
Symphyotrichum boreale	rush aster
Symphyotrichum praealtum	veiny-lined aster
Utricularia intermedia	flat-leaved bladderwort
Viburnum trilobum	highbush-cranberry
Wolffiella gladiata	bog-mat

Table 13. Natural Communities of Special Concern in Crawford County documented in the Pennsylvania Natural Heritage Program database since 1980.

Community Name
Alder – Ninebark Wetland
Alder - Sphagnum Wetland
Black Spruce - Tamarack Peatland Forest
Buckthorn - Sedge (*Carex interior*) - Golden Ragwort Fen
Golden Saxifrage - Sedge Rich Seep
Hemlock - Mixed Hardwood Palustrine Forest
Hemlock (White Pine) -Northern Hardwood Forest
Hemlock Palustrine Forest
Leatherleaf - Sedge Wetland
Mixed Forb Marsh
Northern Hardwood Forest
Oligotrophic Glacial Kettlehole Bog
Poison Sumac - Red-Cedar - Bayberry Fen
Red maple - Black Ash Palustrine Forest
Red maple - Black-Gum Palustrine Forest
Rich Hemlock – Mesic Hardwoods Forest
Silver Maple Floodplain Forest
Skunk Cabbage - Golden Saxifrage Forest Seep
Sycamore – (River Birch) – Box Elder Floodplain Forest

Appendix VII: Sustainable Forestry Information Sources

The *Pennsylvania Forest Stewardship Program* is a voluntary program that assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. Participation 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.sfiofpa.org/ or contact:

SFI® of PA
315 S. Allen Street, Suite 418
State College, PA 16801
814-867-9299 or 888- 734-9366; E-mail: sfi@penn.com

Forest Landowner Associations provide information and educational programs to help members better manage their forest resources. For more information, contact:
Woodland Owners of the Southern Alleghenies
c/o Christine T. Gruitt, Secretary
1482 Town Creek Road
Clearville, PA 15535
E-mail: dgruitt@mindspring.com
(Bedford and Fulton Counties)

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 VIII: GIS Data Sources

Bedrock geologic units of Pennsylvania, scale 1:250,000. Digital datasets prepared by C.E. Miles, T.G. Whitfield, from published 1980 state geologic map. 2001. Pennsylvania Bureau of Topographic and Geologic Survey, DCNR. Available online: http://www.dcnr.state.pa.us/topogeo/gismaps/digital.aspx. Accessed: 2003.

Bishop, Joseph A. 1998. Managed Lands in Pennsylvania. Pennsylvania GAP Analysis Project, Environmental Resources Research Institute.

Bishop, Joseph A. 2003. IBA core polygon boundaries.

Ecological regions of North America, Level III. 1997. North American Commission for Environmental Cooperation. Available online: http://www.epa.gov/wed/pages/ecoregions/na_eco.htm. Accessed: March 2004.

Local roadways in Somerset County, Pennsylvania. 2003. Pennsylvania Department of Transportation, Bureau of Planning and Research, Geographic Information Division.

National Elevation Dataset for Crawford County, Pennsylvania, U.S. Geological Survey, EROS Data Center 1999.

National Land Cover Data Set for Pennsylvania; Albers Grid. Compiled from Landsat satellite TM imagery (circa 1992) with spatial resolution of 30 m. USGS 1999.

National Wetlands Inventory ArcInfo Coverages. U.S. Fish and Wildlife Service. Available online: http://wetlands.fws.gov/Maps/maps.htm. Accessed: April 2003.

Pennsylvania Minor Civil Divisions: PA Explorer CD-ROM Edition, Environmental Resources Research Institute, from the Pennsylvania Department of Transportation's civil divisions data set 1996.

Pennsylvania Natural Diversity Inventory (PNDI) Spatial Database. Pennsylvania Natural Heritage Program, 2006

Pennsylvania-Small Watershed, Environmental Resources Research Institute, Pennsylvania Department of Environmental Protection, 5/3/1997.

Pennsylvania Spatial Data Access. Digital Orthophoto MrSID mosaic (NAPP,II 1993-1995). Available online: http://www.pasda.psu.edu/. Accessed April 2003.

Sevon, W.D. 2000. Physiographic provinces of Pennsylvania (Color), 4th edition, scale 1:2,000,000, 8.5" X 11". (Harrisburg: PA DCNR, Bureau of Topographic and Geologic Survey). (GIS version, Pennsylvania's Physiographic Regions: PA Explorer CD-ROM Edition, Environmental Resources Research Institute, 1996.)

State maintained roadway centerlines of Pennsylvania, 2003. Pennsylvania Department of Transportation, Bureau of Planning and Research, Geographic Information Division.

Streams of Somerset County. PA Explorer CD-ROM Edition, Environmental Resources Research Institute, 1996.

USGS 1:24,000 Topographic quadrangles. Pennsylvania Spatial Data Access (PASDA), downloaded 2003. http://www.pasda.psu.edu/

Bald Eagle

Haliaeetus leucocephalus

Global Rank: G4
State Rank: S2B

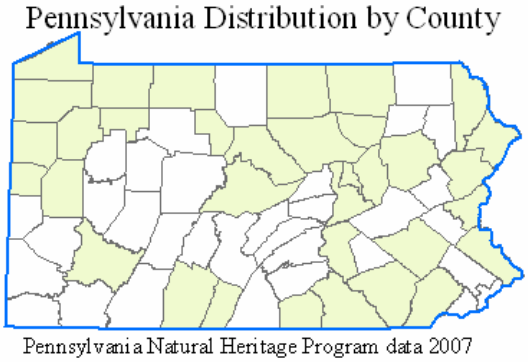
Identification

photo source: Ron Austing

Bald Eagles are large raptors with a body length up to 32 inches and a wing span 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 been found throughout Pennsylvania, with most sightings concentrated in the northwestern and southeastern corners of the state.



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

Great Blue Heron (*Ardea herodias*) Rookery

State Rank: S3S4
Global Rank: G5

General description

A rookery is a colony of nesting birds. Great Blue Herons build their nests as high as 30 meters off the ground, in wooded areas isolated from human disturbance. Although they are wading birds, living on fish caught at the edges of rivers, in ponds, and in wetlands, Great Blue Heron rookeries may be located well away from water features. One colony found in Pennsylvania was as much as 17 miles from good fishing grounds. Great Blue Herons may also nest in mixed-species rookeries with other heron species, other waterbirds, or even raptors such as owls and hawks.

Life in the rookery

Great Blue Herons usually return to the same rookery site every year, starting in the spring when males arrive to scout the area and claim their nests, from which they court the later-arriving females. Nests are re-used and expanded year-to-year – they start as simple platforms of sticks but can eventually become saucers up to a meter deep. Each mated pair builds up the nest together, the male bringing new twigs and other materials to the female, who adds them to the structure. In Pennsylvania, the eggs are laid from mid-March to early June, after the female has had access to sufficient food for a period of about a week. Chicks hatch about a month later, usually less than two days apart, in the order in which their eggs were laid. Broods usually contain two or three chicks. The parents share the tasks of incubating the eggs and feeding the chicks, catching more than 20 percent of their own body weight in fish every day.

