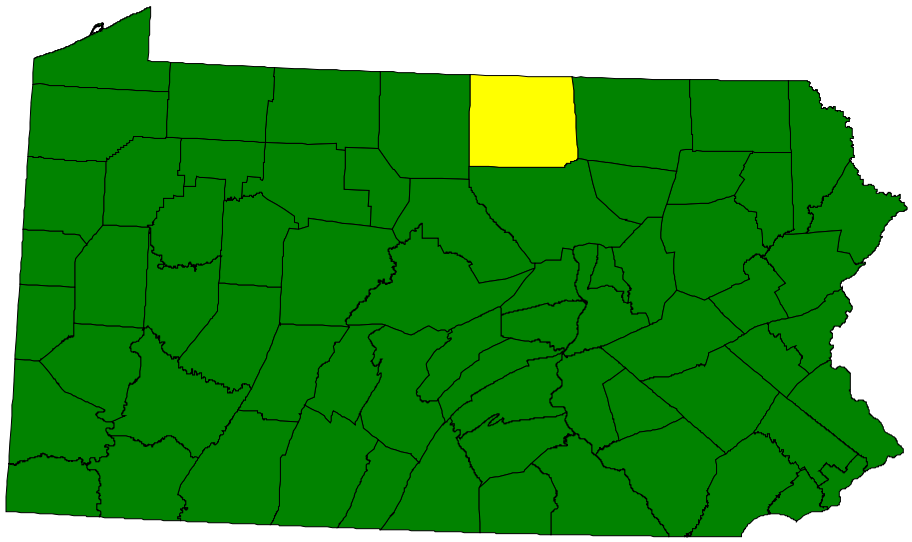
A NATURAL AREAS INVENTORY OF TIOGA COUNTY, PENNSYLVANIA
June 2006



Prepared by:
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Submitted to:
Tioga County Planning Commission
Courthouse Annex
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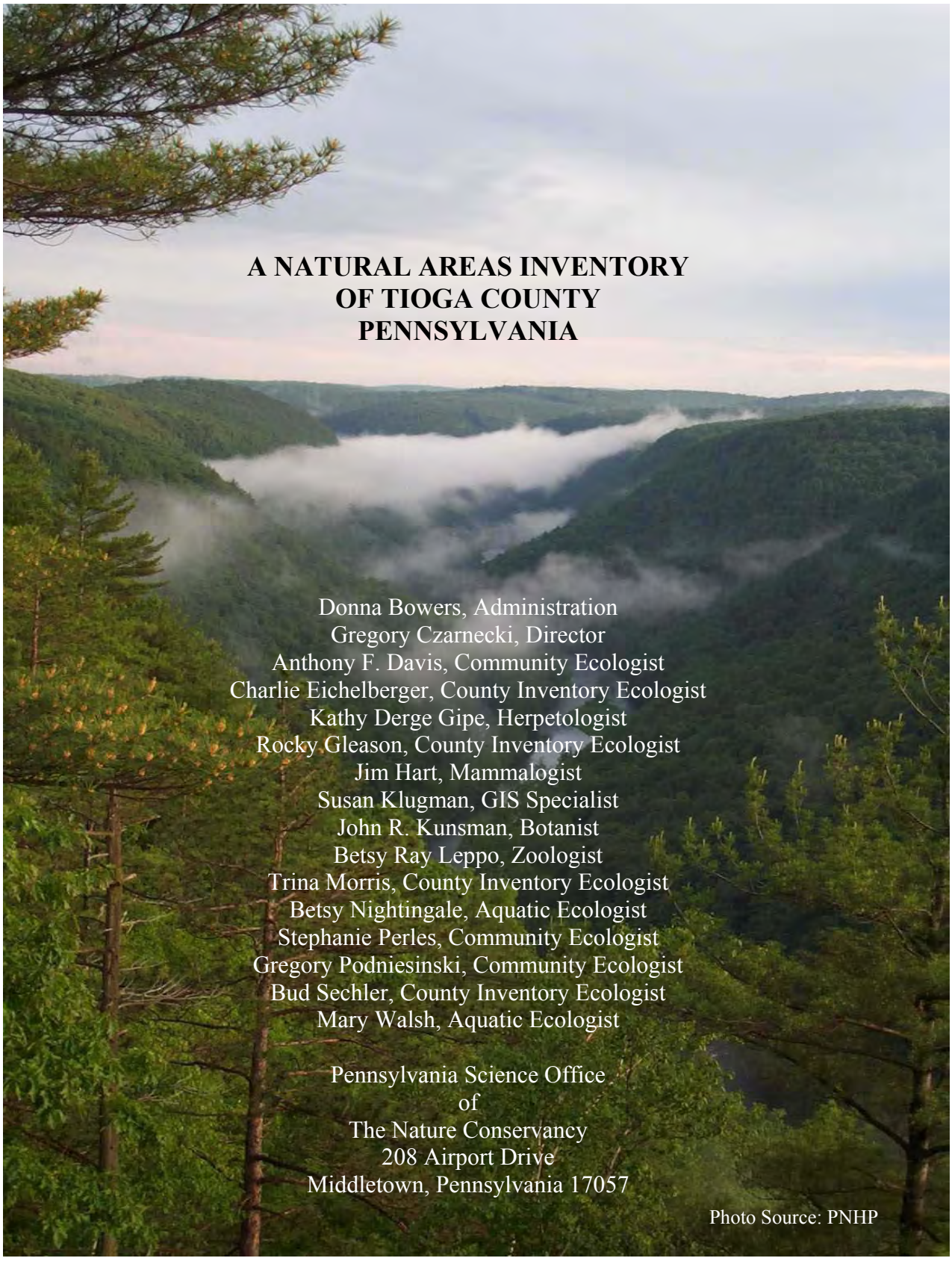
This project was funded in part by a state grant from the DCNR Wild Resource Conservation Program. Additional support was provided by the Department of Community & Economic Development, the U.S. Fish and Wildlife Service through State Wildlife Grants program grant T-2, administered through the Pennsylvania Game Commission and the Pennsylvania Fish and Boat Commission.



A NATURAL AREAS INVENTORY OF TIOGA COUNTY PENNSYLVANIA

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Photo Source: PNHP

Pine Creek Gorge Natural Area – The Grand Canyon of Pennsylvania

PREFACE

The Tioga County Natural Areas Inventory is a document compiled and written by the Pennsylvania Science Office of The Nature Conservancy. It contains information on the locations of rare, threatened, and endangered species and of the highest quality natural areas in the county; it is not an inventory of all open space. It is intended as a conservation tool and should in no way be treated or used as a field guide. Accompanying each site description are general management recommendations that would help to ensure the protection and continued existence of these natural communities, rare plants, and animals. The recommendations are based on the biological needs of these elements (communities and species). The recommendations are strictly those of The Nature Conservancy and do not necessarily reflect the policies of the state or the policies of the county or townships for which the report was prepared.

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

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

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

ACKNOWLEDGEMENTS

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

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

The report benefited from the help of local naturalists and conservationists who gave generously of their time. Thanks to all the help and support given by Merlin Benner, Jim Bissell, Chris Firestone, Kerry Gyekis, Rick Koval, Carol Loeffler, Rick Mellon, Bob Ross, Jim Weaver, and David Werier. Thanks to the many other private citizens who contacted our office with information on natural areas.

Many thanks to everyone who participated in the Technical Advisory Committee by reviewing the draft Natural Area Inventory Report. Finally, we especially wish to thank the many landowners that granted us permission to conduct inventories on their lands. The task of inventorying the natural heritage of Tioga County would have been far more difficult without this tremendous pool of information gathered by many people over many years.

Copies of this document may be obtained from:

Tioga County Planning Commission
Courthouse Annex
118 Main Street
Wellsboro, PA 16901

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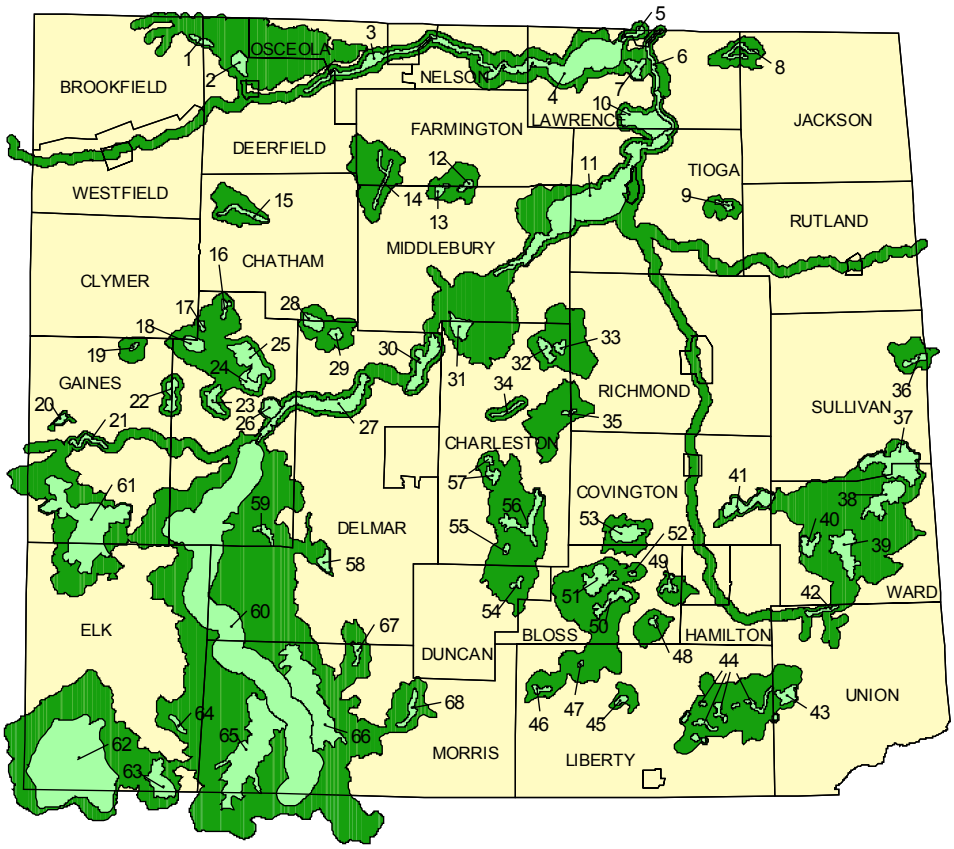

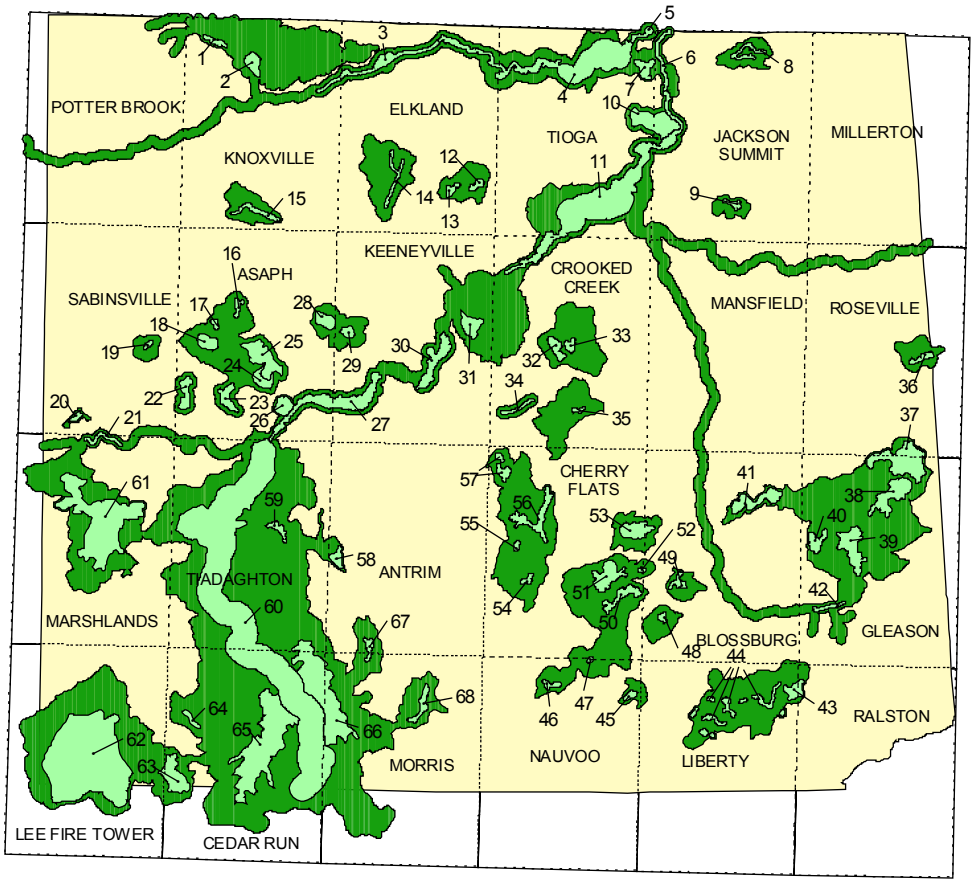

Site Locations Relative to USGS Quadrangles

Directional Site Index Numbered Roughly North to South

Notice that natural areas with species of concern are in capital letters while locally significant sites without speices of special concern are in lower case letters throughout the document

Site #	Site Name	Municipality	USGS Quadrangle	Page #
1	TROUPS CREEK GRAVEL BARS AND OXBOWS	Brookfield, Deerfield	Knoxville	104,126
2	KNOXVILLE SLOPES	Deerfield	Knoxville	126
3	COWANESQUE RIVER	Deerfield, Nelson , Osceola	Elkland, Knoxville	126,188,192
4	COWANESQUE LAKE AND RIVER	Lawrence, Nelson	Elkland, Tioga	166,188
5	LAWRENCEVILLE ROOKERY	Lawrence, New York State	Addison, Tioga	166
6	TIOGA RIVER AT LAWRENCEVILLE	Lawrence	Jackson Summit, Tioga	166
7	C V JUNCTION HILL	Lawrence	Tioga	166
8	HARTS CREEK HEADWATERS	Jackson , Lawrence	Jackson Summit	162, 166
9	West Branch Painter Run Headwaters	Tioga	Jackson Summit	214
10	MITCHELL CREEK SLOPES	Lawrence, Tioga	Jackson Summit, Tioga	166,214
11	HAMMOND LAKE MACROSITE	Lawrence, Middlebury, Tioga	Crooked Creek, Jackson Summit, Tioga	166,175,214
12	ELBRIDGE WETLANDS	Farmington, Middlebury	Elkland	150,175
13	SHINGLEBURY WETLANDS	Farmington, Middlebury	Elkland	150,175
14	CROFT HOLLOW WETLANDS	Farmington, Middlebury	Elkland	150,175
15	Crooked Creek Headwaters	Chatham	Knoxville	115
16	BEAR WALLOW WETLANDS	Shippen	Asaph	200
17	BLACK ASH SWAMP	Clymer, Shippen	Asaph	118,200
18	MIDDLE RIDGE VERNALS	Clymer, Shippen	Asaph	120,200
19	GURNEE ROAD BOG	Gaines	Sabinsville	154
20	State Game Lands #208 Vernal Pools	Gaines	Sabinsville	154
21	PINE CREEK AT GAINES	Gaines	Marshlands , Sabinsville	154
22	WOODRUFF HOLLOW WETLANDS	Gaines, Shippen	Asaph	155,201
23	GOODALL FIRETOWER VERNAL POOLS	Shippen	Asaph	200
24	LAKE LARD SLOPES	Shippen	Asaph	200
25	LAKE LARD POOLS	Shippen	Asaph	200
26	ASAPH SLOPES	Shippen	Asaph	200

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Site #	Site Name	Municipality	USGS Quadrangle	Page #
27	MARSH CREEK FLOODPLAIN	Delmar, Shippen	Asaph, Keeneyville	130,200
28	CANADA RUN BOG	Chatham, Delmar	Asaph, Keeneyville	115,130
29	EAST BRANCH CANADA RUN HEADWATERS	Delmar	Keeneyville	130
30	THE MUCK	Delmar	Keeneyville	130
31	WHITEHOUSE HOLLOW	Charleston, Middlebury	Keeneyville	108,175
32	HILLS CREEK STATE PARK RESERVOIR	Charleston	Crooked Creek	108
33	TAUCHER POND	Charleston	Crooked Creek	108
34	FOSSIL FARM	Charleston	Crooked Creek	108
35	WHITNEYVILLE MEADOW	Chaleston, Richmond	Crooked Creek	108,195
36	ROUTE 6 COUNTY LINE REST STOP WETLANDS	Sullivan, Bradford County	Roseville	210
37	Armenia Mountain Wetlands	Sullivan, Ward	Gleason, Roseville	210,220
38	FELLOWS CREEK WETLANDS EAST	Ward	Gleason	220
39	FELLOWS CREEK WETLANDS WEST	Ward	Gleason	220
40	FALL BROOK WETLANDS	Ward	Gleason	220
41	East Creek Headwaters	Covington, Ward	Blossburg	122,220
42	TIOGA RIVER AT BEAR RUN	Union	Gleason	217
43	WEST MILL CREEK HEADWATERS	Union	Liberty	217
44	East Point Forested Wetlands	Liberty, Union	Liberty	171,217
45	Blacks Creek Headwaters Swamp	Liberty	Nauvoo	171
46	LONG RUN HEADWATERS	Liberty	Nauvoo	171
47	CAT ROCKS WETLAND	Liberty	Cherry Flats, Nauvoo	171
48	FLOWER RUN HEADWATERS	Bloss	Blossburg	98
49	MILLS CREEK HEADWATERS	Bloss	Blossburg	98
50	ARNOT BOG COMPLEX	Bloss	Cherry Flats	98
51	RED RUN HEADWATERS	Bloss	Cherry Flats	98
52	WETLAND NORTH OF ARNOT	Bloss	Blossburg , Cherry Flats	98

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Alphabetical Site Index

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63	ALGERINE SWAMP/REYNOLDS SPRING NATURAL AREA	Elk, Lycoming County	Cedar Run, Lee Fire Tower	142
37	Armenia Mountain Wetlands	Sullivan, Ward	Gleason, Roseville	210,220
50	ARNOT BOG COMPLEX	Bloss	Cherry Flats	98
26	ASAPH SLOPES	Shippen	Asaph	200
56	Babb Creek Headwaters	Charleston	Cherry Flats	108
16	BEAR WALLOW WETLANDS	Shippen	Asaph	200
17	BLACK ASH SWAMP	Clymer, Shippen	Asaph	118,200
45	Blacks Creek Headwaters Swamp	Liberty	Nauvoo	171
7	C V JUNCTION HILL	Lawrence	Tioga	166
28	CANADA RUN BOG	Chatham, Delmar	Asaph, Keeneyville	115,130
47	CAT ROCKS WETLAND	Liberty	Cherry Flats, Nauvoo	171
57	Charleston School Wetlands	Charleston	Cherry Flats	108
66	CLAY MINE ROAD POOLS	Morris	Cedar Run, Morris, Tiadaghton	180
4	COWANESQUE LAKE AND RIVER	Lawrence, Nelson	Elkland, Tioga	166,188
3	COWANESQUE RIVER	Deerfield, Nelson , Osceola	Elkland, Knoxville	126,188,192
14	CROFT HOLLOW WETLANDS	Farmington, Middlebury	Elkland	150,175
15	Crooked Creek Headwaters	Chatham	Knoxville	115
29	EAST BRANCH CANADA RUN HEADWATERS	Delmar	Keeneyville	130
41	East Creek Headwaters	Covington, Ward	Blossburg	122,220
44	East Point Forested Wetlands	Liberty, Union	Liberty	171,217
12	ELBRIDGE WETLANDS	Farmington, Middlebury	Elkland	150,175
40	FALL BROOK WETLANDS	Ward	Gleason	220
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39	FELLOWS CREEK WETLANDS WEST	Ward	Gleason	220
48	FLOWER RUN HEADWATERS	Bloss	Blossburg	98
34	FOSSIL FARM	Charleston	Crooked Creek	108
64	GLEASON HOLLOW	Elk	Cedar Run	142

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11	HAMMOND LAKE MACROSITE	Lawrence, Middlebury, Tioga	Crooked Creek, Jackson Summit, Tioga	166,175,214
8	HARTS CREEK HEADWATERS	Jackson , Lawrence	Jackson Summit	166,162
32	HILLS CREEK STATE PARK RESERVOIR	Charleston	Crooked Creek	108
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46	LONG RUN HEADWATERS	Liberty	Nauvoo	171
27	MARSH CREEK FLOODPLAIN	Delmar, Shippen	Asaph, Keeneyville	130,200
61	Marshlands Slopes	Elk, Gaines	Marshlands	142,154
59	MIDDLE RIDGE SWAMP	Delmar, Shippen	Tiadaghton	130,200
18	MIDDLE RIDGE VERNALS	Clymer, Shippen	Asaph	120,200
49	MILLS CREEK HEADWATERS	Bloss	Blossburg	98
10	MITCHELL CREEK SLOPES	Lawrence, Tioga	Jackson Summit, Tioga	166,214
68	MORRIS MEADOWS	Morris	Morris	180
55	NICKEL RUN HEADWATERS NORTH	Charleston	Cherry Flats	108
54	NICKEL RUN HEADWATERS SOUTH	Duncan	Cherry Flats	139
21	PINE CREEK AT GAINES	Gaines	Marshlands , Sabinsville	154
60	PINE CREEK GORGE	Delmar, Elk, Gaines, Morris, Shippen, Lycoming County	Asaph, Cedar Run, Morris, Tiadaghton	130,142,155, 180,200
67	RATTLER MINE ROAD WETLANDS	Delmar, Morris	Antrim, Morris	130, 181
51	RED RUN HEADWATERS	Bloss	Cherry Flats	98
36	ROUTE 6 COUNTY LINE REST STOP WETLANDS	Sullivan, Bradford County	Roseville	210
53	SAND RUN HEADWATERS	Covington	Cherry Flats	122
13	SHINGLEBURY WETLANDS	Farmington, Middlebury	Elkland	150,175
62	Slate Run Headwaters	Elk, Lycoming County	Lee Fire Tower	142

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INTRODUCTION

The population of Tioga County has been on the rise since the 1930's. Although there has been only a slow steady increase in population in the county, future increases should be anticipated. A substantial increase in population may lead to more development pressure on some of the sensitive natural areas of the county. Economically unsustainable farms may be sold for residential and commercial uses. Farms represent several generations of cultural heritage, and many farms contain a natural component or are adjacent to a natural area. The natural areas that comprise the natural heritage of Tioga County can be easily lost without careful planning of growth and development. Ironically the scenic and remote nature of these areas may make them prime targets for residential developments. Protecting the integrity of these natural systems provides benefits to humans as well as providing for the survival of all flora and fauna, rare and otherwise. Planning for long-term sustainability can maintain open space, including natural environments and the plants and animals associated with them. Using a Natural Areas Inventory as a conservation tool can steer development away from environmentally sensitive areas, creating a needed balance between growth and the conservation of scenic and natural resources.

It is important that county and municipal government, the public, developers and planners know the location of such environmentally sensitive areas in order to maintain a balance and protection of these areas. Knowing where these areas are located can help prevent potential land-use conflicts, and help focus conservation efforts and limited funds to the most vulnerable areas. The Pennsylvania Science Office of The Nature Conservancy, under contract with the Tioga County Planning Commission, has undertaken this project to provide a document and maps that will aid in the identification of these important areas.

The Natural Areas Inventory (NAI) report presents the known outstanding natural features - floral, faunal and geologic- in Tioga County. The Inventory provides maps of the best natural communities (habitats) and the locations of animal and plant species of special concern (endangered, threatened, or rare) in Tioga County. Due to budget and time constraints, some high-quality areas in the county are likely to have been overlooked. The maps do not pinpoint the site of the species of concern but rather represent a zone of species occurrence within the site's watershed. A written description and a summary table of the sites, including quality, degree of rarity, and last-observed date, accompany each map.

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

Potential threats and some suggestions for protection of the rare plants or animals at the site are included in many of the individual site descriptions. Selected geologic features of statewide significance are also noted. In addition, the inventory describes locations of areas that are significant, but have not been ranked in this inventory because no species of concern were documented at these sites. These **"locally significant"** sites are representative of habitats that are relatively rare in the county, support an uncommon diversity of plant species, and/or

provide valuable wildlife habitat. Locally significant sites without documented species of concern are referenced in **lower case lettering** throughout this report.

The information and maps presented in this report provide a useful guide for planning commercial and residential developments, fore sighting recreational parks, for conserving natural areas, and for setting priorities for the preservation of the most vulnerable natural areas. An overall summary identifies the highest quality sites in the county. All of the sites in this report were evaluated for their importance in protecting biological diversity on a state and local level, but many also have scenic value, provide water quality protection, and are potential sites for low-impact passive recreation, nature observation and/or environmental education.

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

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

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

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

Physiography and Geology

The characteristic landscapes and distinctive geological formations classify Physiographic Provinces. Physiography relates in part to a region's topography and climate. These two factors, along with bedrock type, significantly influence soil development, hydrology, and land use patterns of an area. Additionally, both physiography and geology are important to the patterns of plant community distribution, which in turn influences animal distribution. Because of the differences in climate, soils, and moisture regime, certain plant communities would be expected to occur within some provinces and not in others. Physiographic and geologic information was obtained from many sources including Ground Water in Northeastern Pennsylvania (Lohman 1957), The Geology of Pennsylvania (PA Geological Survey and Pittsburgh Geological Survey 1999), Soil Survey of Tioga County, Pennsylvania (USDA 1981), and Physiographic Provinces of Pennsylvania (Sevan 2000).