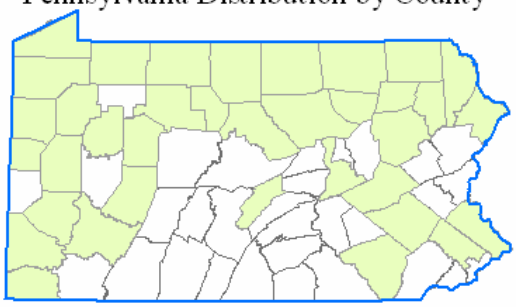
Photo source: Larry Master, NatureServe

Great Blue Herons chicks are covered with a light coat of gray down. Chicks require the most food between 26 and 41 days after hatching, when they may eat 270 grams (about 0.6 pounds) of fish each day. The chicks are ready to leave the nest by the end of the summer.

Threats to heron rookeries:

Protection of breeding grounds is one of the keys to conserving bird species. Great Blue Herons tolerate fewer disturbances to their breeding colonies than most waterbirds. It is recommended that human activity be excluded from a buffer zone of 300 meters (roughly 1000 feet) around heron rookeries to prevent people from scaring the herons off their nests. Severe or prolonged disturbance may cause the birds to abandon the nesting site, though they may re-colonize nearby if they find suitable habitat. Rookeries are also vulnerable to destruction of forest habitat and, when they are located in wetlands, changes to the flood regime that may kill trees.

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2007

References

- Bennett, Darin C., Philip E. Whitehead, and Leslie E. Hart. 1995. "Growth and energy requirements of hand-reared Great Blue Heron (*Ardea herodias*) chicks." *The Auk*, 112(1): 201-9.
- Brauning, Daniel W., ed. 1992. Atlas of Breeding Birds in Pennsylvania. Pittsburgh: University of Pittsburgh Press. 50-1.
- Butler, Robert. W. 1992. "Great Blue Heron." *In* The Birds of North America, No. 25 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.
- NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.2. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed 7 March 2005.
- Rodgers, James A. and Henry T. Smith. 1995. "Set-back distances to protect nesting bird colonies from human disturbance in Florida." *Conservation Biology*, 9(1): 89-99.

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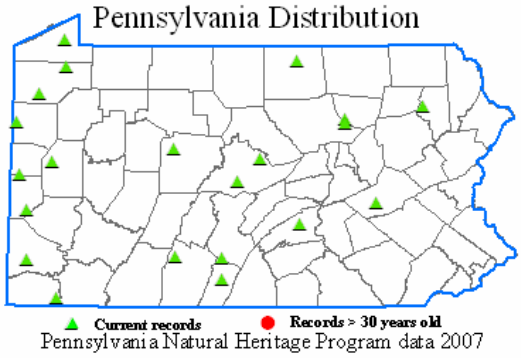
Pied-billed grebe
Podilymbus podiceps

State Rank: S3B, S4N
Global Rank: G5

Victor Loewen, Animal Diversity Web.

What it looks like:
The pied-billed grebe is a small water bird, about 31-38 cm (12-15 in), with a blunt beak that bears a single distinctive stripe in the mating season. Male and female adults are both drab brown with white rumps and diagnostic black patches on the throat and forehead. The chicks are striped in sharp black and white. Because pied-billed grebes are secretive, especially during their breeding season, their population size and distribution are not known in detail.

Where it is found:
Pied-billed grebes inhabit wetlands near open water, including farm ponds, marshes, artificial lakes, and flooded quarries. They require thick vegetation of some sort – rushes, reeds, or cattails – to provide cover and anchorage for their floating nests. They are year-round residents of the North American southeast and west, as well as southern South America and breeding residents from the midwestern and eastern United States north into Canada.



Pennsylvania Natural Heritage Program data 2007

Why it is rare:
The pied-billed grebe is most vulnerable to human alteration of its wetland habitats: draining, filling, or other interference with natural hydrology. However, Ickes (in Brauning 1992) suggests that this danger may be offset by the grebe's willingness to nest in artificial ponds. Recreational activities such as boating and fishing may also disturb the birds.

Robert W. Hines, Digital Library System, 2005.

Conservation considerations:
The pied-billed grebe can benefit most from preservation and restoration of wetland habitats and from control of disruptive human activities near its breeding grounds. NatureServe's management recommendations call for preserved wetlands to be larger than 10 hectares, with healthy populations of emergent and submerged vegetation and for breeding grounds to be protected from chemical pollution, siltation, and eutrophication. Maintenance of stable water levels in managed wetlands can greatly improve the grebes' reproductive success.

References

- Brauning, Daniel W., ed. 1992. Atlas of Breeding Birds in Pennsylvania. Pittsburgh: University of Pittsburgh Press. 44-5.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed 11 January 2005.
- Smith, A. 2003. "Podilymbus podiceps." Animal Diversity Web [web application]. University of Michigan Museum of Zoology, Ann Arbor, Michigan. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Podilymbus_podiceps.html. Accessed 24 February 2005.
- U.S. Fish and Wildlife Service. 2005. Digital Library System: Gateway to Digital Media [web application]. USFWS, Washington, DC. Available at http://www.images.fws.gov. Accessed 14 February 2005.

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Barn Owl
Tyto alba

State Rank: S3B, S3N
Global Rank: G5

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.

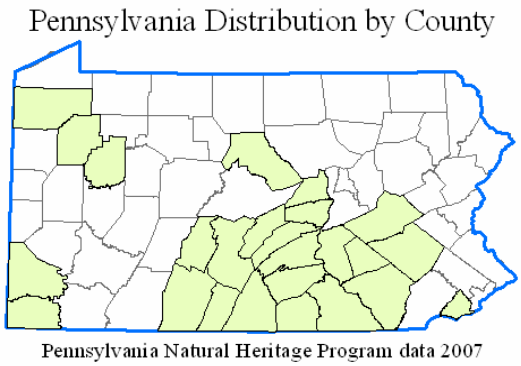
Range

Barn Owls have a nearly world-wide 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.

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.

Pennsylvania Natural Heritage Program

References

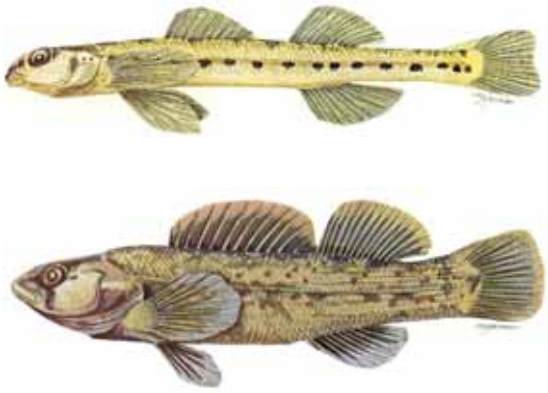
- Austing, Ron. Wildlife Photography, Barn Owl. http://www.ronausting.com/barnowl.htm
- Brauning, D.W. (ed.). 1992. Atlas of Breeding Birds in Pennsylvania Univ. of Pittsburgh Press, Pittsburgh, PA. 484 pp.
- Gough, G.A., Sauer, J.R., Iliff, M. *Patuxent Bird Identification Infocenter*. 1998. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD. http://www.mbr-pwrc.usgs.gov/Infocenter/infocenter.html

Darters

Genus *Ammocrypta*, *Etheostoma*, and *Percina*

Description:

Darters are a diverse group of freshwater fish that make up the bulk of the Perch family (Percidae) in eastern North America. They are generally quite small, usually less than ten centimeters (four inches) long, with small ctenoid, or toothed, scales. Like all percids, darters have two dorsal fins, the foremost of which is spiny. Their pelvic fins, which each have one anterior spine, are located well forward on the thorax. Most darters have smaller teeth than other percids.