Tioga County's bedrock is mostly composed of red and gray sandstone and shale from the Devonian (360-408 MYA), Mississippian (320-360 MYA), and Pennsylvanian (286-320 MYA) eras. This bedrock is overlain with Wisconsin glacial till. The Pine Creek Gorge marks the change from the High Plateau subregion of the Allegheny Plateau to the west, and the Low Plateau subregion to the eastern side of the gorge. The Low Plateau subregion is underlain by softer rock and has been eroded to a larger degree than the High Plateau subregion.

All but the southwestern corner of Tioga County was glaciated during the Illinoian (350,000-550,000 YBP) and Wisconsinan (12,500-22,000 YBP) glacial advances. As the most recent ice age came to an end, the retreat of the ice pack northward carved the landscape and deposited glacial material, creating many of the forms that are seen today. Glacial deposits dammed some of the County's creeks and rivers creating lakes and bogs. Other waterways in the county swelled as a result of the large amounts of melt water, further deepening the valleys and accentuating the hills and mountains (Cuff 1989).

Soils

The glaciers that covered the northern counties of Pennsylvania were relatively thin and therefore deposited more material than was scoured away. As a result, Tioga County has relatively immature soils of highly variable depths largely composed of glacial till. For the most part, glacial till is known to be relatively poor for crop farming (Cuff et al. 1989).

A soil association is a group of soils with a distinctive, proportional pattern of occurrence in the landscape. This description of the soils of Tioga County comes from *The Soil Survey of Tioga County* (USDA, 1981).

Soil Association	Description	Percentage of Area in Tioga County	Land Use
Lordstown-Mardin	Moderately deep and deep, nearly level to very steep, well drained and moderately well drained soils that formed from brownish and olive glacial till; on uplands	23	Primarily woodlands
Volusia-Mardin-Lordstown	Deep and moderately deep, nearly level to very steep, somewhat poorly drained, moderately well drained, and well drained soils that formed from brownish and olive glacial till; on uplands	30	Crop and livestock farming
Morris-Oquaga-Wellsboro	Deep and moderately deep, nearly level to very steep, somewhat poorly drained, well drained, and moderately well drained soils that formed from reddish glacial till; on uplands	8	Primarily woodlands but small areas are used for crop and livestock farming
Oquaga-Morris	Moderately deep and deep, nearly level to very steep, well drained and somewhat poorly drained soils that formed from reddish glacial till; on uplands	9	Primarily woodlands but small areas are used for crop and livestock farming
Oquaga-Lordstown	Moderately deep, gently sloping to very steep, well drained soils that formed from brownish and reddish glacial till; on uplands	22	Almost entirely woodland
Dekalb-Cylmer	Moderately deep and deep, gently sloping to very steep, well drained soils that formed from materials that weathered from sandstone and some siltstone and shale; on uplands	2	Almost entirely woodland
Pope-Chenango-Orrville	Deep, nearly level to moderately steep, somewhat excessively drained, well drained, and somewhat poorly drained soils that formed from alluvium and water-sorted sand and gravel; on flood plains and terraces	6	Primarily farming and small residential

Vegetation

Upland Forest Communities

The vegetative communities in Tioga County are evenly split between the Northern Hardwood Forest and the Appalachian Oak Forest. Northern hardwood forests, which favor moderately well drained soils, are dominated by sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*), yellow birch (*Betula alleghaniensis*), eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*). The Appalachian Oak Forest, which can be found in a broad range of soils, is dominated by white oak (*Quercus alba*), northern red oak (*Quercus rubra*), sweet birch (*Betula lenta*), bitternut hickory (*Carya cordiformis*), American beech, tulip poplar (*Liriodendron tulipifera*), eastern white pine, scarlet oak (*Quercus coccinea*), scrub oak (*Quercus ilicifolia*), chestnut oak (*Quercus montana*), and black oak (*Quercus velutina*) (Cuff et al. 1989).

Wetlands

In addition to influencing the forest community structure in the county, glacial activity heavily shaped the composition of the County's wetlands. These systems, left unaltered, provide highly unique habitats that can support many distinctive plants and animals.

Wetlands are the key to the survival of many species of plants and animals considered rare in the state. Even though wetlands account for only two percent total of Pennsylvania's area, they are home to a diverse array of rare plants and animals and are an extremely productive part of the landscape as a whole (Cuff et al. 1989). The Glaciated Plateau sections of the Appalachian Plateau Province make up 24% of the states area, while they contain 62% of the state's wetlands (Tiner 1987). Tioga County, like the other glaciated counties of Pennsylvania, accounts for a disproportionate share of the state's wetlands. Wetlands differ in size, structure and species diversity. Wetlands also differ according to their placement on the landscape – at stream headwaters, dips in valleys, or on slopes where ground water discharges; and whether the water contained is flowing or stagnant. These different scenarios result in peatlands, marshes, swamps, floodplain forests, forested wetlands, wet meadows, and seeps. Wetlands differ also in vegetative species cover. Tree species such as red maple, yellow birch, eastern hemlock and ash species (*Fraxinus* spp.) usually dominate forested swamps. The understory typically consists of shrub species such as highbush blueberry (*Vaccinium corymbosum*), rhododendron and azaleas (*Rhododendron* spp.), winterberry holly (*Ilex verticillata*), alders (*Alnus* spp.), swamp rose (*Rosa palustris*) and many others.

Photo Source: PNHP

Graminoid marsh

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

- Shrub swamps are wetlands occurring on mineral soils usually with a thick accumulation of peat moss (*Sphagnum* spp.) and other organic matter with water near or above the surface most of the year (Cuff et al 1989). Shrubs under 20 feet

tall dominate this type of wetland. Shrub swamps in the county frequently include highbush blueberry, chokeberry (*Aronia* spp.), mountain holly (*Nemopanthus mucronatus*), alder, leatherleaf (*Chamaedaphne calyculata*), swamp rose, meadowsweet and steeplebush (*Spiraea* spp.), and sedges (*Carex* spp.).

Shrub swamp

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

Much of the County's wetlands are contained within the Acidic Glacial Peatland Complex. These wetlands are oligotrophic, meaning they are low in nutrient levels, and are dominated by evergreen and semi-evergreen shrubs. The nutrient poor and fairly acidic conditions provide unique growing conditions that are suitable for interesting vegetation, in addition to large amounts of peat moss. Common shrubs found in these systems in Tioga County include leatherleaf, highbush blueberry, and cranberry (*Vaccinium macrocarpon*). The herbaceous species known from these systems include cottongrasses (*Eriophorum* spp.) as well as several insectivorous plants including pitcher plants (*Sarracenia purpurea*), sundews (*Drosera* spp.), and bladderworts (*Utricularia* spp.) (Fike 1999).

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

Disturbance

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

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

Another natural disturbance, over-browsing by deer, can have detrimental effects on natural communities and species (Rhoads and Klein, 1993).

Excessive deer browse can decrease the understory of some forests, and halt regeneration of new growth of the canopy and understory. Deer feeding preferences can have a direct effect on rare plants and severely decrease essential habitat for other animal species including birds, mammals, reptiles, amphibians and insects. Private landowners can be encouraged to control deer populations by allowing hunting on their lands.

Disturbances caused by beaver can be either beneficial or detrimental to wetland habitats within the county. On one hand, thinning the canopy and flooding by beavers can eventually create open wetland meadows upon which many unique species rely. On the other hand, damming by beavers can alter habitats to a degree that render the sites no longer suitable for some of the rare species of the county. For example, peatlands support an array of rare plants and animals, but flooding by beaver can degrade these communities until they no longer support the unique bog adapted species. Beaver activity in the long term is critical to the cyclic pattern of wetland disturbance, but in the short term beaver activity can threaten the integrity of wetland habitats and jeopardize many of the unique species that inhabit these natural communities. This creates difficulty in assessing how beavers should be managed. The long-term benefit of habitat creation must be weighed against the potential short-term threat to the existing plants and animals. In certain situations, beaver removal is preferred and implementation of management practices with regard to beaver must be considered on a case-by-case basis.

The recent beaver activity at this site is beginning to flood the hemlock palustrine forest which houses a population of the PA-rare soft leaved sedge.

Human and natural disturbances create different habitats in different scenarios, but human disturbances often leave the most lasting effect on the environment. Many human disturbances can be beneficial, especially to species that require an early successional habitat. However, what may be beneficial to a few species is often detrimental to other species. Many rare species have become rare because they just can't adapt to disturbance of their particular habitat, which is often a specialized niche. Consequently, many species have declined due to human alteration of the landscape. Human disturbances are semi-permanent parts of landscape, but decisions about the type, timing, location and extent of future disturbances are important to the natural ecological diversity that remains.

From a historical perspective, human disturbance to the natural communities of the county have been occurring for hundreds of years. Tioga County was first settled by New Englanders in 1784 and incorporated in 1804 from Lycoming County. Farms and forestry practices were set up shortly thereafter to take advantage of the County's rich resources. Tanneries used tree bark from the county for rendering animal hides, creating a critical industry for the region. Coal mining was also a large industry in the county and remained so until the 1930's (USDA 1981).

Early farms in the county were centered around floodplains and later expanded into the hills. Agriculture has in more recently declined in the area and many of the old farmsteads have been converted to summer retreats and hunting cabins for people from other regions of the state or out of state (USDA 1981).

In many cases, human disturbances have directly affected natural communities and animal and plant species in certain areas. In Tioga County, farming and urbanization have created biological "islands" where small natural areas are surrounded by agriculture or development. This isolates gene pools of wildlife and/or plant species, inhibiting the gene flow between populations. In addition, logging and mining can affect forest age and natural community structure. For example, the amount of old-growth forest has virtually disappeared despite the fact that some scattered old trees remain. Additionally, many wetlands have been intentionally flooded or drained resulting in loss of biodiversity at a given site. As farming remains an important industry in Tioga County, some farm practices and abandoned farmland make conditions favorable for some grassland birds. Birds such as Short-eared Owl, Eastern Meadowlark, Bobolink, Henslow's Sparrow and Vesper Sparrow have benefited from human created and managed early successional habitats, including reclaimed strip mines.

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

Probably the most detrimental indirect effect that human disturbance has had on natural communities and associated species is the spread of non-native (i.e. exotic) invasive species in natural areas. Many of these invasive species, including the chestnut blight that changed the composition of eastern forests, have caused such widespread problems that they are now out-competing native species and decreasing overall quality of natural areas. Non-native plants such as Japanese barberry, multiflora rose, Japanese honeysuckle, tree-of-heaven, garlic mustard and autumn olive have become commonplace in disturbed woodlands, often to the point of excluding some of the native plants. In wetlands and along streams, common reed, European buckthorn, autumn olive, purple loosestrife, multiflora rose, Japanese honeysuckle, Japanese knotweed and tree-of-heaven are aggressive, weedy species that follow in the wake of disturbance and crowd out native species.

Some of these non-native invasive plants have become serious threats to ecosystems in Tioga and in all counties in Pennsylvania. Control of these invasive plants is needed, especially in or adjacent to areas that have been categorized as high quality natural areas to help control further encroachment. It is far more cost effective to prevent invasive species introductions and to control introductions while they are still small, than to control invasive species populations after they have become established. Some nurseries in Pennsylvania now carry a selection of tree, shrub and herbaceous species that are native to Pennsylvania, and these are recommended where plantings are necessary in, or adjacent to, natural areas. Additionally, these native plants are often hardier than non-native cultivars because they are already adapted to the Pennsylvania's climate. *The Vascular Flora of Pennsylvania* (Rhoads and Klein 1993) is a helpful reference for determining whether a plant species is native to the state or not. Additional references include two PA Department of Conservation and Natural Resources publications: *Invasive Plants in Pennsylvania* and *Landscaping with Native Plants in Pennsylvania.*

Invasive Plant Species

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

Garlic mustard (*Alliaria petiolata*)

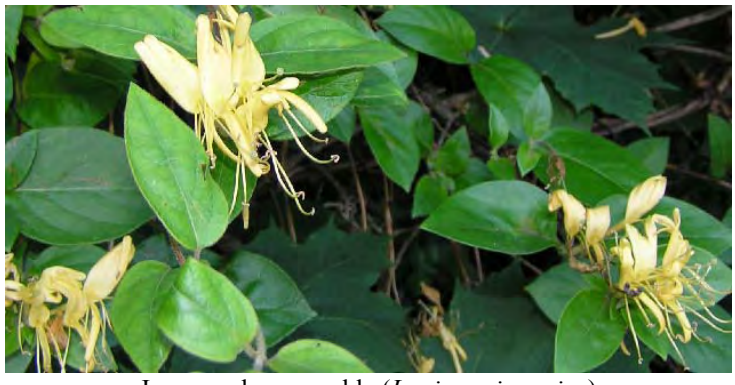
Multiflora rose (*Rosa multiflora*)

Tree of Heaven (*Ailanthus altissima*)

Japanese Knotweed (*Polygonum cuspidatum*)

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

Purple loosestrife (*Lythrum salicaria*)



Japanese honeysuckle (*Lonicera japonica*)

A Review of Tioga County's Animals

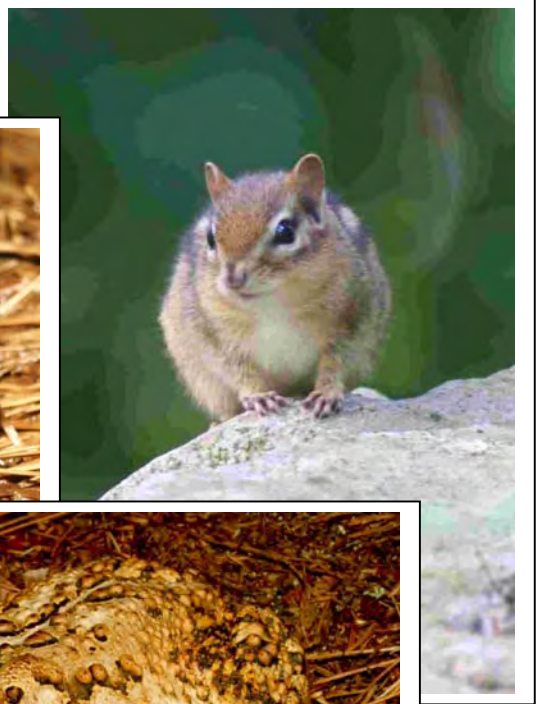
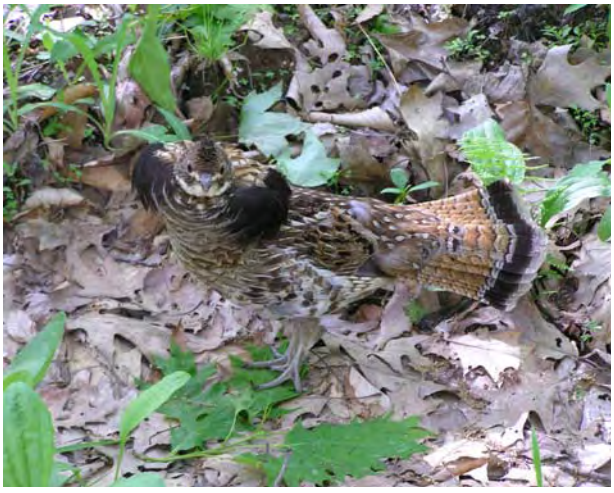


Photo Sources: PNHP, Charlie Eichelberger, Rick Koval



MAMMALS AND MAMMALIAN HABITATS IN TIOGA COUNTY

Tioga County, a mostly forested county, is probably better known for its robust, but well dispersed, deer population than for a wealth of lesser known mammal species. White-tailed Deer (*Odocoileus virginianus*) hunting, one of the County's most important economic resources, likely ranks just above the tourist industry in terms of the economic importance on the County's non-industrial businesses. With over a quarter of the county contained in public lands including state game lands, state forests and state parks, there is plenty of habitat to support the type of deer herds that attract hunters from all over the state. Other important mammal species that occur in the county and are important to local economies during the various hunting seasons include Black Bear (*Ursus americanus*), Grey and Fox Squirrel (*Sciurus carolinensis*, *S. niger*), and fur-bearer species such as the Mink (*Mustela vison*) and other weasels. What is less well known is the fact that these same habitats and many others throughout the county support a diverse and important non-game mammal fauna as well.

Many of the species occurring throughout the county possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout Pennsylvania. These species are termed "generalists" and include the Northern Short-tailed Shrew (*Blarina brevicauda*) and several other shrew and mole species, White-footed Mouse (*Peromyscus leucopus*) and several other rodent species, as well as Striped Skunks (*Mephitis mephitis*), Red Fox (*Vulpes vulpes*), Coyote (*Canis latrans*) and the ubiquitous Eastern Chipmunk (*Tamias striatus*). All of these species occur throughout the many and diverse habitats within Tioga County and are in no jeopardy of disappearing from the landscape.

Other species have fairly restricted habitat needs and are termed "habitat specialists". They may be restricted to grassland and meadow-type habitats, the forest interior, upper elevation ridgelines, wetlands and streams or, during part of their life cycle, to specific habitats such as caves and mines. Examples of these species include the Meadow Vole (*Microtus pennsylvanicus*) (grasslands and meadows), the Fisher (*Martes pennanti*) (forest interiors), Allegheny Woodrats (*Neotoma magister*) (upper elevation ridges), Muskrats and Beaver (*Ondatra zibethicus*, *Castor canadensis*) (wetlands and streams) and most, if not all, of the bat species (caves and mines).

Several species that occur within the county are of special concern due to population declines within other parts of the state or throughout their natural range in the United States. The list includes species such as the Allegheny Woodrat, Eastern Small-footed Bat (*Myotis leibii*) and Northern Flying Squirrel (*Glaucomys sabrinus*). These species are very dependant on large, undisturbed forest habitats as well as specific habitat types. One species that remains unreported from Tioga but may occur during the summer months is the federally endangered Indiana Bat (*Myotis sodalis*), a species that requires large blocks of mature forest.

Eastern Small-footed Bat

Allegheny Woodrat

Habitat availability is just one of a number of factors that determine whether a species of mammal is going to persist within certain areas. Food resources are an extremely important factor as reproductive females and dispersing individuals require consistent and substantial amounts in order to bear young, nurse and travel between nesting and foraging areas or to find new nest sites. Species such as the Allegheny Woodrat have most likely declined due to a possible lack of food resources, as their primary foodstuff of historic times, the American chestnut (*Castanea dentata*), was lost to the chestnut blight during the early part of the previous century. Forced now to rely on more ephemeral food resources like the mast of oaks and other forest trees and a diverse array of greens in the form of the leaves of such prevalent species as elderberry, pokeweed and many other shrubs, they become energy-stressed during times when food resources become limited and food caches created during the fall do not survive mild and damp winter periods due to decay. Competition for these resources with other, more numerous mammal species also reduces the survival chances for these populations, especially when they are isolated from others of their own kind. The Pine Creek Gorge, with large expanses of rock outcrops and cliffs, contains some of the last un-fragmented habitat within Pennsylvania with all the components that could support stable local colonies and larger populations of the Allegheny Woodrat.

Northern Water Shrew

Wetlands and streams play a major role in providing habitat for mammals as well as serving as corridors for dispersal throughout the county. Whenever biologists research mammals, one of the first environs investigated are marshes, bogs and streams as they are often sites where the number of species of mammals, or diversity, is highest. It is not uncommon to find 6 species of shrews, 9-10 species of rodents including the Beaver, 4-5 species of weasels including the Mink, 6-7 species of bats, as well as sign of various medium-sized carnivores, squirrels, bear and deer along these habitats. One species that can be found around small streams within Tioga County is the Northern Water Shrew (*Sorex palustris albibarbis*), a species rarely observed in Pennsylvania.

This species was once thought to be extremely rare but recent evidence seems to indicate that it is much more widespread in the northern tier counties of Pennsylvania than previously thought. One of the larger shrew species, the Northern Water Shrew swims and dives in pools along the smaller tributaries that empty into moderate to larger sized streams. Since its diet consists primarily of macro-invertebrates such as caddisflies, stoneflies, mayflies and other aquatic insect species, it most likely depends on clean, undegraded streams and wetlands and may serve in the future as an "indicator species", a species that may alert us to arising environmental problems such as acid mine drainage or acid rain.

Open land in the form of meadows and reverting grasslands are habitat types that are not usually associated with Tioga County. Normally a product of former and present agricultural practices, these habitats are more often than not found within the valleys and along the plateaus common throughout much of the county. The most well known mammal occurring in these open lands is the Meadow Vole. The runways formed by this medium-sized rodent can be spotted under dense vegetation during the summer months and under the icy crust forming on snow during the winter months. Meadow Voles are so successful at dispersing throughout the county that they are sometimes found in grassy forest clearings within large tracts of forest, having made their way there along the forest roads, pipelines and power right-of-ways. Several other species of mammal are known to occur within open lands including the Eastern Cottontail Rabbit (*Sylvilagus floridanus*), Woodchuck or Groundhog (*Marmota monax*) and Red Fox.

While open lands as mentioned above are familiar to many, one type that is more often than not overlooked is scrub-shrub open lands. 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 and include the Black Bear, Appalachian Cottontail (*Sylvilagus obscurus*) and varying or Snowshoe Hare (*Lepus americanus*). Open lands such as these can most often be found along upper elevation forests in areas where soils are thin and the climate fairly dry.

Fisher

Bats are a common component of the forests of Tioga County, most often encountered during the summer months along the streams and open bodies of water that occur throughout the county. The Small-footed Myotis (*Myotis leibii*) has recently been discovered using rock outcrops and cliffs as summer roosts. During the summer, areas like the Pine Creek Gorge may provide roost sites for this species as it raises its young. Another rarely encountered bat species, the Silver-haired Bat (*Lasionycteris noctivagans*) may occur within Tioga 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 mines in New York or south to caves occurring in the central portion of Pennsylvania. Several species, such as the Hoary Bat (*Lasiurus cinereus*) and Red Bat (*Lasiurus borealis*), don't over-winter in the state at all and migrate further south to states like the Carolinas and Florida and are thought to spend their winter months in hibernation under deep patches of leaf and forest floor litter.

Historically, several species of mammals have either disappeared from Tioga County or their populations had become so low that they were thought to be gone from the county. Two of these species, the Fisher and the River Otter (*Lontra canadensis*) have been re-introduced by the Pennsylvania Game Commission in portions of their range in Pennsylvania where habitat necessary to their existence still occurs. These populations have expanded into other portions of the state and these species likely now occur in Tioga County. It is likely that they will be spotted in the future by hunters and fishermen along the Pine Creek Gorge and other water courses throughout the county as well as interior portions of the existing forests.

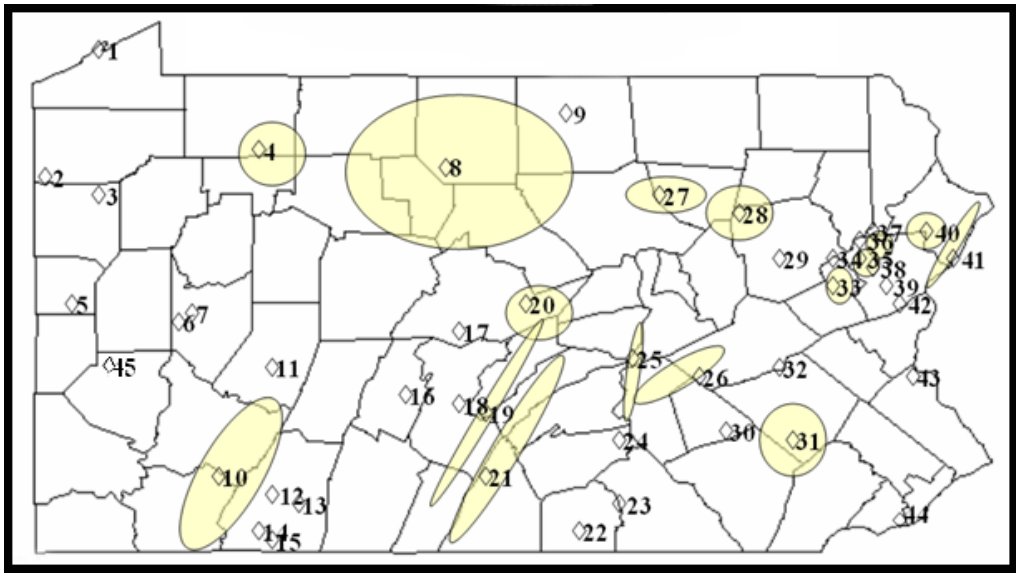
As outlined here, Tioga County is very diverse in terms of the habitats available to the mammal fauna of Pennsylvania. In many portions of the state, most habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix of inhospitable habitat. Development of land, splitting of habitats by uncrossable barriers such as major highways, drainage of wetland areas and environmental degradation have all served to confine many mammal species to very localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction". If enough of these populations disappear from the landscape, these species existence in Pennsylvania may be in jeopardy. Although Tioga has become a popular destination for residents of Pennsylvania during the various hunting seasons and has a brisk tourist trade, it does not appear to be presently affected by uncontrolled and unplanned growth, as is the case in many southeastern Pennsylvania counties. Large blocks of forest land and vegetated stream corridors serve as avenues of dispersal to the diverse list of mammals noted to occur in the county. Continued vigilance as well as enlightened management will ensure that this list will not be shortened and may grow in the future providing opportunities to all Pennsylvanians for viewing the state's mammalian wildlife. This, in turn, will enhance the County's wealth as the ecotourism industry, beginning to flourish in Pennsylvania, gains strength.