The eastern sand darter, *Ammocrypta pellucida*, and the spotted darter, *Etheostoma maculatum*

Kraft et al. 2003 – from *The Inland Fishes of New York State*, C. Lavett Smith (New York State Department of Environmental Conservation, 1985).

Darter species native to Pennsylvania include:
The **eastern sand darter (*Ammocrypta pellucida*)**, which is considered critically imperiled in Pennsylvania and throughout the Northeast (G3, S1); the **spotted darter (*Etheostoma maculatum*)**, which is imperiled in the commonwealth and throughout the Ohio River drainage (G2, S2); the **bluebreast darter (*Etheostoma camurum*)**, which is imperiled in the commonwealth at risk throughout the eastern United States(G4, S2); and the **gilt darter (*Percina evides*)**, which is considered imperiled to critically imperiled in the commonwealth and throughout the mid-Atlantic states (G4, S1S2).

Habitat:

Most darter species have either reduced swim bladders or none at all, which gives them less control of their buoyancy than other percids. Thus they spend most of their time swimming along the bottom of streams and lakes, where they hunt under rocks and pebbles for small crustaceans and insects. Darter species are found in clear streams, ponds, and lakes across North America.

The bluebreast darter, *Etheostoma camurum,* and the gilt darter, *Percina evides*

NatureServe - Noel Burkhead & Virginia Dept of Game and Inland Fisheries (*Fishes of Virginia*)

Darters' use of microhabitats within a stream or pond varies with their reproductive cycle. During the mating season, habitat use may be fairly complex, with males establishing and defending territories in riffles, often surrounding rocks or other areas suitable for egg deposition. Females partition their habitat use as well, searching for food in pools, away from the males' territories in the riffles. Some darter species will migrate upstream at the beginning of the mating season to find breeding habitat.

Threats to Pennsylvania's darters:

Darters are vulnerable to a wide variety of direct and indirect human interference with their environment. They may be harmed by pollutants dumped directly into the water and by polluted runoff from agricultural and residential pesticide or

fertilizer applications. Sudden, irregular changes in stream flow caused by hydroelectric dams may significantly harm fish communities as lowering water levels may leave small fish stranded and rising water levels expose small, shallow-water species to predation by larger, deep-water species. Obstructions to fish movement such as dams and weirs may block darters' migration to breeding habitat, disrupting mating behaviors and significantly reducing mating success. Sedimentation and alteration of streambeds can also significantly affect the health of darter populations, which need clear water and specific kinds of substrates.

Conservation considerations:

Preservation of Pennsylvania's rare and endangered darter species will require coordinated efforts on several fronts. Darter populations need protection from water pollution and habitat alteration. They can benefit from protection and expansion of wetlands, which help to clean and clarify runoff water, as well as from the removal of movement barriers such as lowhead dams. Establishing more uniform flow regimes below hydroelectric dams is also likely to improve conditions for darters.

References

- Bain, Mark B., John T. Finn, and Henry E. Booke. 1988. "Streamflow regulation and fish community structure." *Ecology*, 69(2): 382-92.
- Cooper, Edwin Lavern. 1983. *Fishes of Pennsylvania and the Northeastern United States*. University Park, PA: The Pennsylvania State University Press. 243p.
- Kraft, C.E., D.M. Carlson, and S.C. Brown. 2003. "The On-line Fishes of New York State [web application]." Version 2.1. Department of Natural Resources, Cornell University, Ithaca, NY. Available at http://fish.dnr.cornell.edu/nyfish/fish.html. Accessed 11 March 2005.
- Lachner, Ernest A., Edward F. Westlake, and Paul S. Handwerk. 1950. "Studies on the biology of some percid fishes from Western Pennsylvania." *American Midland Naturalist*, 43(1): 92-111.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed 11 and 14 March 2005.
- Page, Lawrence M. and Brooks M. Burr. 1991. *Peterson Field Guides Freshwater Fishes*. Boston: Houghton Mifflin Company. 273-326.
- Stauffer, Jay R., Jr., Jeffrey M. Boltz, and Laura R. White. 1995. *The Fishes of West Virginia*. Philadelphia: Academy of Natural Sciences of Philadelphia. 288-338.
- Winn, Howard E. 1958. "Comparative reproductive behavior and ecology of fourteen species of darters (Pisces-Percidae)." *Ecological Monographs*, 28(2): 155-91.

Ohio Lamprey
Ichthyomyzon bdellium

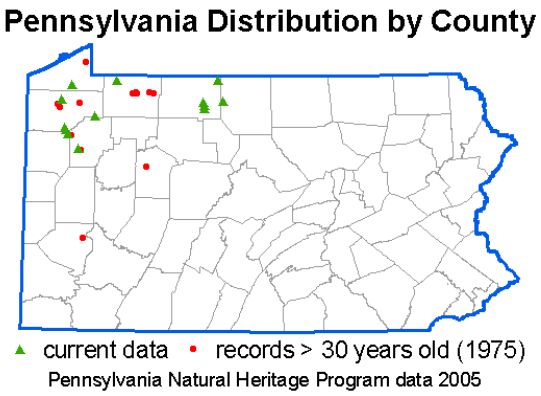
S State Rank: S2
Global Rank: G3G4

What it looks like:

Lampreys are a group of boneless, jawless fish found in fresh and salt waters throughout the world. Their blind larvae, called an *ammocoetes,* live by filtering microorganisms from the water, but the eel-like adults are often parasites, using their toothed oral discs to attach to large fish and rasp holes in their hosts' sides.

Ohio DNR Native Fish Conservancy, Animal Diversity Web

The Ohio lamprey, *Ichthyomyzon bdellium*, is a parasitic species found throughout the Ohio River drainage. Its single dorsal fin is notched, and it is blue to gray above with a lighter, mottled underside. Its oral disc is lined with sharp, well-developed teeth, and as wide or wider than its head when expanded. A black lateral line runs down each side from head to tail.



Where it is found:

Ohio lamprey adults are found in medium to large rivers. They lay their eggs in nests constructed in gravel streambeds. The ammocoete larvae burrow into the muddy bottoms of tributary streams to feed by filtration. This species remains in larval form for about four years, and lives for around two more as an adult.

Why it is rare:

Ohio lampreys are widespread throughout their range, but they are known only from scattered occurrences. NatureServe suggests that more intensive sampling would reveal previously undocumented occurrences.

Conservation considerations:

Because its larval state is a filter-feeder, the Ohio lamprey is sensitive to changes in water chemistry and quality. Environmental changes that adversely affect its host fish populations will also affect the lamprey, and human-built barriers may cut lampreys off from spawning grounds.

References

- Branson BA. 1970. "Measurements, counts, and observations on four lamprey species from Kentucky (Ichthyomyzon, Lampetra, and Entosphenus." *American Midland Naturalist*, 84(1): 243-7.
- "Ichthyomyzon bdellium." Animal Diversity Web [web application]. University of Michigan Museum of Zoology, Ann Arbor, Michigan. Available at http://animaldiversity.ummz.umich.edu/site/accounts/ information/Ichthyomyzon_bdellium.html. Accessed 22 April 2005.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Accessed 22 April 2005.
- Page, Lawrence M. and Brooks M. Burr. 1991. *Peterson Field Guides Freshwater Fishes*. Boston: Houghton Mifflin Company. 273-326.

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Southern redbelly dace
Phoxinus erythrogaster

Global Rank: G5
State Rank: S1

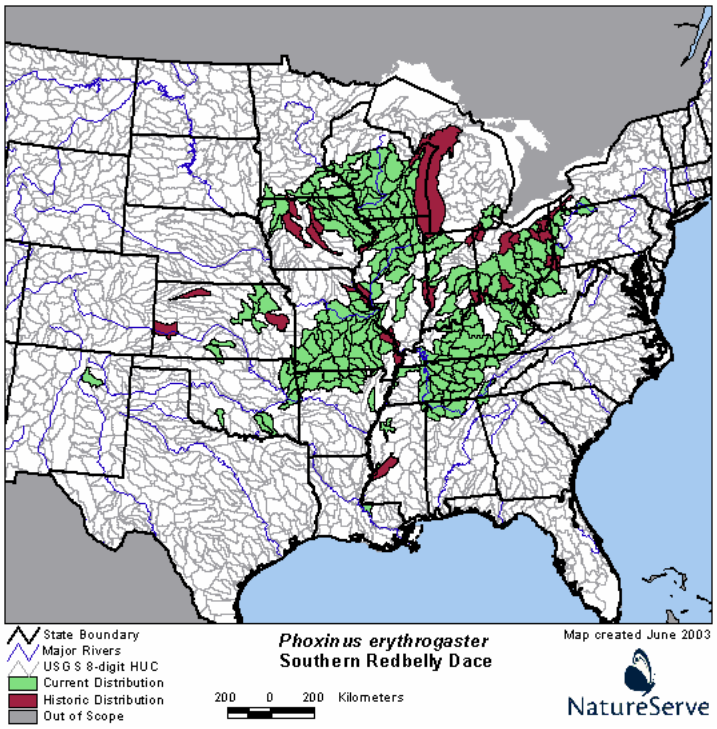
Description

The southern redbelly dace has a reported maximum age of 3 years and a maximum length of 9.1 cm (fishbase.org). It has a cream colored lateral band that is layered between dark bands on its sides. The top dark band starts at the edge of the gill cover and turns into a series of spots at the base of the tail. The lower band encircles the snout and ends at the tail. Black dots are present along the back before the dorsal fin. Its scales are minute (iowadnr.com).

© Native Fish Conservancy

Behavior

Breeding males will develop a striking scarlet stripe along their lower sides during the late May, early June, spawning season. A single female will spawn with a pair of males on sandy or pebbly riffles in contact with the bottom, over the nest of a hornyhead chub. In large congregations of spawning, up to 4 males were observed spawning in a single group (Cooper 1983). There is no nest guarding in this species.



Diet

This species is observed to eat less plant material than its relative, the northern redbelly dace (Cooper 1983). Its major diet is algae and detritus. It will also take aquatic invertebrates, especially chironomids (natureserve.org)

Threats and Protection Needs

This species is globally secure but critically imperiled in Pennsylvania. It is ranked Pennsylvania Threatened (naturalheritage.state.pa.us.) Despite being critically imperiled in many of the states in which it is found, including Colorado, Michigan, New Mexico, Pennsylvania and South Dakota, there is little data available data on threats to the species of protection needs (natureserve.org).

Habitat

The southern redbelly dace is found in headwaters and upland creeks (often spring-fed) in generally clear water. It has been found to school under bank overhangs among tree roots in clear ponds with muck bottoms and also over gravel, rubble or sand. It is found in the Great Lakes and Mississippi River basins from New York to Southern Minnesota, south to Tennessee and Alabama. There are isolated populations in the lower Mississippi river basin as well as Colorado and New Mexico (natureserve.org).

References

- Cooper, Edwin L. Fishes of Pennsylvania and the Northeastern United States. The Pennsylvania State University Press and University Park and London. 1983
- Iowa Department of Natural Resources. Fish and Fishing. http://www.iowadnr.com/fish/iafish/srd-card.html. Accessed: 9/15/05.
- NatureServe Explorer: An online encyclopedia of life [web application]. 2002. Version 1.6. Arlington,VA. Website: www.natureserve.org/explorer.
- Pennsylvania National Heritage Program: information on conservation of biodiversity [web application]. Version 1.0.6.2. Website: http://www.naturalheritage.state.pa.us/. Accessed: 9/15/2005

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Bowfin
Amia calva

Global Rank: G5
State Rank: S2S3

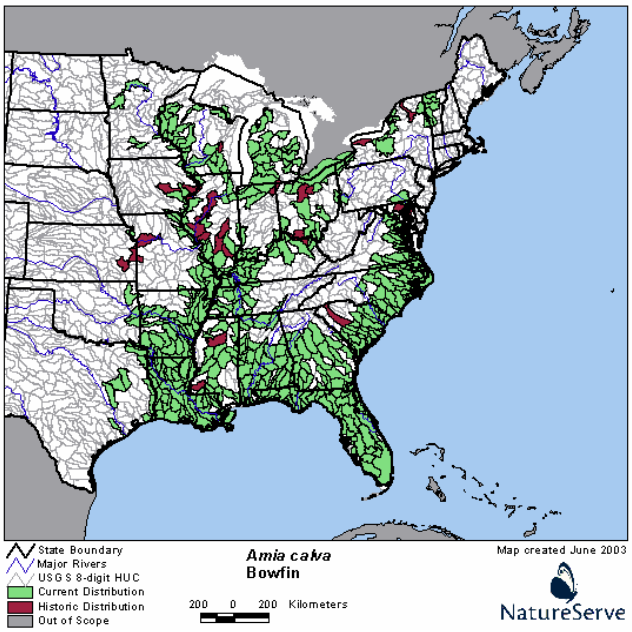
Description

Photo: © Native Fish Conservancy

The Bowfin is the only living member of the Amiidae family, which lived 150 million years ago, and is thus a unique fish. They are a large, robust fish, growing several feet in length and up to ten pounds. Their color is olive-green on the back, lighter and mottled on the sides, and yellowish on the belly. Male bowfins can be identified by the dark spot on the upper side of the base of the tail fin. A single long, low dorsal fin extends over half the length of the body andis barely separeted from the anal fin. The Bowfin has a pair of short barbels near the nostrils and has sharp, strong, teeth (Steiner 2000).