Important Mammal Areas in Tioga County

The Important Mammal Areas Project (IMAP) is being carried out by a broad based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Nominated sites are reviewed by IMAP personnel and local scientists with final site selection managed by the Mammal Technical Committee of the Pennsylvania Biological Survey. The primary concern of the project is to help ensure the future of Pennsylvania's wild mammals, both game and non-game species. Precidence is given to sites with species of special concern but the project is also interested in habitats that have high mammalian diversity or those that offer exceptional educational value. The Northern Allegheny Plateau (IMA #10) and Hills Creek State Park (IMA #9) IMAs both occur within Tioga County.

Important Mammal Areas Project

Current Important Mammal Areas in Pennsylvania



1. Presque Isle State Park	2. Pymatuning Wildlife Management Area/SGL 214
3. Maurice K. Goddard State Park	4. Hickory Creek and Tionesta Creek Drainages
5. CS & M Mine	6. Private Mine
7. US Steel Mine	8. Northern Allegheny Plateau
9. Hills Creek State Park	10. Chestnut Ridge/Laurel Ridge
11. Yellow Creek State Park	12. Kimberly Run Natural Area
13. Allegheny Mountain	14. Forbes State Forest/Mt. Davis Section
15. Salisbury Mine	16. Canoe Creek Watershed
17. The Barrens (SGL 176)	18. 1000 Steps
19. Blacklog Mountain	20. Central Mountains
21. Tuscarora/Blue Mountain South	22. Eisenhower Least Shrew Site
23. East Berlin Least Shrew Site	24. Conodoguinet Creek
25. Central Susquehanna Valley	26. Stony Mt. Woodrat Complex
27. Wyoming State Forest	28. Ricketts Glen State Park/SGL 57, 13, 66
29. Wyoming Valley	30. Middle Creek Wildlife Management Area/SGL 46
31. Hopewell Big Woods	32. Hawk Mountain Sanctuary and Environs
33. Lehigh Valley/Lehigh George State Park	34. SGL 129/Hickory Run State Park/Holiday Pocono/Jonathan?s Point
35. Pocono Lake/Adams Swamp/Two Mile Run	36. Tobyhanna & Gouldsboro State Parks/SGL 127
37. State Game Lands 312	38. Long Pond Preserve
39. Tannersville Cranberry Bog	40. Delaware State Forest, Bushkill Creek Area
41. Delaware Water Gap/Pocono Environmental Education Center	42. Cherry Valley Watershed
43. Durham Mine	44. John Heinz National Wildlife Refuge at Tinicum
45. Latodami Environmental Education Center	

from: http://www.pawildlife.org/imap.htm

REPTILES AND AMPHIBIANS IN TIOGA COUNTY

The herpetofaunal makeup of Pennsylvania is rather unique. The Commonwealth is home to some of the northern species common in the glaciated regions of the Canadian Shield as well as many of the southern species from the lower regions of the Appalachians. The ranges of most Pennsylvania reptiles and amphibians are restricted to certain regions of the state, a testament to the varied topography and physiographic providences within the region. Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptile and amphibian species.

Common Snapping Turtle

Tioga County is home to many common, generalist species, such as the Eastern Garter Snake (*Thamnophis sirtalis*), the Red-spotted Newt (*Notophthalmus viridescens*), and the Common Snapping Turtle (*Chelydra serpentina*). These species occur in many different habitats and exist throughout the entire state. Along with these common species, Tioga County possesses several rarer species of reptiles and amphibians. Many of these less common species 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. Tioga County has retained many large forested tracts, providing a tremendous amount of contiguous habitat for the oft overlooked reptiles and amphibians of the state. The array of habitats within these large forested blocks serves both the generalist and specialist species.

The terrestrial woodland salamanders depend on canopied forests with adequate amounts of leaf litter. These salamanders are voracious predators of the forest floor. Their roll 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 (*Plethodon cinereus*) and Slimy Salamanders (*P. glutinosus*) are the most common woodland species throughout Tioga County's forests.

The numerous waterways and small mountain streams of Tioga County provide habitat for the streamside salamanders, including the Northern (*Desmognathus fuscus*) and Mountain Dusky Salamanders (*D. ochrophaeus*), the Two-lined (*Eurycea bislineata*) and Long-tailed Salamanders (*E. longicauda*) and the Northern Spring

Long-tailed Salamander

Salamander (*Gyrinophilus porphyriticus*). In the cold-water seepy drainages of the county, the brilliant northern Red Salamander (*Pseudotriton ruber*) can be found under the litter and rocks in spring heads. All of the streamside salamanders require high water quality, and forested stream edges. Amphibians as a whole are particularly sensitive to toxins. Consequently, acid mine drainage is detrimental to the salamanders that inhabit affected streams.

Portions of the county support large 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. The Wood Frog (*Rana sylvatica*), and the Jefferson (*Ambystoma jeffersonianum*) and Spotted Salamanders (*A. maculatum*), all of which are vernal pool obligates, are known from Tioga County. These species cannot reproduce without the presence of vernal pools. Therefore, the health of Wood Frog, Jefferson and Spotted Salamander populations rely upon the integrity of vernal pools in the county.

Jefferson Salamander migrating over snow to a vernal pool

The Four-toed Salamander (*Hemidactylum 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.*). An uncommon trait among reptiles and amphibians, the Four-toed Salamander tends its clutch until the young hatch. In addition to the Four-toed Salamander, many frogs and toads that are not vernal pool obligates can also be found using these habitats. The American Toad (*Bufo amercianus*), Spring Peeper (*Pseudacris crucifer*), and Grey Tree Frog (*Hyla versicolor*) are regular visitors to vernal pools and may use these wetlands to breed.

The Bull Frog (*Rana catesbeiana*) and Green Frog (*Rana clamitans*) are found in a wide range of aquatic habitats, from temporary puddles to huge ponds and lakes. These species epitomize the term "generalist". On the other hand, the Pickerel Frog (*Rana palustris*) and Northern Leopard Frog (*Rana pipiens*) are more specialized and they 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. Researchers are now concerned with the future of this species.

Green Frog

The Eastern Box Turtle was likely gone from Tioga County by the time of European settlement. Eastern Box Turtle remains are a common find in archeological digs from western New York State where no recent records exist. It is thought that Eastern Box Turtles were a native species of western New York State and northern Pennsylvania but were wiped out of these regions by over collecting by Native Americans (Dodd 2001).

The Painted Turtle (*Chrysemys picta*) is a common occurrence in Tioga County. This species relies on permanent water habitats including ponds and rivers. The Wood Turtle (*Glyptemys insculpta*) relies on wooded creeks and rivers, and can be locally common in areas. There is now concern for this species because many populations are void of juvenile turtles, indicating that there is little successful reproduction occurring. The nests of the Wood Turtle are laid in sandy substrates along waterways. These sites are used by many nesting females and are easily targeted by overpopulations of Raccoons, Skunks, and Opossums.

Black rat snake

The Northern Coal Skink is the only of Pennsylvania's lizards known from Tioga County. This species occurs in small, isolated populations and there is concern for this species in the state because these small populations are particularly susceptible to localized extinction.

The Northern Black Racer (*Coluber constrictor*) and the Black Rat Snake (*Elaphe allegheniensis*), two fairly common species is 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 triagulum*) 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 Tioga County. This species hunts along open waterways, searching for amphibians and small fish.

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. Another small and secretive snake in the county is the Red-bellied Snake (*Storeria occipitomaculatum*). This species is a common resident and can be found beneath decaying wood. The Eastern Ribbon Snake (*Thamnophis sauritis*) depends on the sedge and grass covered edges of wetlands. This species is thought to be declining due to wetland destruction and is tracked by the Pennsylvania Natural Heritage Program.

Timber rattlesnake

The Timber Rattlesnake (*Crotalus horridus*) has long been persecuted in northeast. Although the snake may deliver a serious bite if threatened, the danger they pose has been drastically over-exaggerated. In fact, there has never been a human fatality in Pennsylvania from a rattlesnake bite. The forested ridges of Tioga County provide excellent habitat for this species and several populations in the county appear to be healthy. This species is able to use a wide range of habitats and may be encountered throughout the forested regions of the county. They primarily occur on rocky slopes where they can find refuge in spaces between the boulders as well as thermoregulate in the sunny openings. Timber Rattlesnakes forage in a variety of habitats, but favor forested areas with healthy small mammal populations. Hibernacula, or dens, often are found under canopy cover but are usually located within several hundred meters of an open basking site. Persistence of these sites relies on forestry practices that maintain a diversity of open areas adjacent to forested foraging habitat.

Timber Rattlesnakes are still considered a game species by the Pennsylvania Fish and Boat Commission and can be collected with an appropriate PAFBC permit. Despite the allowance of rattlesnake hunting, the Timber Rattlesnake is considered a species of special concern because it is declining from human persecution. Timber Rattlesnakes are a protected species in every other state where the snake occurs and are considered during environmental review in Pennsylvania. The wooded habitats along the ridges of Tioga County provide a tempting location for housing development, however housing locations at these sites are not recommended to reduce human-snake encounters.

Tioga County is a significant spot in the state for the Commonwealth's reptiles and amphibians. The county represents some of the northeast's healthiest known populations of the Timber Rattlesnake and the Northern Coal Skink. The large, unfragmented forested tracts with numerous waterways provide critical habitat for the reptiles and amphibians of the county. Of utmost importance to the conservation of the County's herpetofauna is the protection of the region's wetlands, including the communities of vernal pools. The rich and diverse herpetofauna of Tioga County is significant to Pennsylvania and should be considered in the long term plan of the region.

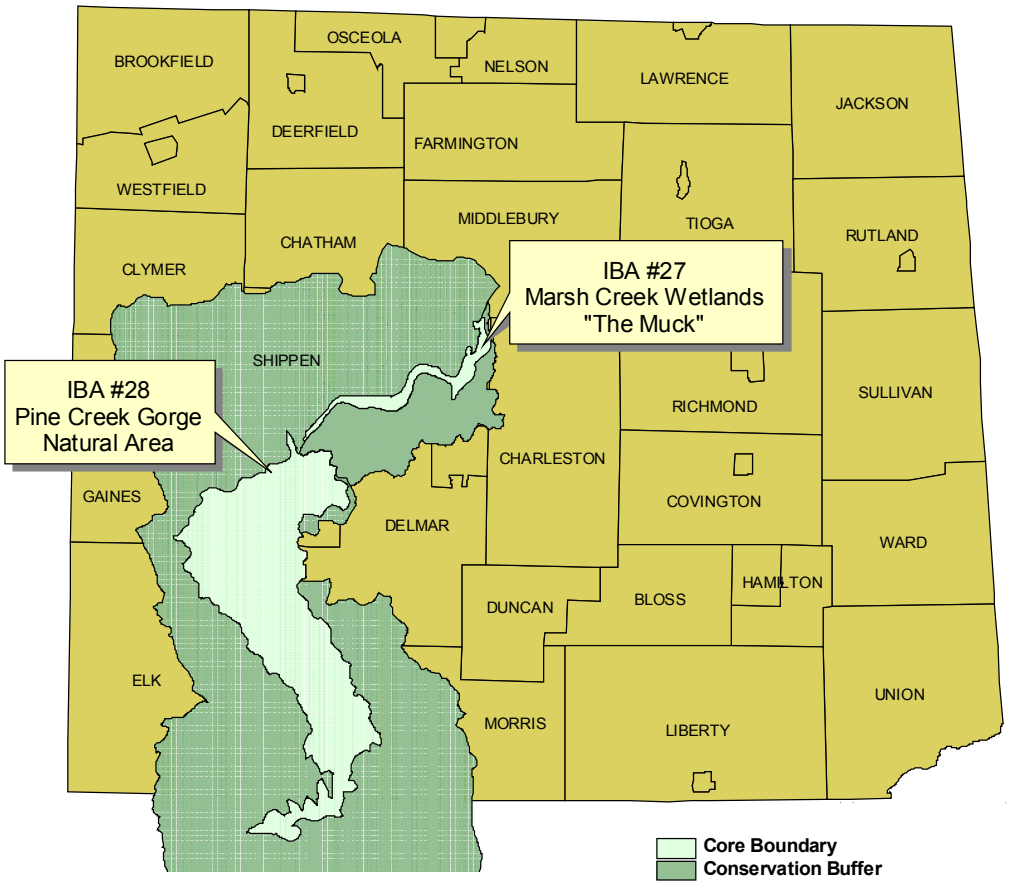
BIRDS OF TIOGA COUNTY

Important Bird Areas in Tioga County

Tioga County has much undeveloped land, forest interior, and a myriad of wetland communities that provide some of the finest bird habitats in Pennsylvania. The forests of the county provide outstanding habitat for bird species that rely on large unfragmented forested tracts, including the Northern Goshawk, Barred Owl and Scarlet Tanager. Pennsylvania's bird diversity is a critical component to the integrity and character of Penn's Woods and Tioga County accounts for a high proportion of the state's forests. Birds provide numerous benefits to human including insect and pest control, plant seed dispersal, tremendous aesthetic value, and in some cases hunting opportunities. Pennsylvania birders spend hundreds of millions of dollars in bird watching activities and equipment purchases every year!

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

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



Forest Interior Birds: Various Warblers, Vireos, Thrushes, Tanagers, Flycatchers, etc.

Neo-tropical migrant landbirds are birds that breed in temperate North America and spend the non-breeding season mainly in South and Central America, the Caribbean Islands, and extreme southern United States. There has been concern over long-term declines of neo-tropical migratory birds since the 1960's. Determining the main causes of the decline is difficult due to the fact that these birds occupy critical habitats over the entire western hemisphere. Loss of suitable breeding habitat, wintering habitat and stopover habitat, and pesticides are the most frequently known causes of the declines. Neo-tropical migrant landbirds will breed in a variety of different habitats, from early successional old-field settings to forested wetlands to open wetlands to large forest interior.

Acadian Flycatcher - Photo Source: Ron Austing

Scarlet Tanager – Photo Source: Ron Austing

Louisiana Waterthrush - Photo Source: Ron Austing

Hooded Warbler – Photo Source: Ron Austing

Forest Interior

Forest interior is defined as unbroken forest at least 200-300 feet from habitat edges and usually is related to size of a patch of forests (large patch size, more forest interior). Forest interior migrant landbirds usually avoid forest edges during nesting and are adapted to forested interior conditions. Consequently, these birds will usually avoid nesting in smaller fragmented landscapes. Studies in the Midwestern United States have documented that forest interior species may not successfully breed in small patches of otherwise suitable habitat. As the threat of suburban development continues to decrease the size of woodlots, forest interior species may have trouble finding enough suitable habitats.

Forest Interior Bird Species in Pennsylvania

Many forest interior bird species occur in Pennsylvania, where large contiguous and diverse forests and wetlands still occur. These species have different types of habitat requirements but all prefer large, contiguous forests with little fragmentation. 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 if 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 occurring in Pennsylvania include Kentucky Warbler (*Oporornis formosus*), Worm-eating Warbler (*Helmitherus vermivorus*), Wood Thrush (*Hylocichla mustelina*), Canada Warbler (*Wilsonia canadensis*), Cerulean Warbler (*Dendroica caerulea*), and Prothonotary Warbler (*Protonotaria citrea*). Other forest interior songbirds occurring relatively commonly in Pennsylvania include Scarlet Tanager (*Piranga olivacea*), Blue-headed Vireo (*Vireo solitarius*), Ovenbird (*Seiurus aurocapilla*), Acadian Flycatcher (*Empidonax virescens*), Hooded Warbler (*Wilsonia citrina*), Black-throated Blue Warbler (*Dendroica caerulescens*), Black-throated Green Warbler (*Dendroica virens*), and Louisiana Waterthrush (*Seiurus motacilla*). Several species, such as Louisiana Waterthrush, Cerulean Warbler, Worm-eating Warbler, Canada

Warbler, and Black-throated Blue Warbler, are priority species in PIF conservation plans for the Allegheny Plateau and/or Northern Ridge and Valley physiographic areas. Rare birds that are state-listed/candidates that rely on forest interior include Prothonotary Warbler, Yellow-bellied Flycatcher (*Empidonax flavescens*), Northern Goshawk (*Accipiter gentilis*), and perhaps Swainson's Thrush (*Catharus ustulatus*), who may also use forest edge and second growth conifer woodland.

Management Recommendations for Forest Birds

Many different species of birds will require different stages of forest succession and it is important to know the needs of forest interior speices, prior to forest management. For instance, it is vital to know what type of wetlands, uplands, forest cover types, and streams/rivers are on a particular piece of property. It is also important to know the size of the forested area, and if it is contiguous with other forested areas. The larger the forest involved, and the more types of habitats within the forested areas, the more management can be conducted. Forest interior birds require large amounts of forested areas, and typically avoid edges of forests. Many forest interior birds, however, require different microhabitat conditions. A mosaic of structural diversity throughout the forest is ideal along with creating openings that do not create edge effects. Edges are often associated with higher amounts of nest predation and brood parasitism, fewer food resources for some species, warmer air and soil temperatures, drier conditions, and more wind than interior forest. Some birds forage or nest only in small saplings or shrubs, whereas other birds spend most of their time high in the forest canopy. It is possible to create more foraging and nesting opportunities for birds by retaining trees, saplings and shrubs in a variety of class sizes that result in providing more vertical layers of forest. Specifically, the following recommendations can increase chances of attracting forest interior birds to a particular forested area.

1) ***Enhance vertical structure within the forest stand***
2) ***Keep forest buffers along streams***
3) ***Do not harvest all trees***
4) ***Retain decaying and standing dead trees (snags)***
5) ***Create irregular edges when harvesting stands***
6) ***Leave large patches of forest close to other forest patches***
7) ***Maximize the forest interior area of unharvested stands***
8) ***Keep house cats inside***
9) ***Allow hunting to reduce White-tailed Deer population***

Keeping Common Birds Common

Projects such as Partners in Flight (Rosenberg et al. 1999) "A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other forest interior Birds" focus efforts on reversing the population decline of Neo-tropical migrant landbirds. Many of these species mentioned above are still relatively common throughout their breeding range. However, if declines continue throughout the species breeding range, these birds could become rare in the future. The goal of these programs is to keep common bird species common by identifying concentrations, population goals, and active management of vulnerable target species of conservation concern. In addition to critical breeding habitat, PIF is identifying critical migratory habitat in the ridges and valleys of Pennsylvania. Forest interior bird species are, as a whole, a good indicator of habitat quality and forest health. A healthy forest will contain good populations of forest songbirds, healthy insect populations, and a good forest structure.

Grassland-dependent Bird Species

Many bird species depend on early-successional habitats such as hayfields, open grasslands and prairies, abandoned strip-mines, and air fields. These species are habitat specialists, and the specificity of their habitat choices has deemed them a species group of management concern. Many of these species cannot tolerate land use changes from open grassland/pasture to row crop agriculture such as cornfields and soybean fields. In Pennsylvania, many of these species are quite unpredictable in their range and site fidelity. Species, such as Dickcissel, for example, occur unpredictably on the fringe of their range. Other species, such as Henslow's Sparrow, may have increased in Pennsylvania due to the reclaiming of abandoned strip mines into grassland habitats. The historic extent of the distribution of grassland-bird dependent species in Pennsylvania is relatively unknown, but indications are that prior to European settlement, grassland bird species were fairly rare in Pennsylvania. However, as forests were cleared in the 1800's, and by 1840, almost half of Pennsylvania was farmland. This cleared the way for grassland bird species to increase in numbers, and become somewhat common up until the mid 1900's. However, by 1980, only 26 percent of the land remained in agricultural production. Many grassland bird species are now decreasing in Pennsylvania and throughout their range. There is hope in programs such as CREP (Conservation Reserve Enhancement Programs), and reclaiming of strip mines into grassland, which have assisted in restoring habitat for these grassland-dependent species.

Species specific habitat requirements

***Upland Sandpiper** (*Bartramia longicauda*) - areas with low to moderate forb cover, low woody cover, moderate grass cover, moderate to high litter cover, and little bare ground (fence posts and display perches may be important components of suitable habitat)- they use native and tame grasslands, wet meadows, hayland, pastures, planted cover, highway and railroad rights-of-way, and grassy areas of airports. The Upland Sandpiper is a Partners in Flight (PIF) priority species in the regional conservation plans for physiographic regions Allegheny Plateau and Northern Ridge and Valley.

Henslow's Sparrow (*Ammodramus henslowii*) - fallow weedy fields, often with broomsedge (*Andropogan* spp.) grasses, reclaimed strip mines, use grasslands that have well-developed litter, relatively high cover of standing dead residual vegetation, tall dense vegetation, and generally low woody stem densities. They may use idle hayfields, CREP lands, or wet meadows. The Henslow's Sparrow is listed on the Partners in Flight (PIF) watch list as a highest concern species and is a priority target species in the regional conservation plans for physiographic regions Allegheny Plateau and Northern Ridge and Valley.

***Dickcissel** (*Spiza americana*) - prefers habitat with dense, moderate to tall vegetation and moderately deep litter. Suitable habitats are found in oldfields, hayfields (especially alfalfa), fencerows, hedgerows, road rights-of-way, planted cover, CREP fields and dense nesting cover, and moderately grazed and idle prairie. The Dickcissel is listed on the Partners in Flight (PIF) watch list as threatened and declining.

Grasshopper Sparrow (*Ammodramus savannarum*) - generally prefers moderately open grasslands and prairies with patchy bare ground, selects different components of vegetation, depending on grassland ecosystem. This species generally avoids grasslands with extensive shrub cover but regularly occurs in hayfields, dry pastures, and reclaimed strip mines.

Savannah Sparrow (*Passerculus sandwichensis*) - occupies similar habitats to Grasshopper Sparrow such as hayfields and pastures, but also may occur in wet meadows. In Pennsylvania, the species occurs in meadows, cultivated fields, grasslands, hayfields, and reclaimed strip mines.

Vesper Sparrow (*Pooecetes gramineus*) - prefer extensive meadowlands or even croplands, cornfields, alfalfa fields, hayfields, reclaimed strip mines. They require elevated perches from which to sing from such as isolated trees, power lines, or tall grass.

Eastern Meadowlark (*Sturnella magna*) - grazed and ungrazed pastures, hayfields, winter wheatfields, idle or fallow areas, reclaimed strip mines. Males prefer areas with an elevated perch, such as a tree or utility perch.

Eastern meadowlark – Photo Source: Ron Austing

Bobolink (*Dolichonyx oryzivorus*) - prefers open fields, moist meadows with heavy stands of hay, clover, alfalfa, or weeds, and reclaimed strip mines. The Bobolink is a PIF priority species in the regional conservation plans for physiographic region Northern Ridge and Valley.

***Short-eared Owl** (*Asio flammeus*) - reclaimed strip mines, field stubble and grasslands, and originally, and possibly still, open marshlands. Within such areas, these owls require cover, dense thickets, grassy tussocks, clumps of rushes or reeds, and even dense evergreen, and an abundance of mammalian prey. The Short-eared Owl is listed on the Partners in Flight (PIF) watch list as threatened and declining.

*Denotes species of concern in Pennsylvania

Conservation/Management Recommendations for Grassland Birds

Many of the above species depend heavily on some type of agricultural practice for maintenance of their preferred breeding habitats. The loss of pasture and hayfields to suburban development and succession of abandoned pasture and hayfields to old-field and woodland habitat are two of the biggest threats to these species in Pennsylvania. Many of the above species nest in active hayfields and pasture, and early mowing and harvesting of these fields in the summer will destroy many nests. It is recommended, if possible and feasible, that farmers delay mowing and harvesting hayfields until late July to give these species juveniles time to fledge. Selling of farms to developers is a process that is occurring most frequently in southern Pennsylvania, where development pressure is high. Reclaimed strip mines may be a harbor for some of these grassland species, especially ones that have been applied proper management. However, there are far too few of these reclaimed strip mines to support healthy populations of these species. Conservation Reserve Enhancement Programs (CREP) have also been proving beneficial to restoring some breeding areas for many of these species, and one of the goals of this program is to provide financial and technical assistance for Pennsylvania farmers to voluntarily restore wetlands, riparian areas and grasslands by enrolling up to 200,000 acres of farmland in CREP. For more information on CREP or to find out how to enroll in CREP, visit http://www.fsa.usda.gov/pas/publications/facts/html/creppa03.htm. This program will hopefully give farmers incentives to plant native grasses and help the populations of grassland birds reach a healthy level.

Partners in Flight Goals for Grassland Birds

Partners in Flight has identified the Northern Ridge and Valley and Allegheny Plateau physiographic provinces as high priorities for conserving grassland bird species. In Northern Ridge and Valley, one objective of Partners in Flight is to identify, and either acquire, manage, or restore grasslands greater than 50 hectares with potential to support Henslow's Sparrow or Upland Sandpiper. Patners in Flight also hopes to preserve 13,000 hectares of pastureland in an effort to support 12,000 pairs of Bobolinks and other grassland species, and at least 1,000 hectares of that area should be conserved where patches are large enough to support 50+ pairs of Upland Sandpipers and potentially Henslow's Sparrow.

Marsh Bird Species

Many bird species depend on herbaceous-dominated marsh wetlands such as cattail-dominated wetlands, sedge-dominated wetlands, and open herbaceous marshes and ponds. These species are habitat specialists, and the specificity of their habitat choices has deemed them a species group of management concern. Marshes are a type of wetland, generally being less acidic than peat moss (*Sphagnum* spp.) dominated wetlands, and support a variety of plant life, most notably cattail (*Typha* spp.) and sedges (*Carex* spp.).

Sora – Photo Source: Ron Austing

Marsh-dependent birds are uncommon to very rare in Pennsylvania. In general, they are also very secretive birds that require abundant time and effort in surveying for them. Many rail species do not fly when flushed from their habitat, as their narrow bodies are supremely adapted to stalking through vegetation when disturbed. Many of these species are area sensitive as well, and will not breed in very small marshes/wetlands. In Pennsylvania, all marsh-related birds are birds of special concern and are either candidates for state listing or are already state-listed.