Behavior

Bowfin mature and are ready to spawn when they are two to four years in age. They begin spawning in the spring when the male clears a round depression in the weedy shallows. Several females will then deposit their adhesive eggs in the nest and the male will guard them until they are older fry. The Bowfin, like gars, have a lung-like swim bladder which enables them to swim to the surface and gulp air when the water becomes too stagnant and anoxic (Steiner 2000).



Diet

The Bowfin is a sluggish fish compared to others. It feeds opportunistically on many kinds of small animals like fish, crayfish, frogs, earthworms, and insects (natureserve.org). The Bowfin has a reputation as a voracious predator, however this is a questionable assumption (Cooper 1983).

Threats and Protection Needs

As a candidate rare species in Pennsylvania, meaning it is geographically restricted in its habitats. Anglers must release the Bowfin immediately if caught (Steiner 2000). Not much data is available on the threats and protection needs of the Bowfin but it is assumed that a primary threat is habitat destruction. Bowfins can tolerate very warm water and have the ability to limit their body functions and slow their activities. Such characteristics allow the Bowfin to tolerate waters that other fish cannot.

Habitat

The Bowfin is widely distributed over the eastern half of the U.S. and adjacent southern Canada. It is found from the Great Lakes region to the St. Lawrence River, south along the Atlantic Coastal Plain to Florida, along the Gulf Coast and in the Mississippi River basin. It becomes most abundant in heavily vegetated warm lakes and rivers (natureserve.org). In Pennsylvania, the Bowfin is considered imperiled and is found only in the Presque Isle region of Lake Erie and at a few other places in the Delaware and Susquehanna drainages. Reports of anglers taking Bowfin from other places are probably due to occasional introductions (Cooper 1983).

References

- NatureServe Explorer: An online encyclopedia of life [web application]. 2002. Version 1.6. Arlington, VA. Website: www.natureserve.org/explorer.
- Cooper, Edwin L. Fishes of Pennsylvania and the Northeastern United States. The Pennsylvania State University Press and University Park and London. 1983
- Steiner, Linda, Pennsylvania Fishes. Pennsylvania Fish and Boat Commission Bureau of Boating and Education Educational Media Section. 2000.

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Brook stickleback

Global Rank: G5
State Rank: S3

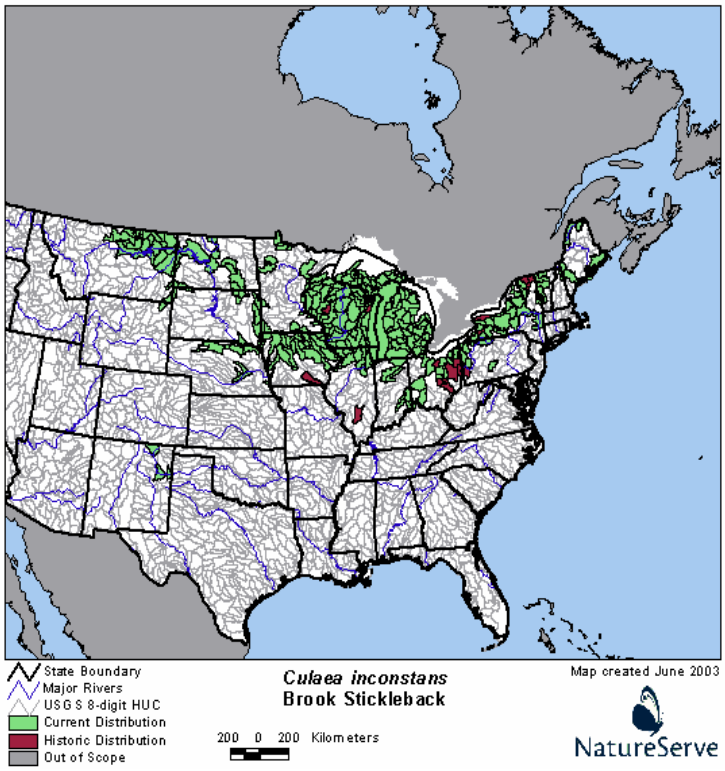
Culaea inconstans

Description

A small fish, the Brook stickleback grows to about two inches long. The adults are dark green to black with light spots on sides, but spawning males are often completely black. The body is laterally compressed, and the head is conical with a truncate lower jaw. The dorsal fins are unique, composed of an average of 5 short, isolated backswept spines with individual membranes followed by 9 soft dorsal rays united by a single membrane. The body is also without scales, although there are small plates by lateral line pores (Colorado Division of Wildlife).

Behavior

The brook stickleback is a nest building species. It is ariadnophils, meaning that the male has the ability to secrete a mucous from its kidney, which it then uses to plaster and bind together a hollow nest made out of bits of vegetation (Cooper 1983).



Diet

The diet of the brook stickleback is quite varied. According to Cooper it consists of nearly any organism small enough to be captured and swallowed. It is an opportunistic species eating various aquatic invertebrates, fish, eggs and larvae of both, and plants (natureserve.org).

Threats and Protection Needs

More northern populations of the brook stickleback, including those in the Great Lakes and further across the provinces of Canada are secure. Thus, little has been published about threats to this species. The range of the brook stickleback in Pennsylvania is historically limited. The Pennsylvania Fish and Boat Commission described the brook stickleback as only being found in the Ohio watershed, but Cooper and other sources (natureserve.org) give it a wider range including isolated watersheds in the Susquehanna drainage. It is a proposed candidate species in Pennsylvania (Steiner 2000).

Habitat

The brook stickleback is a rare but locally abundant species found sporadically in the Ohio, Erie, and Susquehanna watersheds of Pennsylvania (Cooper 1983). It prefers cool, clear, heavily weeded, spring-fed creeks, small rivers, lakes and ponds. They are occasionally found in brackish water. In Pennsylvania the brook stickleback is considered vulnerable (natureserve.org).

References

- Cooper, Edwin L. Fishes of Pennsylvania and the Northeastern United States. The Pennsylvania State University Press and University Park and London. 1983
- Colorado Division of Wildlife. Natural Diversity Information Source. http://ndis.nrel.colostate.edu/wildlifespx.asp?SpCode=010608
- NatureServe Explorer: An online encyclopedia of life [web application]. 2002. Version 1.6. Arlington,VA. Website: www.natureserve.org/explorer.
- Steiner, Linda, Pennsylvania Fishes. Pennsylvania Fish and Boat Commission Bureau of Boating and Education Educational Media Section. 2000

Cylindrical Papershell
Anodontoides ferussacianus

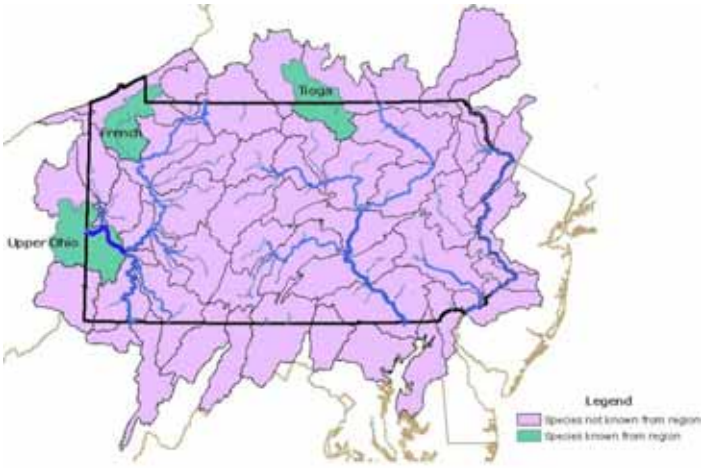
Global Rank: G5
State Rank: S2S3

Identification

The cylindrical papershell (*Anodontoides ferussacianus*) is a small mussel, usually less than 75 mm in length. The shell is subelliptical, elongate, thin, and moderately inflated (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997). The anterior margin is rounded, whereas the posterior margin is bluntly pointed. The posterior ridge is rounded but distinct. The dorsal margin is straight and the ventral margin has a slight indentation, appearing "pinched" at the midpoint. The beaks are somewhat inflated and slightly raised above the hinge line. The beak sculpture is fine and consists of two or three concentric ridges at the peak of the umbo (beak). Hinge teeth are absent but pseudocardinal teeth appear as irregular swellings along the hinge line. The periostracum (outer covering) is usually light green to yellowish brown, sometimes displaying green rays (may appear faint in adult specimens). Black concentric bands on the surface are indicative of rest periods during growth. The nacre (inner iridescent coloring) is bluish white or silvery (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997).

Photo:

http://webdev.museum.state.il.us/ismdepts/zoology/mussels/gallery.html?RollID=mussel 01&FrameID=anodont



Habitat

The preferred habitat of the cylindrical papershell is shallow water near shore in silt. It is thought to inhabit small streams, creeks, and lakes in sand or fine gravel (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997).

Host Fish

Known glochidial hosts for the cylindrical papershell include the bluegill, black crappie, spotfin shiner, largemouth bass, mottled sculpin, bluntnose minnow, common shiner, Iowa darter, white sucker, and the sea lamprey (Parmalee 1998;Strayer and Jirka 1997).

Status

Populations of *Anodontoides ferussacianus* can be found in the Mississippi River basin from Pennsylvania and West Virginia west to Minnesota and Colorado. Individuals have been located throughout the St. Lawrence River system and the Great Lakes, James Bay and Hudson Bay drainage from central Ontario to southeastern Saskatchewan (Parmalee 1998; Strayer and Jirka 1997). This mussel is thought to possibly be extirpated from Tennessee since it has not been reported during surveys for several decades (Parmalee 1998; www.natureserve.org/explorer). This species is not common in Pennsylvania but has been found in the Susquehanna River system and Delaware basin. The Pennsylvania proposed state status of the cylindrical papershell is condition rare (CR) due to the lack of individuals located during mussel surveys (www.naturalheritage.state.pa.us/invertebrates.aspx). The distribution and origin of *Anodontoides ferussacianus* populations call for further study because it is not well understood how this species crossed over into the Susquehanna River basin. It could have migrated due to postglacial influences or it may have been introduced by humans (Strayer and Jirka 1997). More surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

References

- NatureServe Explorer: An online encyclopedia of life [web application]. 2005. Version 4.5. Arlington, VA. Website: www.natureserve.org/explorer.
- Parmalee, P.W. and Bogan, A.E. 1998. The Freshwater Mussels of Tennessee. The University of Tennessee, Knoxville, TN 328 pp.
- 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.
- Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, N.Y. 113 pp and plates.

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Creek Heelsplitter

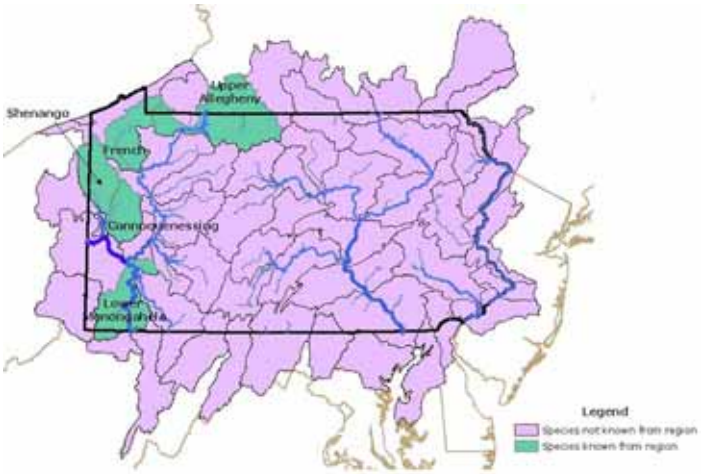
Lasmigona compressa

State Rank: S2S3
Global Rank: G5


Photo: www.darbycreeks.org/creekheelsplitterLittleDarby72.jpg

Identification

The creek heelsplitter (*Lasmigona compressa*) is a moderately sized mussel, usually less than 100 mm in length. The shell is subtrapeziodal in shape, compressed, and moderately thick. Juvenile specimens can sometimes have a small dorsal wing (Strayer and Jirka 1997). The periostracum (outer covering) is somewhat smooth and varies from greenish (juvenile) to greenish-black (adult), sometimes with fine green rays (usually apparent in young individuals). The beak sculpture is obvious and double-looped (Sietman 2003; Strayer and Jirka 1997). Pseudocardinal teeth are present but are smooth and reduced. Lateral teeth are delicate, but functional and interlocking. There is a prominent interdental tooth in the left valve between the lateral teeth and pseudocardinal teeth (Strayer and Jirka 1997). The nacre (inner iridescent coloring) is usually white, but can be cream or salmon colored (especially toward the beak cavity) (Sietman 2003; Strayer and Jirka 1997). *Lasmigona compressa* can be confused with *Lasmigona subviridis*. The latter species is smaller, more ovate, and has a significantly smaller interdental tooth. Additionally, its beak sculpture only has three to four smaller, less deeply curved double-looped bars that are distinctly nodulous. The beak sculpture of *Lasmigona compressa* consists of four to five large, deeply grooved double-looped bars of even height. Additionally, *Lasmigona compressa* is one of the few freshwater mussels that are hermaphroditic (Strayer and Jirka 1997).



Habitat

The creek heelsplitter is typically located in creeks, but can sometimes be observed in streams too small to adequately support other species of freshwater mussels (Strayer and Jirka 1997). It is most commonly found in headwaters of small or medium rivers in fine gravel or sand (Sietman 2003; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

Host Fish

Suitable host fish for the creek heelsplitter include the slimy sculpin, spotfin shiner, black crappie, and the yellow perch (Strayer and Jirka 1997; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

Status

Lasmigona compressa lives in the Mississippi River basin from Kentucky north, as well as in the St. Lawrence basin, the Great Lakes basin, and the Hudson River basin (Strayer and Jirka 1997; www.natureserve.org/explorer). Additionally, *Lasmigona compressa* has been located in the northeastern headwaters of the Susquehanna River basin. It is not well understood how this species migrated to these locations. The Pennsylvania proposed state status is condition rare (CR) due to a lack of individuals located during surveys (www.naturalheritage.state.pa.us/invertebrates.aspx). Little is known about the status of freshwater mussels in Pennsylvania and the United States. Because of this, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

References

- National Park Service. U.S. Dept. of the Interior. Mississippi National River and Recreation Area. Website: www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html
- NatureServe Explorer: An online encyclopedia of life [web application]. 2005. Version 4.5. Arlington, VA. Website: www.natureserve.org/explorer.
- 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. Department of Natural Resources, St. Paul, MN 140 pp.
- Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, NY 113 pp and plates.