Least Bittern – Photo Source: Ron Austing

Marshes provide critical habitat for all species named above and for a variety of other wildlife and plant life. Many marshes/emergent wetlands have been lost to development. From 1956 to 1979, Pennsylvania lost six percent of its vegetated wetlands, a loss of 1,200 acres a year. Wetland loss continues throughout the state, and despite regulations, some estimates have suggested that about half of Pennsylvania's wetlands are now gone. The conversion of marshes/wetlands to lakes ponds and reservoirs, conversion to farmland, urban development, and channelization drainage projects are the largest threats to all wetland habitats.

Species specific habitat requirements:

***Sora** (*Porzana carolina*) - This species nests in a variety of freshwater marshes, bogs, and wet meadows, but prefer cattails and sedges with mud and standing water. It eats primarily seeds, but also some insects as well. According to the first breeding bird atlas, Sora numbers have decreased sharply in PA in the last 25 years, but Sora remains the most common breeding rail in Pennsylvania.

***Virginia Rail** (*Rallus limicola*) - This species inhabits Freshwater and occasionally brackish marshes, mostly in cattails, reeds, and deep grasses,

Virginia Rail – Photo Source: Mark Chappell

also in or close to other emergent vegetation. It prefers to inhabit shallow freshwater emergent wetlands of every size and type, from roadside ditches and borders of lakes and streams to large cattail marshes. This species can occur even in small marshes.

***King Rail** (*Rallus elegans*) - King Rails prefer to nest in large brackish or freshwater marshes, although a diversity of habitats have been used across its entire range. The King Rail is one of the rarest breeding birds in Pennsylvania, and it has been designated as an endangered species. Much of the habits of the King Rail are still unknown, due to its secretive nature.

***Common Moorhen** (*Gallinula chloropus*) - This species inhabits lakes, ponds, and river edges if sufficient vegetation exists. However, for nesting, this species prefers to nest in cattail marshes, which could be large or small in extent. This species tends to inhabit the open areas of the marsh, as opposed to rails, that prefer to be hidden in the thick herbaceous vegetation. It has been noted that this species prefers thick vegetation, preferably cattails, and deep water with scattered open places were important to the nesting success of this species. They may nest in patches of sweetflag, arrow-arum, and in tussocks of sedges and rushes.

***American Coot** (*Fulica americana*) - A rare breeder in Pennsylvania, this species prefers to nest nearer to open water than other marsh species, setting up breeding territories along the edge of an open pool in a cattail marsh, or less commonly, in a large bed of spatterdock. Coots occur most frequently in the northwest part of Pennsylvania, where optimum habitat conditions exist. Scattered other areas occur throughout the state, and anywhere where there is enough open water with herbaceous vegetation, this species could be present.

American Coot – Photo Source: Mark Chappell

***American Bittern** (*Botaurus lentiginosus*) - This species prefers to breed in extensive freshwater marshes, especially those characterized by dense stands of cattail, and thick growths of spatterdock, bulrushes, grasses, and sedges, interspersed with areas of open water. Rarely does this species nest in smaller marshy areas along rivers or sluggish streams and in bogs, ponds, wet meadows, and possibly dry grassy areas. The American Bittern is a rare and declining species in Pennsylvania, and occurs more commonly in the northwest part of the state.

***Least Bittern** (*Ixobrychus exilis*) - Least Bitterns prefer to nest in freshwater or brackish marshes, swamps, and bogs. In Pennsylvania, this species prefers large, deep-water cattail marshes that have scattered shrubs and small trees growing in and around them. This species is very rare in Pennsylvania, and has been designated as a threatened species.

Marsh Wren – Photo Source: Mark Chappell

***Marsh Wren** (*Cistothorus palustris*) - This species almost exclusively nests in large cattail marshes, both brackish and freshwater marshes, in marshy lake or pond edges, and along the banks of tidal rivers and sluggish streams. The first Breeding Bird Atlas determined that Marsh Wrens may be in trouble in

Pennsylvania. Precipitous declines have occurred, and former strongholds for this species are no longer. This species is a species of concern in Pennsylvania, and is a candidate for listing in the state.

***Sedge Wren** (*Cistothorus platensis*) - This species prefers moist upland sedge meadows with little or no standing water, and usually does not occupy deep cattail marshes like its close relative the Marsh Wren frequents. Less commonly, Sedge Wrens may nest in a low pasture among clumps of sweetflag and grasses, or may even nest in orchard grass in an upland hayfield along with the Savannah Sparrow and Bobolink (Brauning 1992). This species is very rare in Pennsylvania, and has been listed as threatened in the state.

Conservation/Management Recommendations for Marsh Birds

Throughout the range of marsh-dependent bird species, breeding habitat continues to be destroyed, with only modest amounts marsh habitat restored and created. As a result, the populations of these species have responded to these changes in habitat availability accordingly. Marsh birds have declined in many locations where large extensive marshes have been drained, filled or developed. For example, King Rails have declined precipitously in the last fifty years and the species has undergone extreme range contraction with virtual disappearance from the northeast, upper Midwest, and southeast Canada. This species continues to decrease even in strongholds in the southeast, where large populations still occur.

Other possible reasons for decline of marsh birds include pesticide and other contaminant/toxic, ingestion of lead and plastic, collisions with stationary/moving structures or objects, degradation of wintering habitat, disturbance at nest, roost, or feeding habitat, and human/research impacts. It is not known to what effect these factors have on marsh bird populations, but research should be conducted to determine reasons for decline. One large discrepancy is the lack of information on the populations of all marsh birds, due to the very secretive nature of these species. The most important conservation need is the immediate preservation of emergent wetlands that provide breeding, migration, and wintering habitats. Many wintering habitats, including coastal marshes in California, Florida, Louisiana, New Jersey, and Texas provide critical habitat for Soras and other marsh bird species, yet these areas are extremely vulnerable to habitat degradation. Marsh birds will benefit from policies and management that eliminate or minimize effects of wetland draining and filling, siltation, competition from resident Canada Geese and exotic Mute Swans, toxic bioaccumulation, eutrophication, and other forms of pollution, and invasion of exotic plant species.

North American Waterbird Conservation Plan

The North American Waterbird Conservation Plan is a management plan that deals with conservation of all waterbirds, including wetland dependent birds in North America. This plan provides a continental scale framework for the conservation and management of over 210 species of waterbirds. Each species is evaluated and the species with the most conservation concerns are highlighted. In the Southeast regional plan, three rail species are identified for immediate conservation management (Yellow Rail, Black Rail and King Rail). In addition, according to the plan, management action is needed for Least Bitterns, American Bitterns, and American Coots. Long-term management and planning was identified as a priority for Virginia Rails, Soras and Common Moorhens. In the Middle-Atlantic and New England region, a marshbird monitoring program is being implemented due to the conservation concerns for these species. The goal is to develop a targeted monitoring program following standardized regional (or national) approach, and using remote acoustical techniques to monitor marshbirds.

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DRAGONFLIES AND DAMSELFLIES: THE ODONATES

INTRODUCTION

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

Damselflies and dragonflies are closely related insects, and they share many features. As adults they have very small antennae, prominent compound eyes, a long abdomen composed of ten segments, and four large wings of approximately equal length, laced with a network of veins. They have similar life histories and utilize a similar suite of habitats.

A Damselfly

Damselflies and dragonflies also differ in several notable ways. All damselflies have eyes that are widely separated, while many dragonflies have eyes that touch or are less widely separated. Damselflies tend to be shorter and more slender in body than dragonflies. Damselflies tend to fly slowly, close to the surface of the water, or stay sheltered in patches of vegetation. Dragonflies tend to be more visible and have a more powerful and aggressive flight. Damselflies usually perch with their wings folded together over their back or cocked open at a 45 degree angle, while dragonflies perch with their wings spread all the way open.

LIFE HISTORY AND HABITATS

Eggs

A Dragonfly

Adult odonates lay their eggs (oviposit) in or near water. There are two common methods of oviposition. Some species lay their eggs inside the stems or leaves of living or dead plant material. This is called endophytic oviposition. Other species lay their eggs in the water, singly or in a mass. This is called exophytic oviposition. Many odonate species have very unique and specific criteria for oviposition sites and females can be observed testing multiple sites before finding the right conditions (Westfall and May 1996). Odonate eggs develop at different rates depending on the species, but in general development quickens as temperature increases (Brooks 2003). The eggs of certain tropical species may hatch in as few as five days, but in temperate regions like Pennsylvania, it is more common for eggs to develop over a period of several weeks to several months. Once the eggs hatch, the larvae seek out their preferred niche in the aquatic habitat.

Larvae

There are many different hunting techniques and habitat preferences among odonate larvae. These preferences are reflected even in the appearance of the larvae. For example, some larvae in the family Gomphidae are found on the silty bottoms of still or slow-moving waters. They have long legs and a wide, flat body that distributes their weight over the soft bottom. This keeps them from sinking deep into the muck. They have small eyes because little light penetrates to the bottom and they rely on touch rather than sight to find food. They are patient hunters, lying in wait rather than actively pursuing their prey. Their long, sensitive legs and antennae help them to detect the movements of nearby prey. They also tend to be covered in long hairs that trap little particles of debris. Their coat of duff camouflages them from both hungry predators and wary prey.

Adult dragonfly newly emerged from nymphal exoskeleton.

In contrast, some odonate larvae, including many members of the Aeshnidae family, prefer to climb about in submerged aquatic vegetation, hunting their prey actively rather than lying in wait for prey to wander past. These species have large, well-developed eyes which they use to watch for the movements of prey or predators. They have short antennae, because they rely on sight rather than touch to find food. Their bodies are long and streamlined. They also lack the hairy coat of their muck-dwelling relatives, but their smooth skin is camouflaged by colored patterns that match their environment.

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

When a larva is fully developed, it undergoes metamorphosis inside its larval skin. Then it crawls out of the water for its final molt. This movement of the larva out of the aquatic habitat to shed its larval skin is called emergence. The site selected for emergence varies by species. Many Gomphidae prefer to crouch on the ground or a low rock. Other species, including many Libellulidae, climb up onto emergent vegetation. Once properly positioned, the larval skin is shed one last time and a winged adult emerges.

Adults

Many insect larvae escape the cavernous appetites of predators such as fish and odonates when they leave the water to become adults, but they are jumping from the frying pan into the fire. Odonates emerge from the water too, transforming from camouflaged stalkers into jeweled fighter planes. Adult odonates continue to feed on the community of insects with whom they shared an underwater life. They also add to their diet additional insects they encounter for the first time as adults such as butterflies.

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

CONSERVATION

There are a few important pieces of information needed when developing conservation and management plans for odonates:

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

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


Photo Source: PNHP

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

   Larval and adult odonates feed on the other insects that share their environment such as mosquitoes, midges, gnats, and other flies. Odonates help control insect species that are considered pests. However, when homes encroach upon wetland habitats, municipalities and homeowners often take pest control into their own hands. The pesticides used to control mosquitoes and other nuisance insects have many negative effects on non-target species. Direct mortality of all insect species occurs when broad-based killing agents are used. More specific killing agents are available that only harm black flies or mosquitoes, but indirectly this still affects predators such as fish and insects who experience a decrease in food availability when their formerly abundant prey items are eliminated.

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

   Landscape scale conservation of wetland habitats and the supporting upland habitat is needed for long term survival of healthy odonate populations. This is addressed in more detail in the 'Threats' and 'Recommendations' sections.

THREATS

The specific habitat requirements of many odonates are not well known. Alteration or destruction of habitat is the greatest threat to populations of odonates (Westfall and May 1996). Many activities take place that destroy or alter odonate habitats so that they are no longer suitable for odonates, or can only support a few tolerant species. These activities are discussed below.

Connectivity (Habitat fragmentation)

Development of extensive agricultural, urban and suburban areas creates biological "islands" of isolated natural areas. It can be difficult for animals to move long distances across unsuitable habitat and to navigate large obstacles such as highways and fences. Some strong-flying odonates are able to disperse over these obstacles. Other odonate species are not strong flyers or are disinclined to fly any great distance from their preferred type of habitat. For those species that can travel large distances, there is increased risk they will not be able to find suitable habitat at the end of their journey in a fragmented landscape with diminished habitat.

Just as habitat fragmentation isolates a group of animals on an island of habitat, it also isolates the gene pool collectively held by that group of animals. When animals cannot make contact with other populations, inbreeding within one population takes place. This means there is no gene flow between populations and a loss of genetic diversity results. As genetic diversity is lost, the ability of that population to adapt to changes in the environment is reduced. This increases the chances that the population will not be able to survive over the long-term.

Hydrology

Alteration of hydrology can also cause odonate mortality. Poor storm water management can cause unusually large fluctuations in water flow. Heavy water demand can lead to decreased water tables and decreased water flow. If natural water flow patterns are altered in an aquatic habitat, many qualities of the habitat are changed such as inundated area and depth, length of inundation, temperature, dissolved oxygen levels, and types and amounts of vegetation in and around the aquatic habitat. All of these factors are important in proper development of odonate eggs and larvae.


Photo Source: PNHP

Substrate

The term substrate is used here to refer to the environment at the bottom of a stream, lake, or wetland. Substrate requirements can be quite specific for odonates. The amount and composition of materials such as cobble, gravel, sand, silt, woody debris, living plant material, and even the rate of water flow over the bottom are important factors. The substrate can be removed or altered by activities such as dredging, dam installation, or bridge installation. Gradual non-point effects from run-off can also change substrate. For example, fine sediments eroding from agricultural fields wash down slope into a gravel and cobble-bottomed stream. The silt settles onto the bottom of the stream in places, filling in the spaces between the gravel and cobble. This deposition of silt in the substrate has effectively eliminated the gravel and cobble habitat needed by certain odonate species.

Vegetation

Removal of wetland or riparian vegetation or a significant change in the composition of the vegetation is a threat. For species that lay their eggs in plant material, a change in the type or amount of vegetation in or around aquatic habitats will eliminate egg-laying sites. For species that lay their eggs in the water, removal of vegetation from around or within aquatic habitat will reduce shade. This causes water temperatures to reach higher temperatures and evaporation rates to increase. This can be particularly noticeable in small wetlands like seasonal pools. One cause of mortality of odonate eggs is prolonged high temperatures or periods of drought (Brooks 2003).

Water Quality

Many human activities have degraded water quality in aquatic habitats. The adverse effects on aquatic life are well documented. Some of the most significant pollution problems are caused by acid mine drainage, discharge from sewage treatment plants, and run-off from urban, suburban, industrial, and agricultural areas.

Agricultural runoff is a major source of pollutants in Pennsylvania where there are abundant farmlands. Agricultural runoff is generated as rain falls and flows through fields that have been treated with artificial and natural fertilizers, herbicides, and insecticides, and through livestock pastures and feedlots, washing the waste into local aquatic systems.

Suburban and urban runoff comes from rainwater that flows off rooftops, down streets and parking lots, through industrial zones and garbage disposal sites, and through lawns and golf courses treated with various chemicals. This runoff contains sediments, garbage, road salt, oil, pesticides, herbicides, and a whole mixed bag of other household and industrial chemicals.

Testing for a variety of synthetic chemicals and heavy metals that can be toxic to wildlife is an important part of water quality monitoring. There are other important variables used to monitor water quality including temperature, pH, dissolved oxygen, sediment load, nutrient levels such as nitrates and phosphates, and bacterial and algal levels. The types of plants and animals found living at a site can be used to evaluate water quality. Certain species are very tolerant of poor water quality, while others will only be found in clean habitats. The types of plants and animals living at a site can be monitored for change over time. If species intolerant of pollution such as certain mayflies disappear from a site, and species tolerant of pollution such as blood worms increase, this is an indication that there is a problem with water quality.

Climate Change

All aspects of the life of an odonate, from egg and larval development to adult feeding, thermoregulation, and reproductive success, depend on certain environmental cues and conditions. While predictions of climate change do not agree on the details, evidence shows that changes in average yearly temperatures, minimum and maximum temperatures, rainfall amounts, and other environmental changes are occurring.

These changes will have an effect on wildlife that cannot control their environment as humans do. There is already evidence that the geographic ranges of plant and animals have been shifting in response to changes in climate. Climate change may be of increasing concern for species of special concern, especially in regard to species that are geographically restricted (Westfall and May 2000).

RECOMMENDATIONS

Protecting habitats where odonates of special concern currently occur is a first step towards ensuring their long-term survival. Tioga County is notable in Pennsylvania for the extent of varied wetland habitats it supports. This is reflected in the number and diversity of odonates that were found in the county during these surveys, including many species of special concern. Protection of large tracts of wetland habitats from alteration and fragmentation is an attainable goal for the county, and will have a positive impact on odonate species conservation for the state as a whole. Restoration efforts should strive to return aquatic habitats and the surrounding uplands to relatively natural conditions in terms of connectivity, hydrology, substrate, vegetation, and water quality.

Pond and Lake Habitats: Several of the state's most rare odonata are species that live in pond and lake habitats. They require ponds and lakes with good water quality and natural vegetation in and around the lake or pond.

- Encourage healthy abundance of aquatic plants and algae by reducing agricultural or urban runoff using a multi-approach, comprehensive storm water management plan
- Maintain / restore natural vegetation in the pond or lake
- Maintain / restore natural vegetation along the shoreline (avoid mowing up to the shoreline)
- Maintain / restore natural vegetation in the surrounding upland (200+ ft) of the pond or lake
- Maintain / restore adjacent wetland habitats
- Avoid spraying herbicides or insecticides around the water. Especially avoid broad-spectrum chemicals that eliminate all insect or plant species, not just the target pest insect or plant
- Avoid introducing fish into ponds where fish do not naturally occur

Wetland Habitats: Several of the state's most rare odonata are species that live in wetland habitats. Conversion of wetlands to lakes and ponds is a common activity but this can make the habitat unsuitable for many odonate species of special concern that require vegetated wetlands. Wetlands themselves can be an effective tool in cleaning up agricultural and urban runoff. However, attempts to manage agricultural and urban runoff using multi-approach, comprehensive storm water management plans should always be made, especially around wetlands of high quality or with species of special concern.

- Carefully screen and minimize activities that destroy or alter wetlands such as draining, filling, flooding, and dredging
- Carefully screen and minimize conversion of wetlands to ponds or lakes. A lake or pond supports less species diversity than a mosaic of wetland types including shrub, graminoid, and forested wetlands (for descriptions of each, please refer to the **Vegetation** >> **Wetlands** portion of the **Natural History Overview of the County**.
- Preserve large areas of good quality wetlands, a variety of wetland types, and wetlands that may serve as stepping stones between good quality wetland habitats.
- Maintain / restore natural vegetation in the wetland
- Maintain / restore natural vegetation in the surrounding upland (200+ ft) of the wetland

- Maintain / restore adjacent wetland habitats
- Reduce agricultural or urban runoff using a multi-approach, comprehensive storm water management plan

Streams and Rivers: Several of the state's most rare odonata are species found in streams and rivers. They require good water quality and healthy in-stream and surrounding upland habitats. It is hard to find large rivers in good, unaltered condition due to the concentration of agricultural, urban, and industrial developments next to large rivers. Because of this, large rivers receive effluents from industry, sewage treatment plants, urban storm water and agricultural runoff. Additionally, dams fundamentally alter the river habitat and change natural flow patterns.

- Minimize and carefully plan major channel alteration
- Carefully site new bridge placement and design
- Carefully site and conduct bridge maintenance
- Minimize and carefully plan dam placement
- Restore riparian zones and upland buffer
- Reduce agricultural or urban runoff using a multi-approach, comprehensive storm water management plan
- Monitor and upgrade sewage treatment facilities
- Exclude livestock from streams

SPECIES DIVERSITY IN PENNSYLVANIA

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

Families of Damselflies (Order Odonata, Suborder Zygoptera) in Pennsylvania:
Calopterygidae – Broad-winged Damselflies
Coenagrionidae – Pond Damsels
Lestidae - Spreadwings

Families of Dragonflies (Order Odonata, Suborder Anisoptera) in Pennsylvania:
Aeshnidae - Darners
Cordulegastridae - Spiketails
Corduliidae - Emeralds
Gomphidae - Clubtails
Libellulidae - Skimmers
Macromiidae - Cruisers
Petaluridae - Petaltails

AQUATIC COMMUNITY CLASSIFICATION

A statewide project of the Pennsylvania Natural Heritage Program (PNHP), the Pennsylvania Aquatic Classification Project, collected aquatic datasets from state and federal agencies, interstate basin commissions, and universities, analyzed the information with standard statistical methods, and identified community types and habitat associations in flowing water habitats, such as rivers and streams. A 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 resulting from the classification project are categorized by types of organisms: macroinvertebrates, fish, and mussels. Aquatic communities for each type of organism can be used to describe the aquatic resources, habitat types, and stream quality.

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. 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.

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 brook trout lay the eggs. Developing fish will be smothered by layers of fine particles.

As filter-feeders, which siphon water to extract particles of food, freshwater 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 very different environment than slower and warmer rivers meandering through valleys, and the aquatic communities reflect the environmental conditions of these different types of waterways. Geology also varies across Pennsylvania and flowing waters may have a unique chemical composition based on the rock that it contacts. Over any natural habitat variations are human alterations to aquatic environments. Many changes within a watershed can be detected within its streams and rivers. If implemented improperly, timber harvest, agriculture, urban development and roads are among some alterations that may cause changes in water quality and stream habitats from non-point source pollution. A number of pollutants enter aquatic systems from point sources to flowing waters, such as discharges from sewage treatment plants, mines, and industrial sources.

Table 1. Watersheds in Tioga County and fish, mussel, and macroinvertebrate community types.

* Surveys by the Pennsylvania Fish And Boat Commission found one or more fish (brown trout, brook trout, and rainbow trout) present of hatchery origin. This suggests that this watershed or a nearby watershed is stocked.

Watershed name	*Stocked Trout Present?	Fish community	Mussel community	Macroinvertebrate community
Asaph Run	y	cold water community		
Babb Creek	y	cold water community		
Babb Creek-Long Creek	n	cold water community		
Blacks Creek	n	cool water community 2		
Blockhouse Creek	y	warm water community 1		
Canoe Camp Creek				brushlegged mayfly community / fingernet caddisfly community
Catlin Hollow				green stonefly (Chloroperlidae)/ giant black stonefly (Pteronarcydae)
Cedar Run	n	cold water community		
Corey Creek		warm water community 1		Nemourid broadback stonefly/ Ameletid mayfly community
Cowanesque River	y	warm water community 1		rolledwinged stonefly / small minnow mayfly community
Cowanesque River-Camp Brook	y	warm water community 1		rolledwinged stonefly / small minnow mayfly community
Cowanesque River-Mapes Creek				green stonefly / giant black stonefly community
Cowanesque River-Troups Creek	y	warm water community 1		
Crooked Creek	n	warm water community 1	eastern floater community	rolledwinged stonefly / small minnow mayfly community
Crooked Creek-Catlin Hollow		warm water community 1		rolledwinged stonefly / small minnow mayfly community
East Branch Stony Fork	y	warm water community 1		
Elk Run	n			
Elk Run				brushlegged mayfly community / fingernet caddisfly community
Elk Run		cold water community		
Hammond Creek				rolledwinged stonefly / small minnow mayfly community
Hills Creek				
Jemison Creek	n	cool water community 1		
Johnson Creek	n	cool water community 1		little plain brown sedge / slender winter stonefly community
Kettle Creek-Little Kettle Creek	y	cold water community		green stonefly / giant black stonefly community

Watershed name	*Stocked Trout Present?	Fish community	Mussel community	Macroinvertebrate community
Long Run	y	warm water community 1		
Lycoming Creek-Rock Run	y	cold water community		brushlegged mayfly community / fingernet caddisfly community
Marsh Creek	y	cool water community 1	eastern ellitptio community	riffle beetle (Elmidae)/ water penny (Psephenidae) community
Marsh Creek-Charlestown Creek/Morris Run				rolledwinged stonefly / small minnow mayfly community
Mill Creek	y			
Mill Creek		warm water community 1		rolledwinged stonefly / small minnow mayfly community
Mudlick Creek				
Phoenix Run	n	cold water community		
Pine Creek-Cedar Run	y		eastern ellitptio community	
Pine Creek-Marsh Creek	y	warm water community 1		
Roaring Branch		cold water community		brushlegged mayfly community / fingernet caddisfly community
Seeley Creek		warm water community 1		rolledwinged stonefly / small minnow mayfly community
Slate Run	n	cold water community		
Stony Fork	y	warm water community 1		
Texas Creek		warm water community 1		
Tioga River-Corey Creek		cool water community 1		brushlegged mayfly community / fingernet caddisfly community
Tioga River-Cowanesque River		warm water community 2		brushlegged mayfly community / fingernet caddisfly community
Tioga River-Crooked Creek		warm water community 1		Nemourid broadback stonefly/ Ameletid mayfly community
Tioga River-Taylor Creek	y	cold water community		green stonefly / giant black stonefly community
Towanda Creek	y	warm water community 1		
Wilson Creek		cool water community 1		
Zimmerman Creek				brushlegged mayfly community / fingernet caddisfly community

TIOGA COUNTY WATERSHEDS

Aquatic Communities in Tioga County

Based on the Aquatic Classification Project, Tioga County is host to 5 distinct fish communities, 6 macroinvertebrate communities, and 2 freshwater mussel communities. 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, species listed by community types give a general account of what organisms to expect in a community habitat. The characteristics of each community type lead to recommendations for conserving or restoring the watershed. None of the communities identified in the county are considered rare within the Commonwealth, though many are of conservation priority based on their quality or vulnerability to degradation. Stocking of trout species (brown trout, rainbow trout, and brook trout) is very pervasive in Pennsylvania. Steps were taken to describe communities of wild trout without the influence of stocking. In communities where stocked trout may be temporary residents, they are not listed common community members.