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Mitchell's sedge
Carex mitchelliana

State Rank: S1
Global Rank: G3G4

What it looks like:

Mitchell's sedge (*Carex mitchelliana*) is a grass-like perennial herb with a triangular stem. The leaves are long and slender, usually one to two decimeters (six inches to one foot) long by 2.5 to five millimeters (0.1 to 0.2 inch) wide. Flowers are very small, arranged in three or more unisexual spikes: the male upright and smaller, located at the tip of the stem. The female spikes lower, larger, and drooping.

Where it is found:

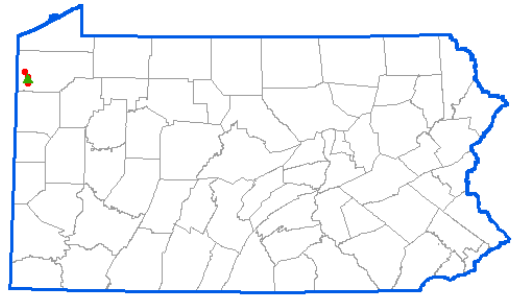
Mitchell's sedge grows in swampy woods and wet meadows from New York and Massachusetts south to Mississippi and Florida.

Why it is rare:

Mitchell's sedge occurs in many populations, but is rare and scattered throughout its range.

Conservation considerations:
Mitchell's sedge can recover in Pennsylvania if its wetland habitats are preserved and protected from draining or other hydrological alterations. Control of invasive exotic species such as imported varieties of the common reed (*Phragmites australis*) will also be necessary.

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2005

Pennsylvania Natural Heritage Program

References

- Denton, Shirley. 2001. Native and Naturalized Plants of Florida [web site]. Biological Research Associates, Sarasota, Florida. Available at http://www.biologicalresearch.com/plants. Accessed 5 January 2005.
- Gleason, Henry A. and Arthur Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second ed. New York: The New York Botanical Garden. 731.
- Harrison, Jason W. 2001. Ecologically significant areas in Wicomico County: Rare plant sites newly identified or updated in 2000. Maryland Dept. of Nat. Res., Annapolis, Maryland. 84.
- Holmgren, Noel H. 1998. The Illustrated Companion to Gleason and Cronquist's Manual. New York: The New York Botanical Garden. 684.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed 22 December 2004.

Cattail sedge
Carex typhina

State Rank: S2
Global Rank: G5

What it looks like:

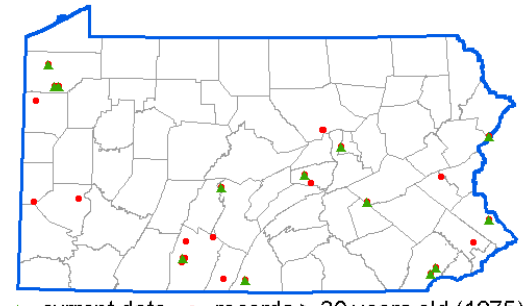
Robert H. Mohlenbrock, USDA-NRCS PLANTS Database - from *Midwest wetland flora: Field office illustrated guide to plant species.* (USDA SCS, Midwest National Technical Center, Lincoln, NE., 1989)

Cattail sedge is a grass-like perennial that grows from 30 to 90 centimeters tall. The leaves are long and narrow, with parallel veins and a pronounced midrib. The lowest leaves grow from a point on the stem well above the ground, rather than at the base of the stem, a feature described as aphyllopody. Flowers are small, simple, and unisexual, grouped in a spike-like head at the apex of the stem. Pistillate (female) flowers form a cylindrical head above the smaller cluster of staminate (male) flowers.

Where it is found:

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.

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2005

Why it is rare:

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 considerations:

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

- Gleason, Henry A. and Arthur Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States ar* New York: The New York Botanical Garden. 735.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. Nat Available http://www.natureserve.org/explorer. Accessed 3 March 2005.
- 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.

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Harbinger-of-spring
Erigenia bulbosa

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Description

Harbinger-of-spring is a delicate perennial herb with a weak, hairless stem that may grow up to 6 inches (15 cm) in height. The hairless leaves are subdivided into numerous linear or narrowly oblong leaflets. This species represents one of the earliest-blooming wildflowers in Pennsylvania, with the flowers generally appearing from March into early April. The tiny individual flowers occur in small clusters at the end of a long stalk. Each flower has 5 white petals that are only about 1/8 of an inch (3-4 mm) in length, and contrast noticeably with the blackish anthers. The tiny fruit breaks into 2 sections at maturity. The leaves and stem usually die back to the ground in June.

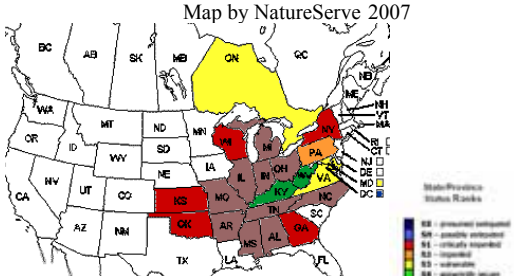
Photo source: John Kunsman (PNHP)

Distribution & Habitat

Harbinger-of-spring has a range from southern Canada south into the Great Lakes states and the Middle Atlantic states. In Pennsylvania, it has been documented historically in several western and southeastern counties. It grows on wooded slopes, floodplain forests, and in rich woodlands.

North American State/Province Conservation Status

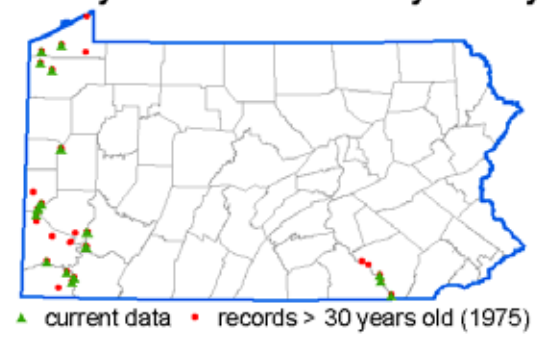
Map by NatureServe 2007



Current State Status

The PA Biological Survey considers harbinger-of-spring to be a species of concern, based on the relatively few occurrences that have been recently documented. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 40 populations are currently known from the state.