Aquatic Classification Project: Communities Identified in Tioga County

I. Fish Communities

Community type: Warm Water Community 1 **-** Central Stoneroller *(Campostoma anomalum)/* Northern Hogsucker *(Hypentelium nigricans)*

Other community members: River Chub (*Nocomis micropogon*), Longnose Dace (*Rhinichthys cataractae*), Cutlips Minnow (*Exoglossum maxilingua*), Mottled Sculpin (*Cottus bairdii*), Margined Madtom (*Noturus insignis*), Creek Chub (*Semotilus atromaculatus*), Rosyface Shiner (*Notropis rubellus*), Fantail Darter (*Etheostoma fabellare*), Greenside Darter (*Etheostoma blennioides*)

Species of concern: none

Habitat: The warmwater community 1 usually occurs in small to medium size watersheds (average 128 sq mi) at moderate to relatively high elevations and in streams with less than 1% gradient.

Streams have intermediate alkalinity (average 50 mg/l) and conductivity (average 175 µS/cm) relative to other groups and nearly neutral pH values (average 7.2). Warm water temperatures are also characteristic of this community group. Thermal tolerances of fish in the community group are higher than the cold and cool water communities. Habitat preferences of indicator taxa suggest this community occurs in warm water streams with moderate to high gradients and currents and little silt.

Stream quality rating: Medium

Community rarity: No

Threats: Water quality and habitat may be influenced by non-point source pollution. Poorly managed agriculture can be a threat to this community. In most cases, where this community occurs, about 1/3rd of the watershed is agriculture. In Tioga County, large portions of some warm water watersheds are agricultural. Potential nutrient enrichment and excess sedimentation of streams from mismanaged agricultural practices could degrade conditions for this community type.

Conservation recommendations: Many watersheds in Tioga County are primarily characterized by warm water community 1, including: Cowanesque River, North Fork Cowanesque River, Cowanesque River-Troups Creek, Cowanesque River - Camp

Brook, Crooked Creek-Caitlin Hollow, Long Run, Seeley Creek, Corey Creek, Pine Creek-Marsh Creek, Pine Creek-Cedar Run, Towanda Creek, Stony Fork, Roaring Branch, Blockhouse Creek, Texas Creek, Tioga River- Crooked Creek, Mill Creek, and Crooked Creek.

This community is a high conservation priority. Warm water 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 that need protection in Pennsylvania.

Since warm water 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, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Community members:

Photo Source: http://www.ohiodnr.com/

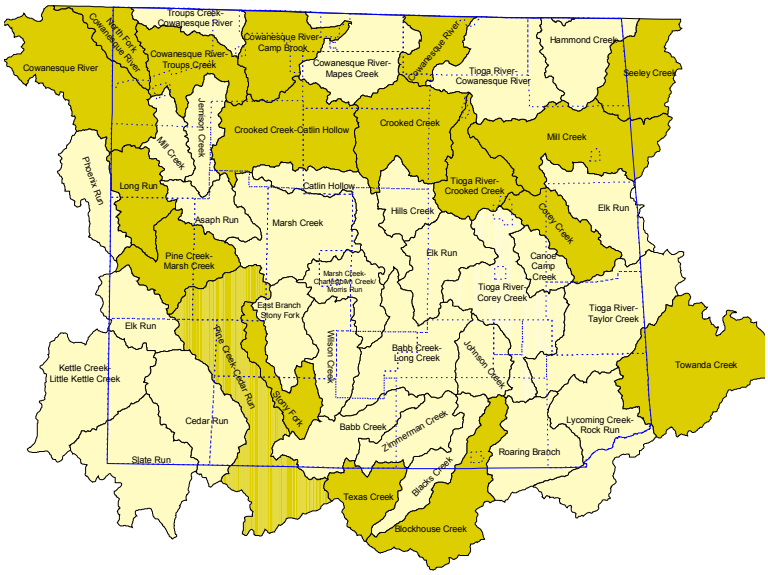
Photo Source: http://www.ohiodnr.com/

Habitat:

Photo Source: PNHP

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

Distribution in Tioga County:



Community type: Warm Water Community 2 **-** Redbreast Sunfish *(Lepomis auritus)* and Rock Bass *(Ambloplites rupestris)*

Other community members: Spotfin Shiner (*Cyprinella spiloptera*), Fallfish (*Semotilus corporalis*), Smallmouth Bass (*Micropterus dolomieu*), Spottail Shiner (*Notropis hudsonius*), Common Shiner (*Luxilus cornutus*), Tessellated Darter (*Etheostoma olmstedi*), Pumpkinseed (*Lepomis gibbosus*), Bluntnose Minnow (*Pimephales notatus*), Bluegill (*Lepomis macrochirus*), Green Sunfish (*Lepomis cyanellus*), Satinfin Shiner (*Cyprinella analostana*), Swallowtail Shiner (*Notropis procne*), Yellow Bullhead (*Ameiurus natalis*), Shield Darter (*Percina peltata*), American Eel (*Anguilla rostrata*), Largemouth Bass (*Micropterus salmoides*), Common Carp (*Cyprinus carpio*)

Less common community members: Comely Shiner (*Notropis amoenus*), Chain Pickerel (*Esox niger*), Banded Darter (*Etheostoma zonale*), Brown Bullhead (*Ameiurus nebulosus*), Redfin Pickerel (*Esox americanus*), Creek Chubsucker (*Erimyzon oblongus*), Sea Lamprey (*Petromyzon marinus*), Rosyside Dace (*Clinostomus funduloides*)

Species of concern: none

Habitat: The warm water community 2 is found in larger streams than the warm water 1 community. The typical habitat is in medium-size streams and rivers with average watershed area of 626 sq mi in areas with moderate elevation and low gradient.

Many community fish are habitat generalists. They tend to prefer pools in warm streams or ponds. Some indicator fish are fairly tolerant of water quality.

Typical water chemistry values are moderate alkalinity (average 47mg/l) and conductivity (average 237 µS/cm) with the pH being neutral and generally warm water temperatures.

Stream quality rating: Medium

Community rarity: No

Threats: Similar to the other warm water community, non-point source pollution is a threat. Nine percent urban land cover typically occurs with this community group and about 39% agricultural land cover. River modifications through dams, channelization, and bridge construction also threaten the natural habitat of this community type.

Many fish in the community were not originally present in the Tioga River watershed, but have since been transplanted by humans. Likewise, many fish in the community were not originally present in the Susquehanna River basin that includes all of Tioga County. For instance, Rock Bass and Smallmouth Bass have been transplanted into the Susquehanna River basin.

Conservation recommendations: In Tioga County, this community type only occurs in the main stem of the Tioga River (Tioga River - Cowanesque River), as it flows north into New York State. It represents the fish community of a small river, providing habitats for fish that specialize in this environment, like some darters and minnows.

This community is downstream of many human settlements and has been altered to some degree from its natural condition. Protection of the variety of habitats in small rivers is key to maintaining a diverse fish community. Shallow and deep pools (slow moving areas) and swift current habitats are examples of habitat types in a small river. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Community Members:

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

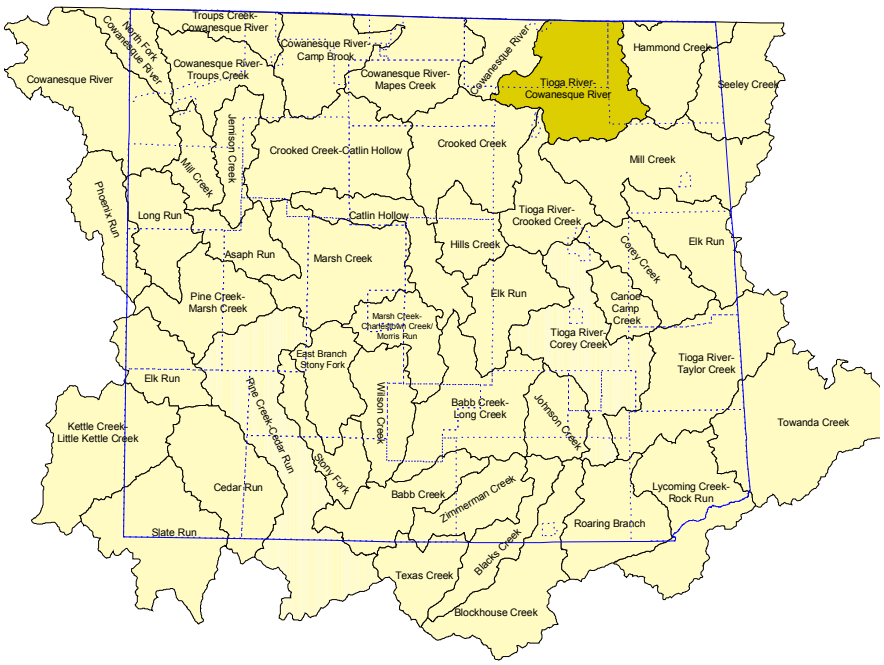
Photo Source: http://www.nj.gov/dep/

Habitat:

Photo Source: PNHP

In large streams and rivers with warm waters, this community occurs because a variety of habitats support the diverse fish community.

Distribution in Tioga County:



Community type: Cool Water Community 1 - Slimy Sculpin (*Cottus cognatus*)

Other community members: stocked Brown Trout (*Salmo trutta*), Fathead Minnow (*Pimephales promelas*), Pearl Dace (*Margariscus margarita*)

Species of concern: none

Habitat: Small streams with an average watershed area of 54 sq mi are the most common habitats for this community type. Streams often occur in areas of relatively high elevation and gradient.

Water chemistry is similar to the warm water community types with relatively high alkalinity (average 54 mg/l) and conductivity (average 225 µS/cm); pH (average 7.0) values are moderate. Water temperatures are cooler than warm water streams.

Community fish prefer cool, rocky streams that may occur in transitional areas between coldwater streams and warm water ones. This community type may represent streams with put-and-take trout fisheries or cool streams with seasonally warm temperatures.

Threats: This community occurs downstream of headwaters and is not usually protected from human influences. Stream temperature may be warmer than previously because protective vegetation on stream banks was removed. Stream habitats may also have been altered where this community is found.

Similar to other valley stream systems, non-point source pollution in the biggest threat. Runoff from agriculture and roads alters water quality.

Stream quality rating: Low

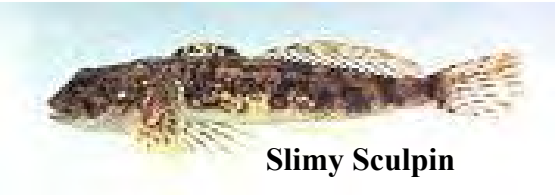
Community rarity: No

Conservation recommendations: This community type occurs in the Wilson Creek, Marsh Creek, Jemison Creek, Tioga River – Corey Creek, and Johnson Creek watersheds.

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. In some watersheds with this community type in Tioga County, mine drainage is also negatively influencing the stream community.

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

Community Members:



Slimy Sculpin

Photo Source: http://www.nj.gov/dep/

Photo Source: http://www.cnr.vt.edu/efish/

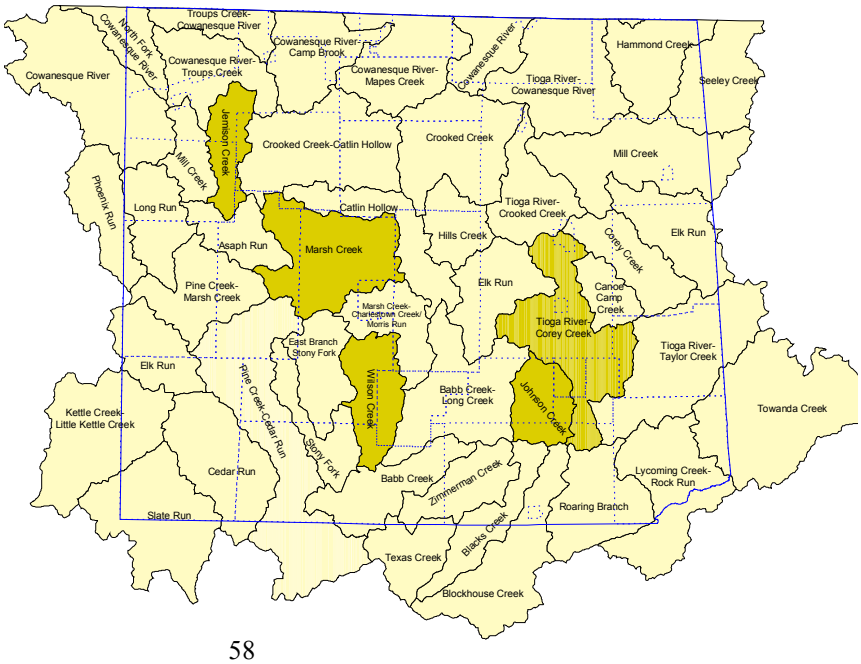
Habitat:

Photo Source: PNHP

Photo Source: PNHP

Medium size streams like Marsh Creek (left) and faster-flowing Wilson Creek (above) are two examples of streams characterized as cool water 1 community.

Distribution in Tioga County:



Community type: Cool Water Community 2 - Blacknose Dace (*Rhinichthys atratulus*) and White Sucker (*Catostomus commersoni*)

Other common fish: Golden Shiner (*Notemigonus crysoleucas*)

Habitat: This community type is similar to cool water community 1 since it occurs in small to medium size streams (average watershed area of 46 sq mi) at moderate to relatively high elevations. Streams are faster than warm water streams and are intermediate in temperature between warm and cold streams.

Stream chemistry indicates that alkalinity (average 55.6 mg/l) and conductivity (average 213 µS/cm) are relatively high compared to other community groups. The pH is nearly neutral (average 7.2).

Community fish are habitat generalists and generally pollution tolerant. There are few fish species present in the cool water community 2. This community type may represent small cool water communities that are more degraded than cool water communities 1.

Stream quality rating: Low

Community rarity: No

Threats: Threats to cool water communities 2 are similar to threats cool water communities 1, but may be worse in cool water communities 2. 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.

Conservation recommendations: This community type occurs only in the mainly agricultural East Branch Stony Fork Creek and Black Creek watershed. The low community diversity and high pollution tolerance of community members indicates that pollution and habitat alteration have diminished stream quality. Mitigating runoff from agriculture will improve stream conditions.

Community members:

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

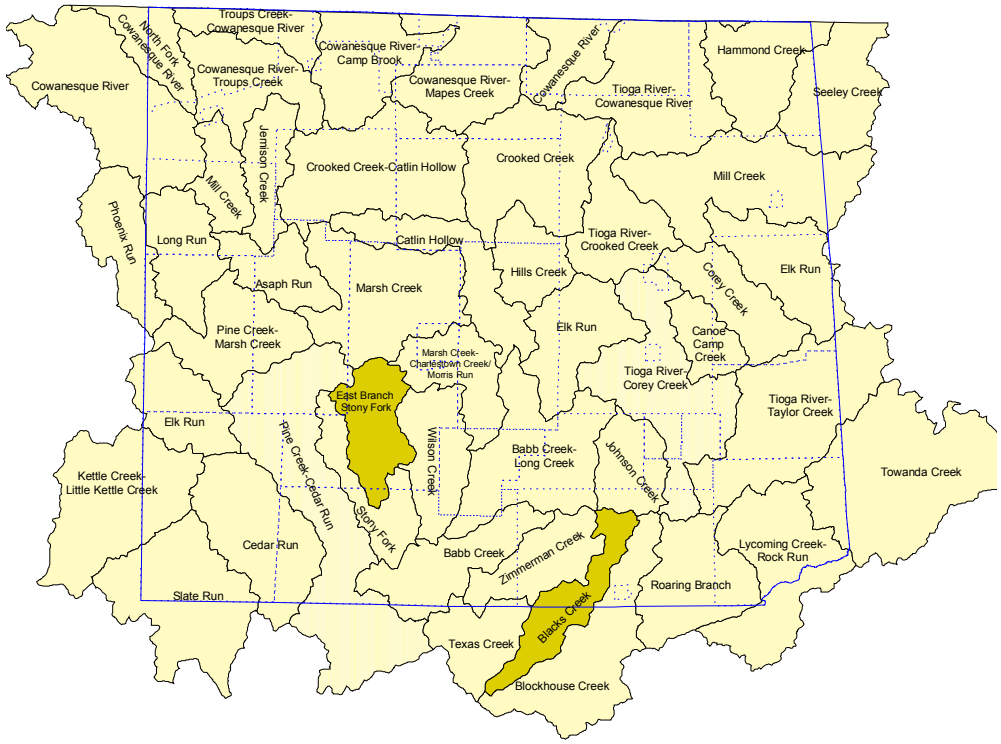
Photo Source: www.nj.gov/dep/

Habitat:

Photo Source: PNHP

Cool water 2 communities tolerate a variety of habitats in medium-sized streams and small rivers. Habitat-generalist fish tolerate slow and silty streams.

Distribution in Tioga County:



Community type: Coldwater Community - Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*)

Other community members:
Rainbow Trout (*Oncorhynchus mykiss*)

Species of concern: none

Habitat: This headwater stream community occurs in small watersheds (average watershed area of 18 sq mi). Swift streams running off ridges at relatively high elevation at fairly high gradient typify the habitat for this community type. Water temperatures are the coldest among the fish communities.

Streams have low alkalinity (average 27mg/l) and conductivity (average 140 µS/cm); water temperatures are cold. The pH is lower than for other community types (average 6.7).

The coldwater community represents headwater streams with Brook Trout and slightly larger streams with Brook Trout and Brown Trout or Brown Trout only.

Stream quality rating: High

Community rarity: No

Threats: Acid mine drainage and atmospheric deposition can severely alter stream water quality.

Conservation recommendations:
Watersheds with cold water communities in Tioga County are: Kettle Creek-Little Kettle Creek, Slate Run, Cedar Run, Elk Run, Phoenix Run, Asaph Run, Babb Creek and Babb Creek-Long Creek, Lycoming Creek-Rock Run, Roaring Branch, and headwaters of the Tioga River (Tioga River – Taylor Creek).

Streams in these watersheds have wild-reproducing populations of Brook and Brown Trout and may be a valuable fishery resource. Because cold, headwater streams often occur in terrain unsuitable for human developments, they are not usually subject to the same types of water pollution issues as valley streams. However, in Tioga County other water quality impairments occur because of acid mine drainage, especially in the Babb Creek watershed and the Tioga River headwaters.

Streams are also acidified in some cold water community watersheds because of atmospheric acid deposition, especially in the Tioga River headwaters and Lycoming Creek watersheds. Low stream pH can occur from acidic precipitation stemming from air pollution.

Trout streams in Pennsylvania have been greatly altered since European settlement and 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. Restoration of native trout habitats would return cold water streams to their natural state.

Addressing water pollution from acid mine drainage and acid deposition are critical for headwater, cold water streams. Restoration of native trout habitats would return cold water streams to their natural state.

Community members:

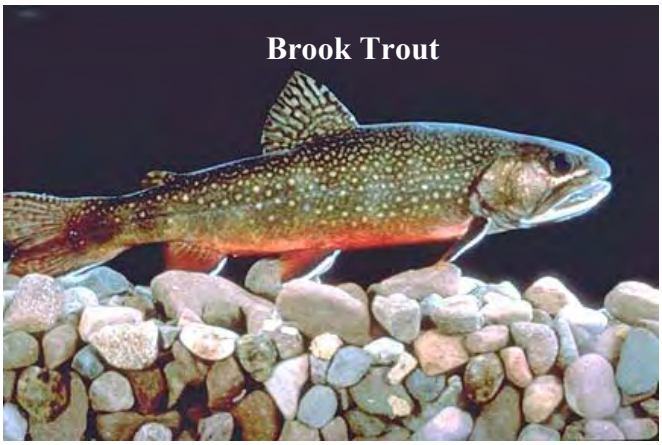


Photo Source: http://www.cnr.vt.edu/efish/

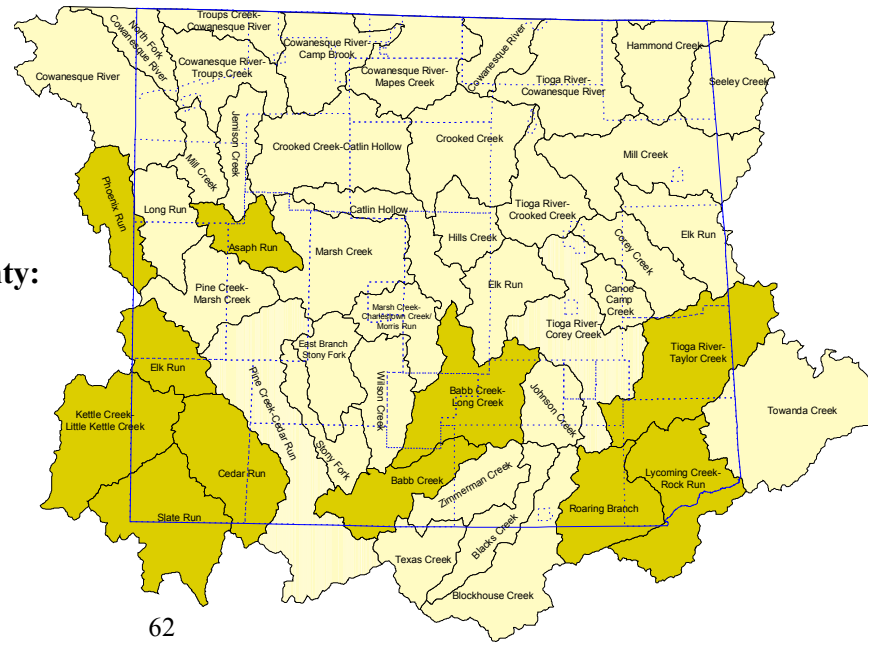
Photo Source: http://www.cnr.vt.edu/efish/

Habitat:

Photo Source: PHNP

Small, high gradient streams with forested watersheds are typical of the cold water community habitat.

Distribution in Tioga County:



II. Macroinvertebrates:

Community type: Riffle Beetle (*Elmidae*)/ Water Penny (*Psephenidae*) Community

Other community members: 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)

Species of concern: none

Habitat: Found in medium sized streams, this community occurs in relatively slow moving, low gradient valley streams. The stream habitat associated with this community type can be relatively poor because of a number of factors.

Water chemistry is distinct from other macroinvertebrate communities, because alkalinity (average 76 mg/l) and conductivity are relatively high (average 318 µS/cm), but pH is neutral.

Stream quality rating: Low

Community rarity: No

Threats: The exotic Asian Clam, *Corbicula fluminea*, occurs with this community type. The Asian Clam is a threat to other bivalves because of increased competition for food resources and habitat.

Conservation recommendations: In Tioga County, this community type occurs in the Marsh Creek watershed.

Where this community is common, non-point source pollution from the surrounding watershed may be contributing to non-ideal water quality and habitat conditions. Although this community type does not signify extremely poor stream quality, some stresses to stream condition are indicated.

Areas with large amounts of agriculture and roads have the potential for non-point source pollution. Management of stormwater from roads and urban developments and from agriculture, improvements in stream habitat and mitigation of any direct stream discharges are recommended. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Community members:

Photo Source: http://www.epa.gov

Photo Source: http://www.dec.state.ny.us

Habitat:

Photo Source: PNHP

Slow moving, low gradient valley streams with some pollution from agriculture are typically where this community is found.

Distribution in Tioga County:

Community type: Brushlegged Mayfly (*Isonychiidae*)/ Fingernet Caddisfly (*Philopotamidae)*

Other community members:
Dobsonfly (Corydalidae), Saddlecase Maker (Glossosomatidae), Watersnipe Fly (Athericidae), Common Burrower (Ephemeridae), Snailcase Maker caddisfly (Helicopsychidae)

Species of concern: none

Habitat: This community is found in streams with lower elevation and lower gradient than other macroinvertebrate communities. Sandy stream bottoms mixed with larger cobble and boulders are typical. High quality habitats usually occur with this community type; stream organisms tolerate little pollution.

Chemistry components of this habitat are usually typified by moderate alkalinity (53 mg/l), moderate conductivity (203 µS/cm) and neutral pH.

Stream quality rating: High

Community rarity: No

Threats: Organisms in this community type are sensitive to organic pollution and habitat degradation. Non-point source pollution from agriculture and urban sources could alter this community. Some acid mine drainages also threaten this community type.

Conservation recommendations: The Brushlegged Mayfly and Fingernet Caddisfly community was identified in Lycoming Creek, Roaring Branch, Canoe Camp Creek, and Elk Run watersheds. It was also found in several sections of the Tioga River watershed: 1) below Morris Run in Hamilton Township and above Corey Creek in Mansfield Borough (Tioga River – Corey Creek watershed), and 2) below Bear Creek in Tioga Township through its outflow from Tioga County (Tioga River – Cowanesque River watershed).

Some watersheds like Lycoming Creek, Roaring Branch, and the mid reaches of the Tioga Creek watershed have streams where acid mine drainage and acid deposition are impairing streams. Where streams in these watersheds are less affected by these problems, this community can exist. Improperly managed agriculture near the streams and resultant non-point source pollution can affect stream quality. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Because this community type represents a river system where water quality and habitat are relatively intact and because a diverse suite of organisms typically occurs with this community group, watershed, with this community type should be a conservation priority within the county.

Community members:

Brushlegged Mayfly

Photo Source: http://www.dec.state.ny.us

Fingernet Caddisfly

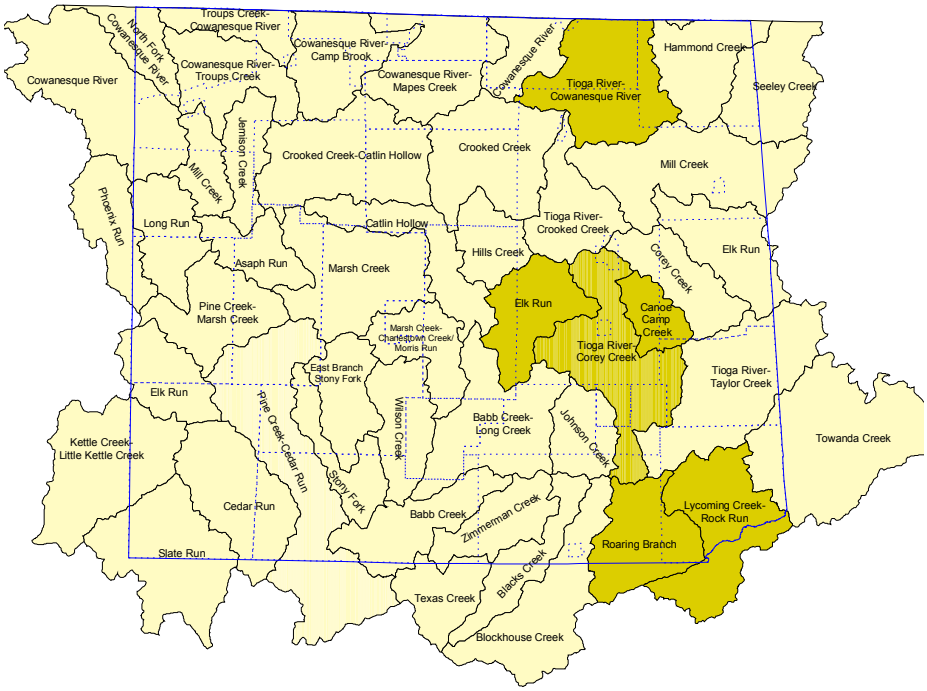
Photo Source: http://www.dec.state.ny.us

Habitat:

Photo Source: PNHP

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

Distribution in Tioga County:



Community type: Rolledwinged Stonefly (*Leuctridae*) / Small Minnow Mayfly (*Baetidae*)

Other community members: Crayfish (Cambaridae), Trumpetnet Caddisfly (Polycentropodidae), Darners (Aeshnidae)

Habitat: Occurring in small high gradient streams in high quality habitat, this community represents moderate to high quality streams in the Commonwealth. Organisms in this community are sensitive to pollution.

Water chemistry usually has moderate alkalinity (average 51 mg/l), conductivity (average 223 µS/cm) and pH values.

Stream quality rating: Medium/High

Community rarity: No

Threats: Nutrient excesses in Cowanesque River from agriculture runoff appear to be impairing stream quality. A large impounded section of Crooked Creek alters the natural stream habitat.

Conservation recommendations:
Several watersheds in Tioga County have this community type: Mill Creek, Seeley Creek, Hammond Creek, Crooked Creek-Catlin Hollow, Cowanesque River, and Cowanesque River – Camp Brook watersheds.

Managing runoff from agricultural and urban sources would be most beneficial for improving stream quality. Community watersheds appear to have large sections of agriculture along the stream corridor. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Community members:

Rolledwinged stonefly

Photo Source: http://www.dfg.ca.gov

Small minnow mayfly

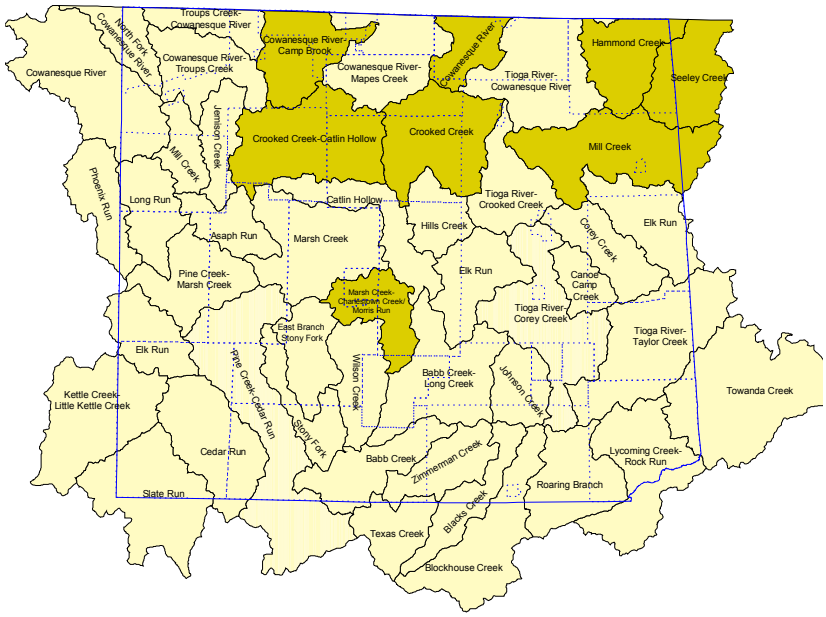
Photo Source: http://www.fullnet.com/u/guill/

Habitat:

Photo Source: PNHP

Small, fast-moving streams with rocky habitats are typical of this community type

Distribution in Tioga County:



Community type: Nemourid Broadback Stonefly (*Nemouridae*)/ Ameletid Mayfly (*Ameletidae*) Community

Other community members:
Taeniopterygid Broadbacks (Taeniopterygidae)

Species of concern: none

Habitat: Habitat for this community is similar to the Leuctridae/Baetidae community. The streams occur at relatively high elevation and are usually swift moving, high gradient streams. The stream habitat is high quality. Water chemistry usually has moderate alkalinity (average 58 mg/l), high conductivity (average 320 µS/cm) and moderate pH values. Macroinvertebrates are slightly more tolerant of organic pollution than the Leuctridae/Baetidae community.

Stream quality rating: Medium

Community rarity: No

Threats: Agricultural runoff from non-point source pollution and urban influences from Mansfield Borough may be contributing to stream degradation. The main stem of the Tioga River is influenced by pollution from acid mine drainage.

Conservation recommendations: The community type occurs in smaller tributaries to Tioga River like Corey Creek tributaries in the mid section of the Tioga River watershed (Tioga River – Crooked Creek), and at the headwaters of the Cowanesque River watershed (North Fork Cowanesque River, Cowanesque River).

Management of agriculture and urban runoff and acid mine drainage will improve stream quality and habitat for this community type. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution.

Community members:

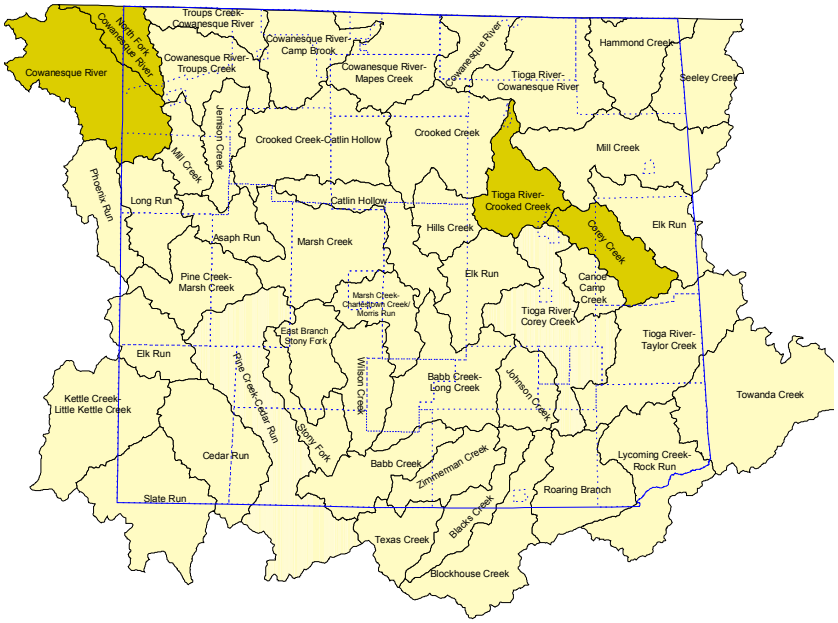
Nemourid Broadback Stonefly

Photo Source: http://www.dec.state.ny.us

Ameletid Mayfly

Photo Source: http://www.dec.state.ny.us

Distribuitn in Tioga County:



Habitat:

Photo Source: PNHP

Small, high gradient streams are typical of the community type. Non-point source pollution can cause excess stream sediment.

Community type: Green Stonefly (*Chloroperlidae*)/ Giant Black Stonefly (*Pteronarcydae*)

Other community members: Spiny Crawlers (Ephemerellidae), Flatheaded Mayflies (Heptageniidae), Free-living Caddisfly (Rhyacophilidae), Light Brown Stonefly (Perlodidae), Pronggill Mayflies (Leptophlebiidae), Common Stoneflies (Perlidae), Cranefly (Tipulidae), Roachlike Stoneflies (Peltoperlidae), Clubtail Dragonfly (Gomphidae), Northern Case Maker (Limnephilidae), Uenoid Caddisfly (Uenoidae), Odonocerid Caddisfly (Odontoceridae)

Species of concern: none

Habitat: The Green Stonefly and Giant Black Stonefly community is found in the smallest, highest elevation systems with good habitat quality, and low alkalinity (27 mg/l), low conductivity (178 µS/cm), and moderate pH. Watersheds typically are undisturbed by humans and are often headwater, forested basins.

Stream quality rating: High

Community rarity: No

Threats: Headwater streams in Tioga County are subject to acid deposition from air pollution sources. Acid mine drainage also contributes to some streams in the headwaters of the Tioga River.

Conservation recommendations: The community occurs in small streams in headwaters of the Tioga River (Tioga River – Taylor Creek Catlin Hollow watershed), Catlin Hollow watershed, Kettle Creek – Little Kettle Creek watershed, and the mid-reaches of the Cowanesque River (Cowanesque River – Mapes Creek watershed).

This community type represents a high quality, headwater streams with few impairments. Protection of these streams should be a priority for natural resource management in Tioga County. Remediation of acid mine drainage discharges will improve water quality in acidified streams.

Community members:

Photo Source: http://www.dec.state.ny.us

Photo Source: http://www.dec.state.ny.us

Habitat:

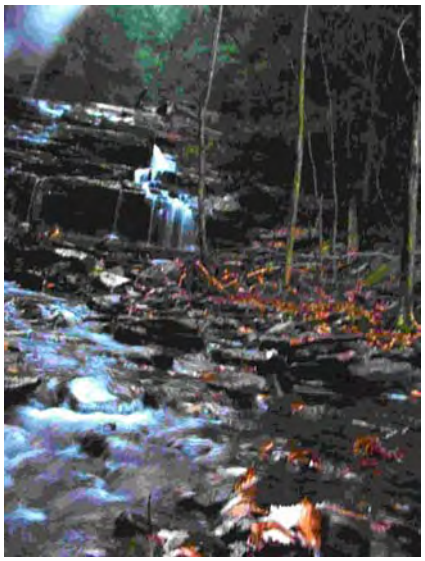
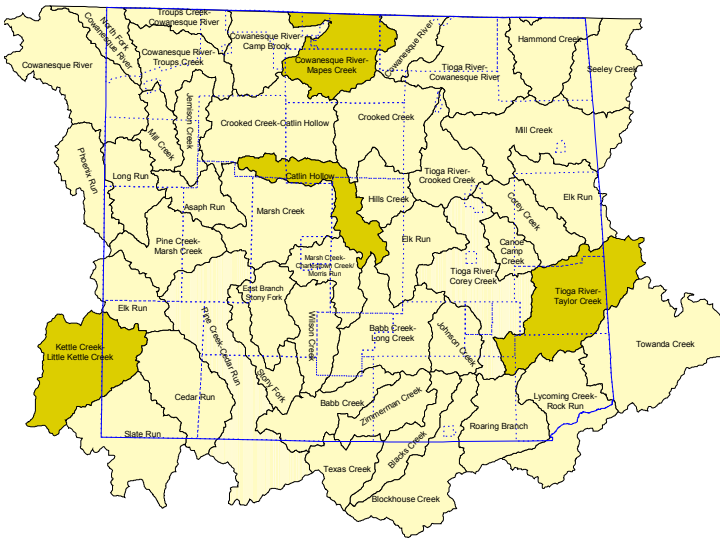


Photo Source: PNHP

High gradient, small streams with high quality habitats and water quality are the habitat of this community.

Distribution in Tioga County:



Community type: Little Plain Brown Sedge (*Lepidostomatidae*) / Slender Winter Stonefly (*Capniidae*)

Other community members: Spiketail Dragonflies (Cordulegastridae)

Species of concern: none

Habitat: This community type usually occurs in habitats that are in good condition with the exception of acid mine drainage influences. It is found in small, high gradient systems with good quality habitat. The watershed is primarily forested where this community occurs.

Water chemistry tends to have low alkalinity (average 22 mg/l) and pH with moderate conductivity (average 269 µS/cm).

Stream quality rating: Low

Community rarity: No

Threats: Acid mine drainage contributes metals and acid stream water to flowing waters. Deposits of iron precipitate may also coat stream bottoms. Acidic streams are tolerated by some stoneflies that seem to be adapted to low pH; however, few other organisms can survive in streams that are toxic with acid mine drainage.

Conservation recommendations: In Tioga County, Johnson Creek watershed had many occurrences of this community because of mining influences.

Treatment of acid mine drainage will improve water quality by normalizing pH and metal concentrations.

Community members:

Little Plain Brown Sedge

Photo Source: http://www.dec.state.ny.us

Slender Winter Stonefly

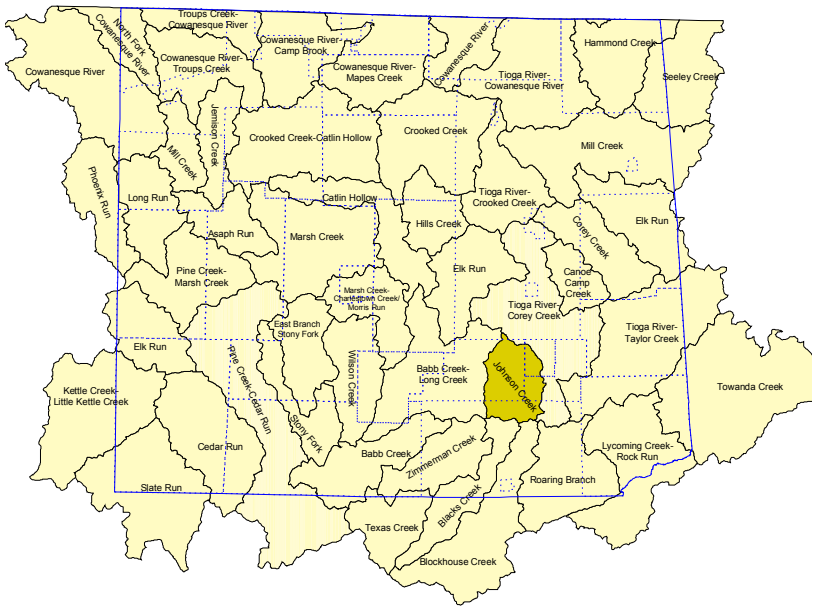
Photo Source: http://www.dec.state.ny.us

Habitat:

Photo Source: PNHP

Stream habitats of high quality in small streams are the preferred habitat of this community type. However, sources of acid mine drainage (above) may impair these streams.

Distribution in Tioga County:



III. Mussels:

Community type: Eastern Elliptio (*Elliptio complanata*)

Other community members: Rainbow Mussel (*Villosa iris*), Brook Floater (*Alasmidonta varicosa*), Yellowlamp Mussel (*Lampsilis cariosa*), and Eastern Lampmussel (*Lampsilis radiata*) are not consistent community members, but are often associated with this community.

Species of concern: Rainbow Mussel (*Villosa. iris*) (S1 G5), Brook Floater (*Alasmidonta varicosa*) (S2 G3), Yellowlamp Mussel (*Lampsilis cariosa*) (S3S4 G3G4), and Eastern Lampmussel (S1 G5).

Habitat: The Eastern Elliptio community is usually found in large streams with moderate elevation. Stream bottom habitats can be variable, but this community requires some sand and silt mixed with larger cobble and gravel.

This community occurred mainly in the lower reaches of Marsh Creek and in Pine Creek below its confluence with Marsh Creek. Slow moving low gradient stream habitats with soft sediments characterize this area. Water quality in the habitats of this community is typified by moderate alkalinity, and low conductivity.

This community is common throughout Pennsylvania.

Stream quality rating: Medium

Community rarity: No

Threats: This community is threatened by non-point source pollution from agriculture and urban development. Alteration of in-stream habitat would also be very detrimental to the Eastern Elliptio community.

Conservation recommendations: The Marsh Creek and Pine Creek- Cedar Run watersheds have Eastern Elliptio communities. Although the Eastern Elliptio is not a rare species in Pennsylvania, some of the associated species that may occur with this community are relatively rare. Mussels, in general, are 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 rare. Large streams and rivers in good quality without major habitat alterations are few.

Protection from upstream non-point source pollution from agriculture and urban developments is important for this mussel resource. Mussels are sensitive to sedimentation and alteration to habitat. Protection of habitats for Eastern Elliptio community is important to sustain communities. Major channel alteration, bridge building, and dams could potentially destroy habitat.

Community members:

Photo Source: PNHP

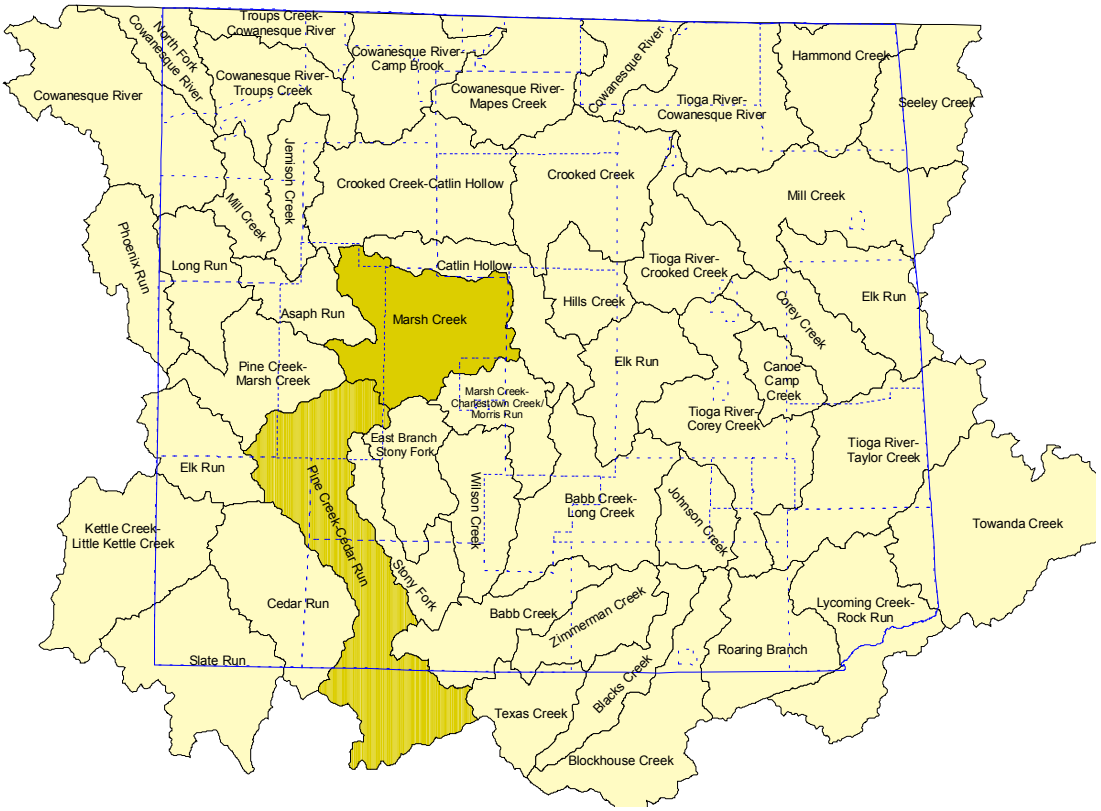
Eastern Elliptio

Habitat:

Photo Source: PNHP

Medium-sized streams and small rivers with some soft, sandy substrate are habitats for the Eastern Elliptio community in Tioga County.

Distribution in Tioga County:



Community type: Eastern Floater (*Pyganodon cataracta*)

Other community members: Triangle Floater (*Alasmidonta undulata*) is not a consistent community member, but it is associated with this community.

Species of concern: Triangle Floater (*Alasmidonta undulata*) (S3S4 G4)

Habitat: The community is found in medium to large river systems at moderate elevations. Species in the community prefer quiet backwaters of rivers. However, the habitat of the community is not well known at this time.

Stream quality rating: Medium

Community rarity: Yes

Threats: Dams in the watershed provide impassible barriers for the dispersal of mussels. Mussel communities upstream of the Hammond Dam are prevented from access to other habitats in the watershed. Additionally, alteration of stream flow can negatively influence mussels downstream of the dam.

Conservation recommendations: The Eastern Floater community was only found in the Crooked Creek watershed in Tioga County. Increased survey efforts may reveal its existence in other locations in the county. However, the community type is relatively rare in Pennsylvania.

Dam removal in the watershed would be beneficial for mussel habitats in the long term. Barring dam removal, maintenance of flow patterns similar to natural stream conditions would benefit mussel communities.

Management of non-point source pollution from agriculture and urban development is necessary for the general health of the Crooked Creek watershed and for the viability of mussel communities.

Community members:

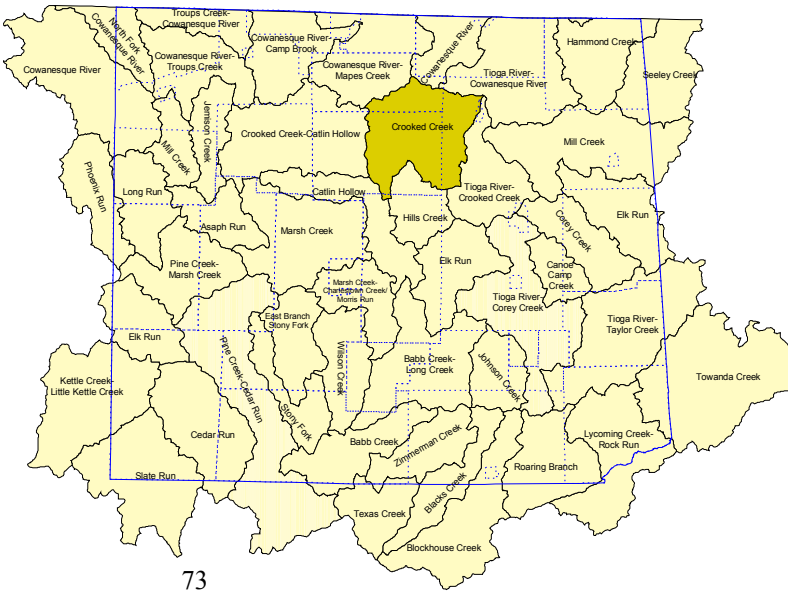
Photo Source: PNHP

Habitat:

Photo Source: PNHP

The Eastern Floater community prefers quiet backwaters of rivers.

Distribution in Tioga County:



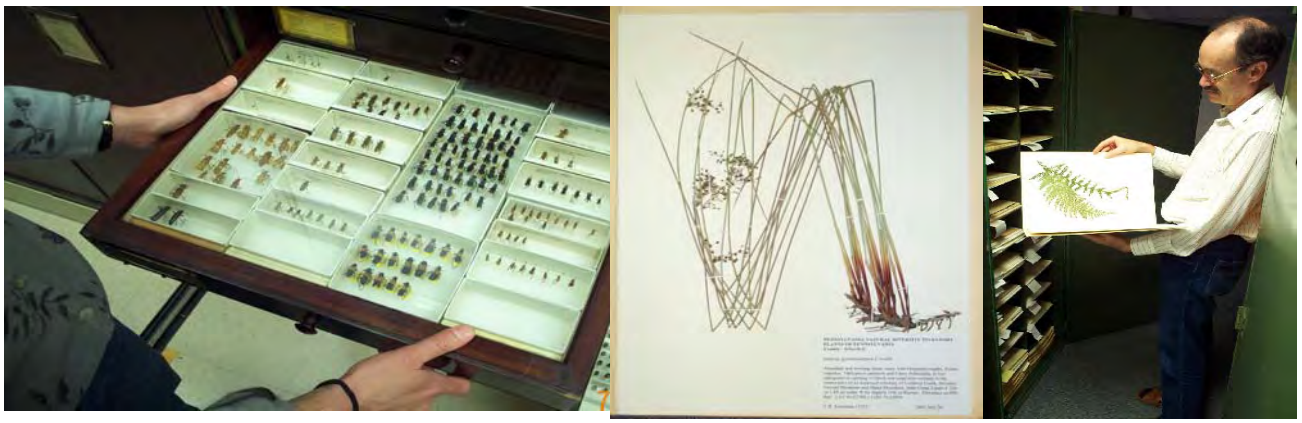
PENNSYLVANIA NATURAL HERITAGE PROGRAM DATA SYSTEM

In order to conduct an inventory of significant flora, fauna, and natural communities in the county, scientists from the PA Science Office (PSO) of The Nature Conservancy first consulted the Pennsylvania Natural Diversity Inventory (PNDI) database. PNDI 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). In it's more than 20 years of operation, the PNDI database has become Pennsylvania's chief storehouse of information on outstanding natural habitat types (natural communities) and sensitive plant and animal species of special concern. Several other noteworthy natural features are also mapped, including DEP designated Exceptional Value Streams (Shertzer 1992) and outstanding geologic features (based on recommendations from Geyer and Bolles 1979 and 1987).