Pennsylvania Distribution by County



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Conservation Considerations

The known populations of harbinger-of-spring have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

NatureServe conservation status ranks

G5 – Secure globally; S2– Imperiled in Pennsylvania

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References

- NatureServe. 2006. 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 T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Queen-of-the-prairie

Filipendula rubra

State Rank: S1
Global Rank: G4G5

What it looks like:

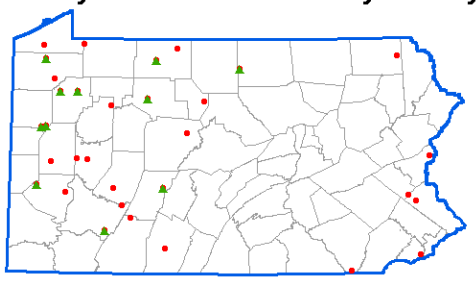
Queen-of-the-prairie is a member of the rose family (Rosaceae) that spreads clonally by the growth of underground stems called rhizomes, as well as reproducing sexually. Individual ramets, or members of a clone, grow from one to two meters tall. A single clone may spread over scores of square meters. Leaves are pinnately compound, with the terminal leaflet the largest, up to 20 centimeters wide, divided into five to nine palmate lobes, and coarsely toothed. Five to nine lateral leaflets are smaller versions of the terminal leaflet, with three to five lobes apiece. Flowers usually have five deeply pink petals, with a ring of long stamens surrounding a cluster of club-shaped pistils. They grow in large, showy inflorescences up to 20 centimeters wide.

Robert Bierman, WISFLORA

Where it is found:

Queen-of-the-prairie grows mainly in fens, calcium-rich peat-producing wetlands, but clones may also be found in wet woodlands and grassland seeps. Its grows from Newfoundland south in to Georgia, and has been found as far west as Wyoming, but its natural range is probably somewhat smaller.

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2005

Why it is rare:

Queen-of-the-prairie is rare because its preferred habitat, fens, are generally rare. The species also suffers from potential reproductive limitations – some populations produce very little viable seed. This may be because queen-of-the-prairie populations are often composed of only a handful of clones, which reduces their genetic variability.

Conservation considerations:

Queen-of-the-prairie populations will benefit greatly from protection of their wetland habitats, which are often destroyed or fragmented by human development. Forest management practices can also be altered to allow more natural disturbances to create early successional habitat, and existing populations should be protected from collection, which may be a minor concern. Efforts to re-establish queen-of-the-prairie populations in unoccupied habitat should make use of seed or transplant material taken from a wide variety of parent clones to ensure that new populations will have sufficient genetic diversity to produce viable seed.

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References

- Aspinwall, Nevin, and Terry Christian. 1992a. "Clonal structure, genotypic diversity, and seed production in populations of *Filipendula rubra* (Rosaceae) from the northcentral United States." *American Journal of Botany*, 79(5): 488-94.
- ——. 1992b. "Pollination biology, seed production, and population structure in queen-of-the-prairie, *Filipendula rubra* (Rosaceae) at Botkin Fen, Missouri." *American Journal of Botany*, 79(3): 294-9.
- Bond, W.J. 1994. "Do mutualisms matter? Assessing the impact of pollinator and disperser disruption on plant extinction." *Philosophical Transactions: Biological Sciences*, 344(1307): 83-90.
- Gleason, Henry A. and Arthur Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. Second ed. New York: The New York Botanical Garden. 246.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Accessed 3 March 2005.
- 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 3 March 2005.
- University of Wisconsin. 2005. WISFLORA: Wisconsin vascular plant species [web application]. University of Wisconsin, Madison, Wisconsin. Available at http://www.botany.wisc.edu/wisflora/. Accessed 3

Fens

What they are:

Fens are peat-accumulating wetlands with heavy mineral input, usually from groundwater. They form in low-lying areas where water can collect and stagnate, permitting the growth of a surface mat of moss and other plants. As this mat sinks and decomposes, it becomes peat and accumulates below the water level. Peat decomposition and accumulation is generally associated with increased acidity, anaerobic (low oxygen) conditions, and low nutrient conditions, but the mineral-rich groundwater input that defines a fen helps to counteract the acidification, allowing fens to maintain a neutral chemistry and develop rich plant communities.

Because they store decayed vegetable matter, fens perform an important function worldwide by removing carbon from circulation. An estimated 25 percent of the world's terrestrial carbon is stored in peatlands. Atmospheric carbon dioxide, especially that released from human use of fossil fuels like coal and oil, is a major contributor to global climate change. However, plants use carbon dioxide to make food, and if the plants are sequestered in a fen after they die, that carbon dioxide is taken out of circulation. Restoring and protecting fens and other peatlands may therefore be vital to reducing the impact of global climate change.

NatureServe identifies two different types of fen communities that can occur in Pennsylvania. **North-central Appalachian seepage fens** are found in the northern part of the state in areas once covered by the Wisconsonian glaciers. These fens tend to be more alkaline (able to absorb acid without becoming acidic), and are rarely wooded, though shrubs will grow up if they are not grazed by livestock or wildlife. **Southern and central Appalachian fens** occur in the southern part of the state in unglaciated areas at lower elevation. They tend to be more acidic than northern fens. These fens are also generally open, but shrub thickets and even forest can grow in them.

inland sedge (*Carex interior*), golden ragwort (*Packera aurea*), and alderleaf buckthorn (*Rhamnus alnifolia*).

Photos by Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database

What lives in them:

Fen communities may include a wide variety of wetland plant and animal species, including many which are rare or endangered. In Pennsylvania's fens, sedges such as *Carex interior* dominate the vegetation, along with golden ragwort (*Packera aurea*) and alderleaf buckthorn (*Rhamnus alnifolia*). Fens also provide habitat for the endangered bog turtle (*Clemmys muhlenbergii*).

Threats to Pennsylvania's fens:

Like most aquatic systems, fens are endangered by human-created nitrogen inputs, such as fertilizer runoff from agricultural fields or residential lawns and atmospheric nitrogen released by fossil fuel combustion and livestock manure. Excessive nitrogen input can create wide fields of only nitrogen-loving plant species, which crowd out other plants, reducing the fen community's normally rich species diversity. Invasive exotic plant species can pose a threat for the same reason. Fens may also be actively destroyed by draining to allow their use in agriculture or development.

Conservation considerations:

Fens need protection from the impacts of human activity, whether outright draining and development, nutrient-rich runoff from adjacent developed land, or atmospheric nitrogen from a nearby hog farm. Management and control of invasive plant species will help to keep the fen community healthy, and controlled grazing can help to prevent the growth of woody species, which may eventually turn fens into forest.

References

- Bedford, Barbara L., Mark R. Walbridge, and Allison Aldous. "Patterns in nutrient availability and plant diversity of temperate North American wetlands." *Ecology*, 80(7): 2151-69.
- Glaser, Paul H., Jan A. Janssens, and Donald I. Siegel. 1990. "The response of vegetation to chemical and hydrological gradients in the Lost River peatland, northern Minnesota." *Journal of Ecology*, 78(4): 1021-48.
- Harding, James. 2002. "Clemmys muhlenbergii." Animal Diversity Web [web application]. University of Michigan Museum of Zoology, Ann Arbor, Michigan. Available at http://animaldiversity.ummz.umich.edu/site/accounts/ information/Pandion_haliaetus.html. Accessed 3 March 2005.
- USDA-NRCS. 2005. The PLANTS Database [web application]. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. Available at http://plants.usda.gov. Accessed 9 February 2005.
- Zoltai, Stephen C. n.d. "Wetland Classification and Ecology [web page]." Devonian Botanic Garden, University of Alberta, Alberta, Canada. Available at http://www.devonian.ualberta.ca/peatland/peatinfo.htm. Accessed 9 February 2005.

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