PNDI 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, PNDI has focused its efforts on, and conducts systematic inventories for, the best occurrences of the priority species and natural communities.

PNDI 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).

The PA Science Office has used this systematic inventory approach to identify the areas of highest natural integrity in Tioga 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 Tioga County is preserved for the future.



The Pennsylvania Natural Diversity Inventory database has collected existing data on occurrences of species and communities (elements) of special concern, drawing from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists.

NATURAL AREAS INVENTORY METHODS

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

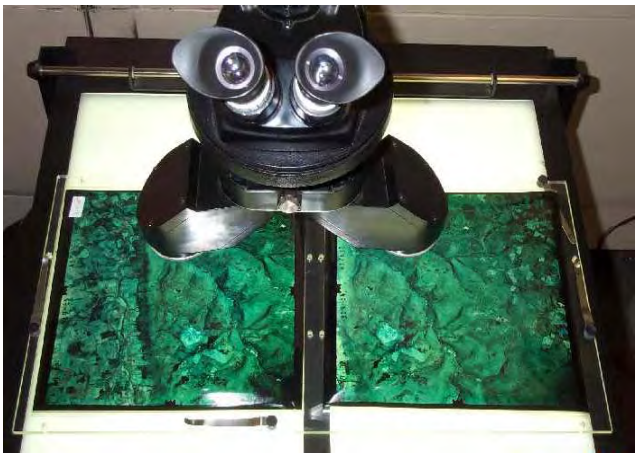
Information Gathering

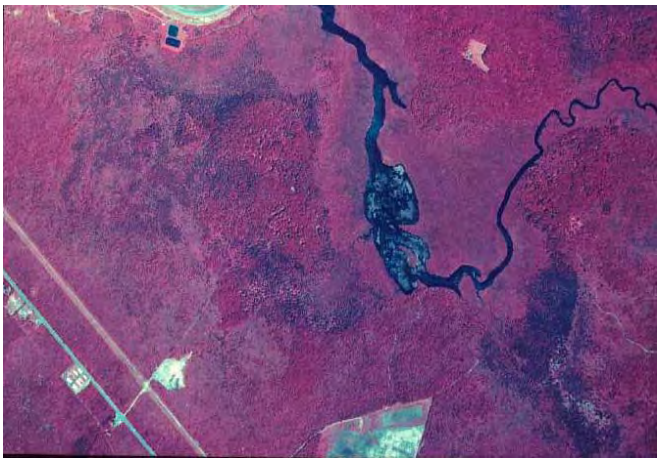
A list of natural features found in the county was prepared from the PNDI database and supplemented with information volunteered by local individuals and organizations familiar with Tioga County. In October of 2004 a public meeting was held and recommended Natural Area Survey Forms (Appendix I) were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

Map and Air Photo Interpretation

PSO ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented (Appendix II). Additional data from vegetation maps, soil survey maps, field survey records and other sources were consulted to gain familiarity with Tioga County's natural systems. This information, along with references on physiography, geology, and soils, was used to interpret photos and designate probable vegetation types and potential locations for exemplary communities and rare species. In many instances, vegetation was classified at an ecosystem level, and it was therefore critical that an ecologist or person with similar training interpret the maps and aerial photos.

Work progressed systematically within the area encompassed by each USGS topographic map. The natural area potential of all parcels of land was assessed using aerial photographs. Areas continuing into adjacent counties were examined in their entirety. Topographic maps used during field surveys were marked to indicate locations and types of potential natural areas based on characteristics observed on the photos. For example, an uneven canopy with tall canopy trees could indicate an older





forest; a forest opening, combined with information from geology and soils maps, could indicate a seepage swamp community with potential for several rare plant species. Baseline information on sites appearing to have good quality communities or potential for rare species was compiled to help prioritize fieldwork.

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

Field Work

Experienced PSO biologists and contractors conducted numerous field surveys throughout Tioga County during 2004 and 2005. Biologists evaluated the degree of naturalness of habitats (including assessment of percent of native vs. non-native plant species, degree of human disturbance, age of trees, etc.) and searched for plant and animal species of special concern. Workers also categorized the vegetation of each potential natural area visited. An evaluation of quality was made for each potential natural community element, with care being taken to give reasons for the quality rank. Boundaries of the community types were redrawn, if needed, based on new field information. Community information recorded included the dominant, common, and other species, as well as disturbances to the community. Field forms were completed for all occurrences of plant and animal species of special concern and natural communities (see sample Field Survey Form, Appendix III), the quality of each population or community was assessed, and locations were marked on USGS topographic quadrangle maps.

In April of 2004, one low altitude reconnaissance flight was flown over the county to provide a more accurate overview of the current condition and extent of known natural areas and to assess the potential of any additional areas.

Data Analysis

To organize the natural features data and set conservation priorities, each natural community or species (element) is ranked

Small Mammal Surveys

Invertebrate Surveys

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

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

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

Botanical Surveys

Landscape Analysis

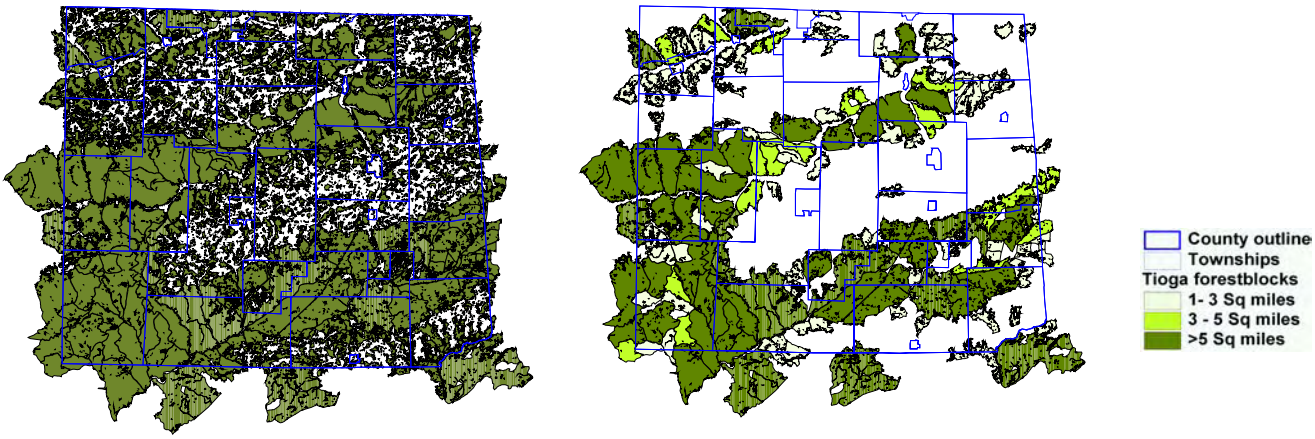
Background: Fragmentation of the landscape by roads, utility lines, and other human disturbances can impact the surrounding landscape significantly. A road or utility line cut through a forested block cleaves the large block into two smaller blocks and significantly increases the amount of edge habitat within the forest. When a forest with a closed canopy is disturbed by road building activities, the newly disturbed soil and open canopy favor the establishment of invasive species of plants and animals. Many of these will out-compete and displace native species in this disturbed habitat. These smaller forest fragments will have significantly more edge habitat and less forest interior than the original forest block. Furthermore, fragmentation of large forest blocks decreases the ability of many species to migrate across manmade barriers such as roads. Migration corridors, once severed, isolate populations of species one from another, limit the gene flow between populations and create islands of suitable habitat surrounded by human activity. Much of the native biological diversity of an area can be preserved by avoiding further fragmentation of these large forested areas. Historically, edge habitat was created to provide habitat for organisms, namely game species, which often thrive in disturbed areas. Today, we realize that by fragmenting forests we are eliminating habitats for the forest interior species. Those species that utilize edge habitats are typically considered generalists, capable of utilizing many different habitats and are usually not of immediate conservation concern.

The larger forested blocks in the County (those of at least one mile in area ~ 640 acres) have been highlighted in an effort to draw attention to the significance of large forested blocks within the County. Besides being habitat suitable for many native species, large unfragmented forest blocks in close proximity to each other become natural corridors for species movement within and through the county. In many cases, by highlighting the larger forested blocks, the most natural landscape corridors become evident.

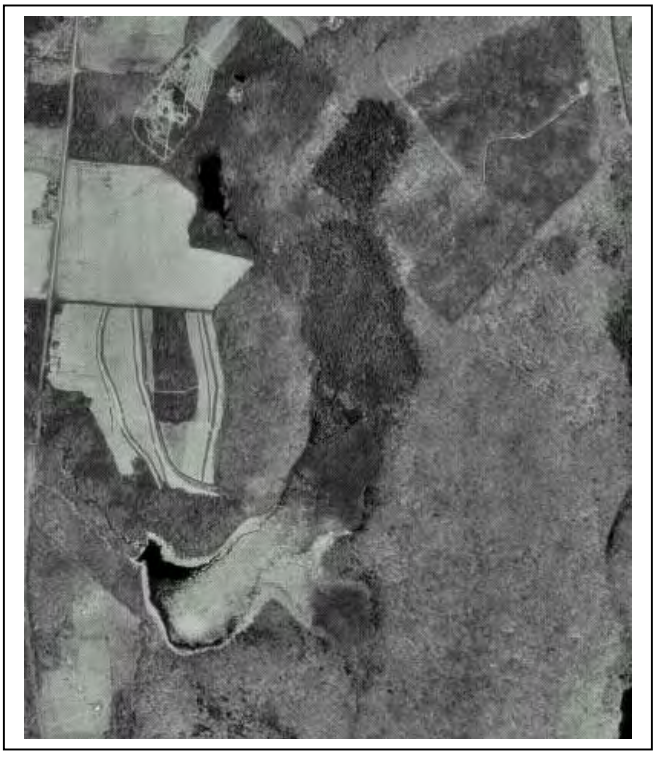
GIS Methodology: Creating NAI Forest Block Layers

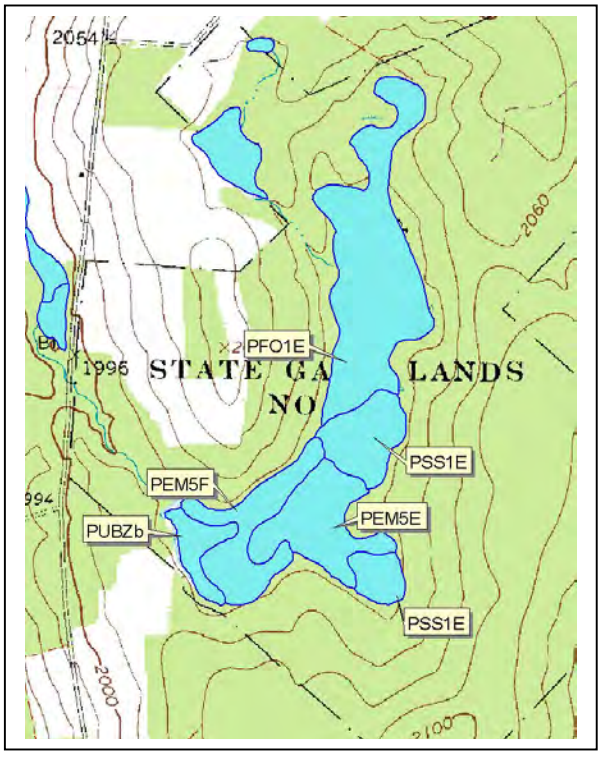
The Pennsylvania portion of the National Land Cover Dataset (NLCD) was created as part of land cover mapping activities for Federal Region III that includes the states of Maryland, Delaware, Pennsylvania, Virginia, West Virginia, and the District of Columbia. The NLCD classification contains 21 different land cover categories with a spatial resolution of 30 meters. The NLCD was produced as a cooperative effort between the U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (US EPA) to produce a consistent, land cover data layer for the conterminous U.S. using early 1990s Landsat thematic mapper (TM) data. The analysis and interpretation of the satellite imagery was conducted using very large, sometimes multi-state image mosaics (i.e. up to 18 Landsat scenes). Using a relatively small number of aerial photographs for 'ground truth', the thematic interpretations were necessarily conducted from a spatially-broad perspective. This evaluation must be made remembering that the NLCD represents conditions in the early 1990s (The Nature Conservancy 1999).

Deciduous, evergreen and mixed forest land cover types were grouped to provide a single "forested" cover type. This forest block layer was overlain by the Penn DOT road layer to identify forest blocks fragmented by roads. The Penn DOT right-of-way (ROW) distance was applied as a buffer to roads: interstates have a 500-foot ROW, PA and US designated roads have a 150-foot ROW, and local roads have a 100-foot ROW. Forest blocks with an area of greater than one square mile were selected from the forest land cover type. This process highlights interior forest blocks greater than one square mile in area as presented on the following page.



At first glance, most of Tioga County appears forested (left). Unfortunately much of the county's forested areas are in small fragmented blocks with a high edge to interior ratio. When forest blocks of at least one square mile are selected from the county's forested areas, the most important forest blocks become more apparent (right). These large forested blocks are critical habitat for plants and animals that are dependent of forest interior conditions such as many migrating bird species, fishers, bobcats, Northern Goshawks and Barred Owls. These forest blocks and their adjacent streams should be considered the backbone of wildlife habitat in the county. Conservation efforts in the county should concentrate on maintaining these large forest blocks by avoiding further fragmentation with additional roads, development and utility rights-of-way.





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

Riparian Buffer Recommendations

Riparian areas are lands directly adjacent to streams, creeks and rivers. Land adjacent to waterways and wetlands has an immediate influence on the quality of the water and the habitat it supports. An undisturbed (no-cut) riparian buffer of 100 meters is recommended adjacent to all streams. The riparian buffers recommended in this report also include wetlands over one acre in size, while artificially created farm ponds have been excluded from this riparian buffer.

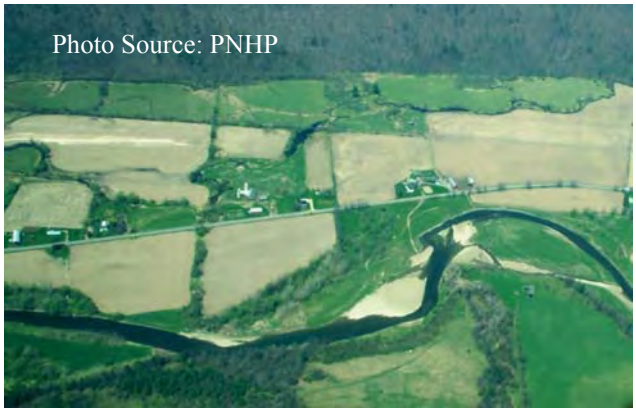
The literature varies with regard to buffer distances. From a strictly water quality standpoint, wetland buffers of 35-100 feet are thought to be sufficient for water quality maintenance. However, many of these buffer recommendations do not take wildlife habitat into account. Unfortunately, many states still refer to older literature with regard to wetland buffers and many of these studies are now considered to be rather obsolete. Newer scientific techniques have allowed researchers to conduct better studies with regard to habitat buffers. For example, wetland buffers of 15-30 meters were once thought to be sufficient to protect vernal pool amphibians. A series of papers from Conservation Biology (Semlitsch and Brodie 2003 - Buffer Zones for Wetlands and Riparian Habitats) conclude that buffers of this size are inadequate to protect terrestrial habitats for amphibians and reptiles. Some bird species require forested buffers to be closer to 500 meters!

PNHP recommends minimum buffers of 100 meters to maintain the water quality of the wetland as well as to support many of the species of wildlife found in these sites. These buffers were not created for any one particular species but are thought to overlap the habitats used by both common and rare species found at these sites. Certainly, expanding these buffers will still provide water quality protection while increasing habitat for species that require larger blocks of contiguous forest, such as the Fisher and Northern Goshawk. It is our scientific judgment that a minimum buffer of 100 meters should be implemented around the wetland and riparian areas identified in the report to continue to support the species, both common and rare found at these locations.

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

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

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



CONSERVATION RECOMMENDATIONS

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

Approaches to protecting a natural area are wide-ranging and factors such as land ownership, time constraints, and tools/resources available should be considered when prioritizing protection of these sites. Prioritization works best within a planning situation, however, opportunities may arise that do not conform to a plan and the decision on how to manage or protect a natural heritage area may be made on a site-by-site basis. Keep in mind that personnel in our program or staff from state natural resource agencies are available to discuss more specific options as needed.

1. Consider conservation initiatives for natural areas on private land.

- *Conservation easements* protect land while leaving it in private ownership. A conservation easement is a legal agreement between a landowner and a conservation or government agency that permanently limits a property's use in order to protect its conservation values. It can be tailored to the needs of both landowner and conservation organization. Tax incentives apply to conservation easements.
- *Leases, management agreements, and mutual covenants* also allow the landowner to retain ownership and ensure permanent protection of land, though in a much more limited way. There are no tax deductions for these conservation methods. A lease to a land trust or government agency can protect land temporarily and ensure that its conservation values will be maintained. This can be a first step to help a landowner decide if they want to pursue more permanent protection methods. Management agreements require landowner and land trust to work together to develop a plan for managing resources such as plant or animal habitat, or protecting a watershed. Mutual covenants can be appropriate where land protection is important to several landowners but not of sufficient benefit to the general public to warrant a conservation easement.
- *Land acquisition* can be at fair market value, as a last resort by conservation organization, or as a bargain sale in which a sale is negotiated for a purchase price below fair market value with tax benefits that reduce or eliminate the disparity. The NAI will help to pinpoint areas that may be excellent locations for new county or township parks. Sites that can serve more than one purpose such as wildlife habitat, flood and sediment control, water supply, recreation, and environmental education would be particularly ideal. Private lands adjacent to public should be examined for acquisition when a priority site is present on either property and there is a need of additional land to complete protection of the associated natural features.
- *Fee simple acquisition* gives landowner maximum control over the use and management of the property and its resources. This conservation initiative is appropriate when the property's resources are highly sensitive and protection cannot be guaranteed using other conservation approaches.
- *Local zoning ordinances* are one of the best-known regulatory tools available to municipalities. Examples of zoning ordinances a municipality can adopt include: overlay districts where the boundary is tied to a specific resource or interest such as riverfront protection and floodplains, and zoning to protect stream corridors and other drainage areas using buffer zones.

2. Prepare management plans that address species of special concern and natural communities.

Many of the already-protected natural areas are in need of additional management recommendations to ensure the continued existence of the associated natural elements. We hope that managers will incorporate specific recommendations into existing plans or prepare new plans. These may include: removal of exotic plant species; leaving the area alone to mature and recover from previous disturbance; creating natural areas within existing parks; limiting land-use practices such as mineral extraction, residential or industrial development, agriculture and certain forestry practices.

Existing parks and conservation lands provide important habitat for plants and animals at both the county level and on a regional scale. For example, these lands may serve as nesting or wintering areas for birds or as stopover areas during migration. Management plans for these areas should emphasize a reduction in activities that fragment habitat. Adjoining landowners should be educated about the importance of their land as it relates to species of special concern and their habitat needs and agreements should be worked out to minimize encroachments that may threaten native flora and fauna.

3. Protect bodies of water.

Protection of reservoirs, wetlands, rivers, and creeks is vital; especially those that protect biodiversity, supply drinking water, and are attractive recreational resources. Many sites that include rare species, unique natural communities or locally significant habitats are associated with water. Protection of high quality watersheds is the only way to ensure the viability of natural habitats and water quality. Land managers and township officials should scrutinize development proposals for their impact on entire watersheds not just the immediate project area. Cooperative efforts in land use planning among municipal, county, state, and federal agencies, developers, and residents can lessen the impact of development on watersheds.

4. Provide for buffers around natural areas.

Development plans should provide for natural buffers between disturbances and natural areas, be it a barrens community, wetland, water body, or forest. Disturbances may include construction of new roads and utility corridors, non-conservation timber harvesting, and disruption of large pieces of land. County and township officials can encourage landowners to maintain vegetated buffer zones within riparian zones. Vegetated buffers (preferably of PA-native plant species) help reduce erosion and sedimentation and shade/cool the water. This benefits aquatic animal life, provides habitat for other wildlife species, and creates a diversity of habitats along the creek or stream.

Watersheds or subwatersheds where natural communities and species of special concern occur (outlined on the Township maps in this report) should be viewed as areas of sensitivity, although all portions of the watershed may not be zones of potential impact. As an example, conserving natural areas around municipal water supply watersheds provides an additional protective buffer around the water supply, habitat for wildlife, and may also provide low-impact recreation opportunities.

5. Reduce fragmentation of surrounding landscape.

Residents and township officials should encourage development in sites that have already seen past disturbances. Care should be taken to ensure that protected natural areas do not become "islands" surrounded by development. In these situations, the site is effectively isolated and its value for wildlife is reduced. Careful planning can maintain natural environments and the plants and animals associated with them. A balance between growth and the conservation of natural and scenic resources can be achieved by guiding development away from the most environmentally sensitive areas.

The reclamation of previously disturbed areas, or brownfields development, for commercial and industrial projects presents one way to encourage economic growth while allowing ecologically sensitive areas to remain undisturbed. Cluster development could be used to allow the same amount of development on much less land and leave much of the remaining land intact for wildlife and native plants. By compressing development into already disturbed areas with existing infrastructure (villages, roads, existing 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, providing information about easements, land acquisition, and management and stewardship of protected sites. Increasingly, local watershed organizations and land trusts are taking proactive

steps to accomplish conservation at the local level. When activities threaten to impact ecological features, the responsible agency should be contacted. If no agency exists, private groups such as conservancies, land trusts and watershed associations should be sought for ecological consultation and specific protection recommendations.

7. Manage for invasive species.

Invasive species threaten native diversity by dominating habitat used by native species and disrupting the integrity of the ecosystems they occupy. Management for invasives depends upon the extent of establishment of the species. Small infestations may be easily controlled or eliminated but more well established populations might present difficult management challenges. Below is a list 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 Wild Resource Conservation Program funded The Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) to develop an Invasive Plant Tutorial. This tutorial is designed to help with identification, prioritizing, preventing, and managing invasive plant species through resources already available through the internet. http://intraforestry/invasivetutorial/index.htm

The Nature Conservancy's Weeds on the Web at: http://tncweeds.ucdavis.edu/

The Virginia Natural Heritage Program's invasive plant page at: http://www.dcr.state.va.us/dnh/invinfo.htm

The Missouri Department of Conservation's Missouri Vegetation Management Manual at: http://www.conservation.state.mo.us/nathis/exotic/vegman/

The following site is a national invasive species information clearinghouse listing numerous other resources on a variety of related topics: http://www.invasivespecies.gov/

Species Ranking

Each year biologists representing various taxonomic groups of the Pennsylvania Biological Survey meet to discuss and rank the most important species for the protection of biodiversity in Pennsylvania. The various Biological Technical Committees include the Vascular Plant Technical Committee, the Herpetological Technical Committee and the Ornithological Technical Committee. These meetings consist of a review and ranking of species of concern within the state, in terms of the rarity and quality of the species or habitats of concern, potential threats, and protection needs. The results of these meetings provide a baseline for evaluating the statewide significance of the species recognized in the Natural Areas Inventory.

Priorities for Protection

The Natural Areas Inventory recognizes sites at two primary levels of significance for the protection of biological diversity: 1) sites of statewide importance and 2) sites of local significance.

Table 2 presented in the Results section prioritizes sites with natural communities and species of concern documented in Tioga County. These sites are displayed in **UPPER CASE LETTERS** throughout the report. This table ranks sites from the most important and threatened to the least, with 1 representing the highest priority sites and 5 representing the lowest priority sites for the conservation of biodiversity in the county. Ranks are based on rarity, quality, and threats or management needs of the elements at the site. Sites in this category that are ranked 1 or 2 may contain some of the best natural areas in the state. Table 2 lists the site name, local jurisdiction, and pertinent information about the site. A more detailed description for each site is included in the text for each Township in which it occurs.

"Locally Significant" sites are indicated in **lower case letters** throughout the document, and are briefly discussed in the text accompanying each map. These are sites at which species of special concern or high-quality natural communities could not be documented during the survey period. These areas are not exemplary at the state level, but may be important at the county level. Examples would include relatively intact forested areas, large wetlands, and other areas significant for maintaining local biodiversity. These secondary sites are arranged in Table 3 in the Results section. They have been given qualitative ranks (high, medium, or low) according to size, level of disturbance, proximity to other open-space lands, and potential for sustaining a diversity of plant and animal life. These secondary-site ranks must be viewed as very approximate.

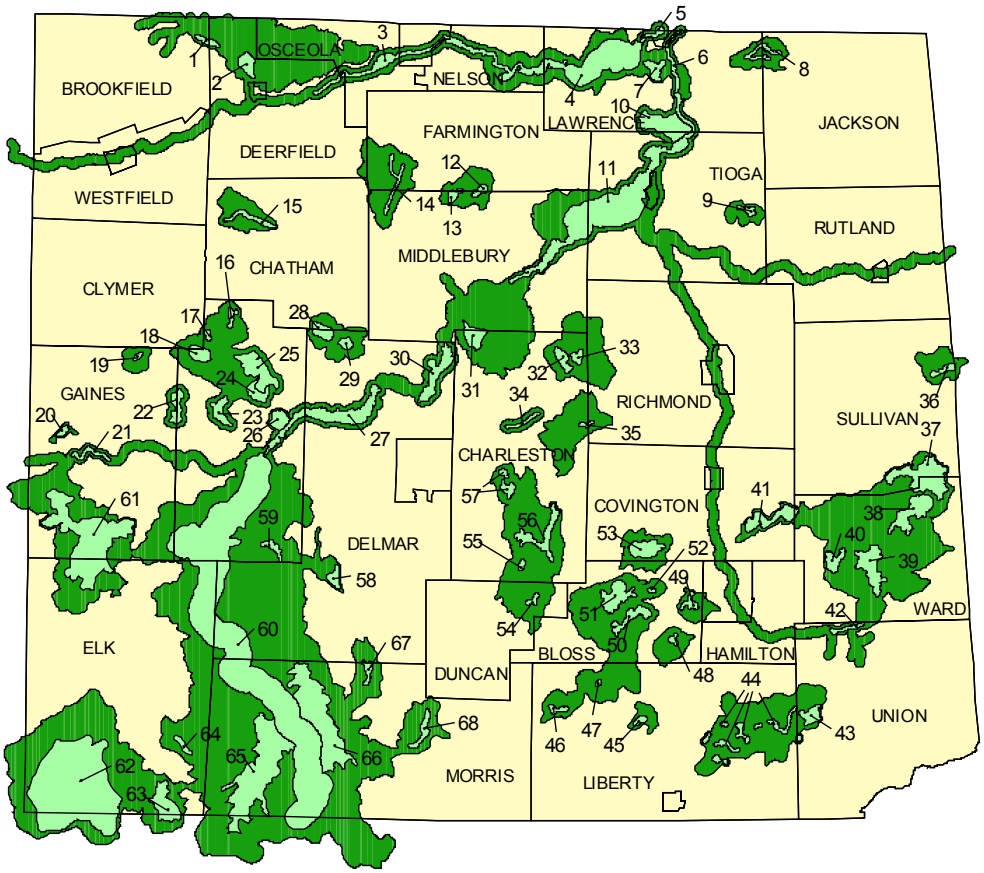
Each of the primary sites identified in this report has associated with it areas described as **Core Habitat** and **Supporting Landscape**. Core Habitat areas are intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance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

Site Ranking

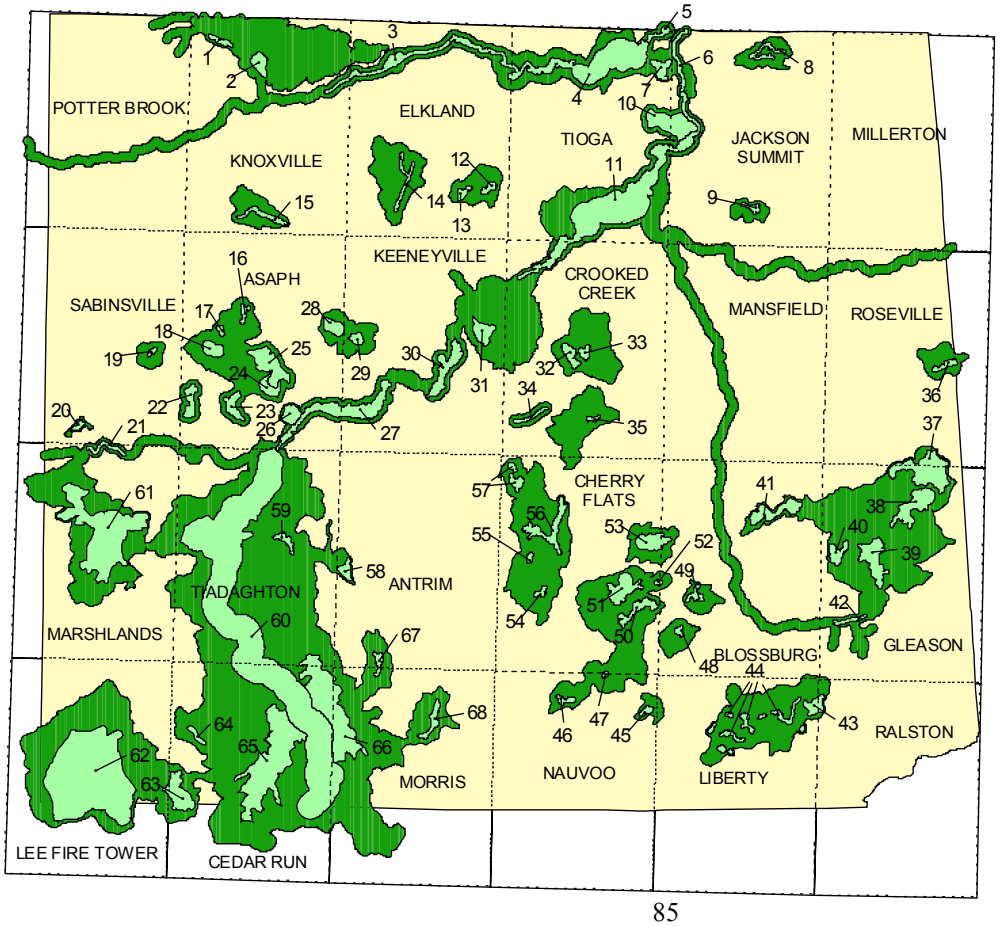
The Pennsylvania Natural Heritage Program considers several criteria when ranking NAI sites to ensure that all sites, regardless of ecological differences, are evaluated systematically. Each criterion is considered independently and then all are examined collectively to ensure that no one criterion receives more emphasis than another. First, the commonness/rareness of the species at a site, defined by the global and state ranks (G & S ranks Appendix IV), is considered in the site ranking process. Those sites which include rarer species with lower ranks (i.e. G3 or S1) are given precedence over sites with more common, higher ranked species (i.e. G5 or S3). Next, the number of different species occurring at a site is also considered in the ranking process. Sites with multiple tracked species are considered to be higher conservation priorities than sites with fewer tracked species. The ecological characteristics of the species at each site are also considered in the ranking process. For example, species that have highly specialized habitat requirements and are not known to readily disperse during periods of disturbance are under greater ecological pressure than species that have more general habitat requirements and have a greater capacity for dispersion. Finally, the site ranking process examines the landscape context of each site. For example, a site that is entirely isolated due to fragmentation, with little chance of restoration of connectedness, is a lower conservation priority than a site which remains connected to other suitable patches of habitat. Site connectedness is critical because the potential for connected populations to remain viable is far greater than small isolated populations. By considering these criteria, the conservation priorities within Tioga County are highlighted to promote appropriate use of conservation dollars and efforts.

Tioga County NAI Site Index

Site Locations Relative to Townships



Site Locations Relative to USGS Quadrangle



RESULTS

Table 2: The sites of statewide significance for the protection of biological diversity in Tioga County in approximate order of priority from the most important (rank = 1) to the least (rank = 5). The presence of species of special concern and/or exemplary natural communities has been documented at these sites. More in-depth information on each site including detailed site descriptions and management recommendations where appropriate can be found in the text of the report following the maps for each municipality. Quality ranks, legal status, and last observation dates for each species of special concern and natural communities are located in the table that precedes each map page. Appendix IV gives an explanation of the PA Heritage and Global vulnerability ranks.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
1	CLAY MINE ROAD POOLS	66	180	Morris	This site is a cluster of **GNR S3 Ephemeral/Fluctuating Natural Pools**, or vernal pools, a unique tracked community in the state. The forest surrounding the pools is composed of black gum, red maple, eastern hemlock, and black cherry. Several of the pools at this site house healthy populations of the **federally endangered G3 S3 northeastern bulrush (*Scirpus ancistrochaetus*).**
1	PINE CREEK GORGE	60	130, 142, 155, 180, 200	Delmar, Elk, Gaines, Morris, Shippen, Lycoming County	This area encompasses the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. The gorge also has major biodiversity significance. The steep upper slopes and rims of the gorge often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various shrubs and herbaceous plants. These scrubby areas support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened Allegheny Woodrat (*Neotoma magister*),** and another **animal species of special concern ranked G5 S2S3B,S3N**. The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5 S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*)**, and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked G3 S2,** the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked G3G5 SU**, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **Red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge and Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
1	WEST RIM VERNAL POOLS	65	181	Morris, Lycoming County	The forest to the west of the Pine Creek Gorge contains an **entire complex of Ephemeral/ Fluctuating Natural Pools, a GNR S3 community of concern**. This wetland complex is part of the Tioga State Forest and the Pine Creek Gorge Natural Area. The high density of vernal pools in this area is unique to the county and many of them support populations of the **federally endangered northeastern bulrush (*Scirpus ancistrochaetus*), a G3 S3 species** as well as the **Pennsylvania threatened G5 S3 bog sedge (*Carex paupercula*)** and the **PA-rare G5 S3 creeping snowberry (*Gaultheria hispidula*)**. **Hemlock Palustrine Forests, a GNR S3 tracked community** can be found at the headwaters of some of the rivulets that drain into Pine Creek Gorge. This site also supports a **population of the Sweetflag Spreadwing (*Lestes forcipatus*), a G5 S3S4 species of concern**.
2	ALGERINE SWAMP/ REYNOLDS SPRING NATURAL AREA	63	142	Elk, Lycoming County	Algerine Swamp and Reynolds Spring are expansive, open, high elevation wetlands. The entire plant community at Algerine Swamp, the **GNR S3 Boreal Conifer Swamp**, is a tracked community in Pennsylvania. This wetland has a deep layer of Sphagnum mosses and a shrub layer dominated by leatherleaf. Recent surveys uncovered populations of the **state endangered G5 S1 bog aster (*Oclemena nemoralis*)**, the **state threatened G5 S3 bog sedge (*Carex paupercula*)**, the **PA-rare G5 S3 creeping snowberry (*Gaultheria hispidula*)**, as well as the **G4G5 S2 Bog Copper (*Lycaena epixanthe*)**. Reynolds Spring is a **nonglacial bog, a GNR S3 tracked community** in the state. At this site the peat moss is limited to elevated hummocks between areas of soupy muck. This site supports a population of the **state endangered G5 S1 bog aster (*Oclemena nemoralis*)**, the **Pennsylvania rare G5 S3 creeping snowberry (*Gaultheria hispidula*)**, and the **G4G5 S2 Bog Copper (*Lycaena epixanthe*)**. Surveys in 2004 uncovered **a population of the G5 S3S4 Green-striped Darner (*Aeshna verticalis*), a population of the G5 S3S4 Band-winged Meadowhawk (*Sympetrum semicinctum*),** and **a population of a G5 S2 Brush-tipped Emerald (*Somatochlora walshii*)**. These species are primarily found in wetlands. Additionally, a population of the **Blueberry Sallow (*Apharetra (purpurea) dentata*), a G4 S2 species of concern** was found at Reynolds Spring.
2	CANADA RUN BOG	28	115, 130	Chatham, Delmar	Canada Run Bog is a high elevation **Acidic Glacial Peatland Complex, a GNR SNR tracked community** at the headwaters of Canada Run. A rather robust population of the **G5 S2 state threatened few-seeded sedge (*Carex oligosperma*)** covers much of the open portion of the bog. Additionally, the **northeastern bulrush (*Scirpus ancistrochaetus*), a G3 S3 federally endangered plant** can be found at the site. The site also houses a population of the **G5 S3 PA-rare plant, the soft-leaved sedge (*Carex disperma*)**.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
2	FELLOWS CREEK WETLANDS WEST	39	220	Ward	This site is a boggy wetland with shrubs and small trees with open portions dominated by Sphagnum moss and graminoids. This site includes a **Hemlock Palustrine Forest, a GNR S3 tracked community**. Recent surveys of this site located a **population of creeping snowberry (*Gaultheria hispidula*) a G5 S3 PA-rare species** and a **G5T5 S1S3 species of concern, the Silver-bordered Fritillary (*Boloria selene myrina*)**. Additionally, surveys uncovered a population of **marsh willow-herb (*Epilobium palustre*), a G5 S1 species of concern** and **a population of the state endangered showy mountain-ash (*Sorbus decora*), a G4G5 S1 species**.
2	MARSH CREEK FLOODPLAIN	27	130, 200	Delmar, Shippen	This site is an expansive but rather narrow stretch of cattail dominated marsh that stretches along Marsh Creek in an agricultural and rural housing setting. An old railroad bed trail is adjacent to the marsh. A survey of the floodplain in 2005 revealed a population of a **G5 S2S3B candidate rare bird species**. This species requires shallow wetlands that support tall marsh plants in which they build their nests. Additionally, during the most recent site survey **a population of the G5 S3 Northern Bluet (*Enallagma annexum*)** was captured and a **G4 S3S4 species of concern, the Triangle Floater (*Alasmidonta undulata*),** was located at the site in 1997. Both of these species use wetlands as their primary habitats. This site is within Important Bird Area #27.
2	RED RUN HEADWATERS	51	98	Bloss	The headwaters of Red Run are a part of a large wetland complex around the town of Arnot. This complex is a sphagnus bog with a forested buffer of eastern hemlock, red maple, eastern white pine, and yellow birch. Portions of the site are dry shrub openings dominated by leatherleaf and fringed with sedges. Surveys that occurred on site in 2004 revealed a population of a **G5 S3 threatened species, the bog sedge (*Carex paupercula*)**, a **Leatherleaf – sedge wetland which is a GNR S3 tracked community**, a **G5 S3 PA-rare species, creeping snowberry (*Gaultheria hispidula*)**, **a population of a G4 S1 species of concern the Incurvate Emerald (*Somatochlora incurvata*),** a **population of the Gray Comma (*Polygonia progne*), a G5 SU species of concern**, and confirmed nesting of **a G5 S3BS4N species of concern**.
2	THE MUCK	30	130	Delmar	Also known as "Stokesdale Marsh", this 500 plus acre marsh lies just north of Wellsboro. The marsh is largely owned by the Pennsylvania Game Commission with several private landowners owning the remaining marsh acerage. The Muck is now a **mixed graminoid-robust emergent marsh, a GNR S2S3 tracked community**. This community houses several species of rare birds including a **G5 S3S4B,S4N species of concern**, and there are confirmed breeding records of both **a G5 S3B species of concern** and **a G5 S2S3B species of concern** at The Muck. This site is within Important Bird Area #27.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
3	ARNOT BOG COMPLEX	50	98	Bloss	Arnot Bog Complex is a very expansive series of wetlands that house several plant communities. Some of the wetlands in this series have been previously modified by beavers and are now open wet meadows while other sections of the wetland complex currently support beaver populations and have portions of standing water. Populations of a **threatened G5 S3 plant, the bog sedge (*Carex paupercula*)**, a **PA-rare G5 S3 plant, creeping snowberry (*Gaultheria hispidula*)**, the **G5 S3 PA-rare soft-leaved sedge (*Carex disperma*)**, and an **endangered G5 S1 plant, Torrey's bulrush (*Schoenoplectus torreyi*)** all occur within the Arnot Bog Complex. Recent surveys uncovered a population of a **G4G5 S2 species of concern, the Bog Copper (*Lycaena epixanthe*)**. Additionally, **a population of the G4 S1 Dion Skipper (*Euphyes dion*), a species of special concern**, was documented at Arnot Bog Complex in 1986. This species uses wetlands as its primary habitat.
3	COWANESQUE LAKE AND RIVER	4	166, 188	Lawrence, Nelson	The Cowanesque Lake reservoir has been built within the last 30 years, and despite its relatively young age, the lake and surrounding forest has become a hotspot for **Osprey (*Pandion haliaetus*), a G5, S2B threatened species**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the site has been used by a nesting pair of **Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B threatened** species.
3	FELLOWS CREEK WETLANDS EAST	38	220	Ward	The Fellows Creek Wetlands East site is a boggy, Sphagnum dominated wetland. The Sphagnum moss forms a carpet with cottongrass and cinnamon fern as associates. Recent surveys of this site located a **population of creeping snowberry (*Gaultheria hispidula*),** and a **population of the Norhtern Bluet (*Enallagma annexum*), a G5 S3 speices of concern**. This site is also used by **a G5 S3B,S4N animal species of concern**, for breeding.
3	GOODALL FIRETOWER VERNAL POOLS	23	200	Shippen	This site includes several small wetlands, some of which are characteristic of vernal pools. In several of these pools is the **G3 S3 PA-endangered northeastern bulrush (*Scirpus ancistrochaetus*)**. This plant is considered to occur almost exclusively in temporary pools. The majority of the occurrences of this globally rare species occur in Pennsylvania, and the Tioga County populations of this species are an important component of the global distribution of this species.
3	HAMMOND LAKE MACROSITE	11	166, 175, 214	Lawrence, Middlebury, Tioga	Hammond Lake supports the **G5 S2B threatened species, the Osprey (*Pandion haliaetus*)**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the **threatened Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B species** have nested around Hammond Lake. In 1994, **the G5 S3B,S4N Pied-billed grebe (*Podilymbus podiceps*), a species of concern,** was found nesting at this site.
3	LAKE LARD POOLS	25	200	Shippen	Lake Lard Pools contains a high elevation group of **Ephemeral/Fluctuating Natural Pools, a GNR S3 tracked community** and **an Acidic Glacial Peatland Complex, a GNR SNR tracked community**. Within this group of wetlands is a large boggy wetland with graminoid herbaceous vegetation. This site has a carpet of Sphagnum moss, interspersed with cinnamon fern, woolgrass, rattlesnake mannagrass, and three-way sedge. The dominant species at this site is the **state threatened G5 S2 few-seeded sedge, *Carex oligosperma*** which creates a monoculture in a portion of the wetland.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
3	TROUPS CREEK GRAVEL BARS AND OXBOWS	1	104, 126	Brookfield, Deerfield	This site is a mosaic of different habitats including a creek channel, a steep eroding bank, and a cluster of oxbow wetlands. A 2005 survey of this site revealed a population of a **G5 S1 Pennsylvania endangered broad-leaved water-plantain (*Alisma triviale*)**, a population of the **G5 S1 state endangered backward sedge (*Carex retrorsa*)**, and the **Pennsylvania threatened G4 S1 stalked bulrush (*Scirpus pedicellatus*)**.
4	FALL BROOK WETLANDS	40	220	Ward	The Fall Brook Wetlands site is a reforesting wetland with a base of mosses. The site is dominated by saplings and small trees of red maple, eastern hemlock, yellow birch and clumps of shrubs, including mountain holly and withe-rod. The site has several openings throughout that are dominated with tawny cotton grass. During 2005 surveys, a population of **creeping snowberry (*Gaultheria hispidula*), a G5 S3 species of concern** was found at this site.
4	MIDDLE RIDGE SWAMP	59	130, 200	Delmar, Shippen	This site is a relatively undisturbed wetland dominated by cattails and other herbaceous plants. Occasional thickets of shrubs or small trees are present. Some bog species were encountered at the site including leatherleaf. The thick vegetation at the site provides good wildlife habitat. A recent survey of the site yielded **a population of a G5 S2 species of concern, marsh bedstraw (*Galium trifidum*)**.
4	NICKEL RUN HEADWATERS NORTH	55	108	Charleston	This wetland is dominated by marsh graminoids, primarily sedges. Small patches of Sphagnum moss occur within the wetland with a surrounding forest of eastern hemlock, yellow birch, red maple, American beech, and eastern white pine. The wetland has a very open aspect with very few woody species and has a history of beaver activity. A small but healthy population of the **G5 S3 PA-rare plant species, the soft-leaved sedge (*Carex disperma*)** was found in 2005. This species inhabits shaded wetland margins.
4	NICKEL RUN HEADWATERS SOUTH	54	139	Duncan	This site, found on Tioga State Forest land, includes a seepy eastern hemlock, yellow birch, and red maple forest which is drained by a diffuse streamlet. Sections of this wetland are drier, with hummocky spots and a moderately open canopy. During recent surveys, a population of a **G5 S3 PA-rare plant species, the soft-leaved sedge (*Carex disperma*)** was found at this site.
4	RT-6 COUNTY LINE WETLANDS	36	210	Sullivan, Bradford County	This site contains forested wetlands that support a good–quality population of the **soft-leaved sedge (*Carex disperma*) a G5 S3 PA-rare plant species of concern.** This site has richly diverse vegetation that includes a **GNR S3 Hemlock Palustrine Forest Natural Community**.
4	TAUCHER POND	33	108	Charleston	Expansive stands of wetland plants attest to the relatively shallow depth of Taucher Pond. A **G5 S2S3B bird species of concern** was located at this site in 2005. This species requires shallow wetlands that support tall marsh plants in which they build their nests. During the same survey in 2005, **a Green-striped Darner (*Aeshna verticalis*), a G5 S3S4 species of concern,** was captured at Taucher Pond. This species primarily resides in wetlands.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
4	TIOGA RIVER AT LAWRENCEVILLE	6	166	Lawrence	In 2001, several nests of a **G5 S2B Pennsylvania threatened species** were found along the edges of the Tioga River just south of Lawrenceville. This species requires high water quality and healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This bird species exhibits strong nest fidelity.
4	WEST MILL CREEK HEADWATERS	43	217	Union	The West Mill Creek Headwaters site is a fair sized **Hemlock Palustrine Forest, a GNR S3 tracked community**, with a Sphagnum layer and dense cinnamon fern. This area also has some dryer hemlock forested areas. During recent surveys of the site, a **population of the soft-leaved sedge (*Carex disperma*), a G5 S3 species of concern** was found. This site lies on private property.
4	WHITEHOUSE HOLLOW	31	108, 175	Charleston, Middlebury	The site at Whitehouse Hollow is a southwest facing hillside that abruptly rises 900 feet from the base of the valley. A small stream meanders down the slope to the floor of the ravine. In 2004 a population of a **G5 S3 species of concern** was found at Whitehouse Hollow.
5	ASAPH SLOPES	26	200	Shippen	The Asaph Slopes site overlooks the Marsh Creek Floodplain. A nest site of **a G5 S3S4B,S4N species of concern**, was located at this site in 1987.
5	BEAR WALLOW WETLANDS	16	200	Shippen	A population of the **G5, S3 PA-rare plant soft-leaved sedge (*Carex disperma*)** was documented in a small shrub-dominated sphagnum wetland. This wetland is isolated from flowing water, getting its water input primarily from precipitation and runoff and is carpeted in sphagnum moss.
5	BLACK ASH SWAMP	17	118, 200	Clymer, Shippen	Black Ash Swamp is a 25-30 acre, high elevation marsh dominated by cutgrass and woolgrass with a mixture of cattail and sedges. This site is the result of previous beaver activity. **Graminoid marshes are a tracked community in Pennsylvania and are ranked GNR S3**. Surveys in 2005 located a **population of Baltimore Checkerspot (*Euphydryas phaeton*), a G4 S2S4 species of concern**.
5	C V JUNCTION HILL	7	166	Lawrence	The forest at this site has a considerable canopy opening created by a gas and powerline right of way and some small shallow wetlands. During several 2003 surveys of this site, **a population of the G4 S3B,S3N species of concern, the Northern Myotis (*Myotis septentrionalis*)** was found feeding along the open areas at this site.
5	CAT ROCKS WETLAND	47	171	Liberty	Located on Tioga State Forest Land, Cat Rocks Wetland is part of a group of peatlands surrounded by eastern hemlocks. These wetlands are dominated by Sphagnum moss, tawny cotton-grass, and cinnamon fern. In 2005, a population of **screw-stem (*Bartonia paniculata*), a G5 S3 species of special concern,** was found at the Cat Rocks Wetland.
5	COWANESQUE RIVER	3	126, 188, 192	Deerfield, Nelson, Osceola	The Cowanesque River supports breeding pairs of **a G5, S2B Pennsylvania threatened species**. This species requires healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This species exhibits strong nest fidelity.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
5	CROFT HOLLOW WETLANDS	14	150, 175	Farmington, Middlebury	The Croft Hollow Wetlands have been modified or created by past beaver activity. Multiple breeched beaver dams are present at this site and the former beaver ponds have shrunk, with much of the area becoming open wet meadows. A thick herbaceous layer has developed as the pond waters have lowered. During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located.
5	EAST BRANCH CANADA RUN HEADWATERS	29	130	Delmar	This site is a relatively small **Hemlock Palustrine Forest, a GNR S3 tracked community** in the state. The site has an open eastern hemlock, eastern white pine, Sphagnum palustrine area with a dense cinnamon fern understory. The swamp is surrounded by ridgetop mixed oak with mountian laurel and some eastern white pine. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area.
5	ELBRIDGE WETLANDS	12	150, 175	Farmington, Middlebury	The Elbridge Wetlands site is composed of a variety of habitats surrounding an open water pond. Portions of the pond are bordered by shallow marshlands and a hemlock forest. The shallow marsh is composed of a mix of marsh graminoids including a variety of sedges. Surveys of this area in 2005 revealed **a population of larger Canadian St. Johns-wort (*Hypericum majus*), a G5 S2 state threatened species**. At the margins of the hemlock forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.
5	FLOWER RUN HEADWATERS	48	98	Bloss	Flower Run Headwaters is a long established, but currently inactive beaver pond. This wetland has rather distinct zones of vegetation, primarily composed of a variety of graminoids including a population of the **G5 S1 state endangered plant, Torrey's bulrush (*Schoenoplectus torreyi*)**.
5	FOSSIL FARM	34	108	Charleston	This site lies just east of the village of Charleston along the northern branch of the Catlin Hollow. Here a small steam has been modified by beavers, creating some small open ponds. These small open water wetlands, the creek and floodplain provide habitat for many plant and animal species. A **G5 S2 animal species of special concern, the Brush-tipped Emerald (*Somatochlora walshii*)** was captured at this site in 2005. This species relies upon wetlands for its primary habitat.
5	GLEASON HOLLOW	64	142	Elk	The Gleason Hollow site sits on Tioga State Forest land. A shallow wet depression on a forested hogback houses a population of a **G5 S1S2 plant species of special concern, the mountain starwort (*Stellaria borealis*)**.
5	GURNEE ROAD BOG	19	154	Gaines	Gurnee Road Bog is surrounded by a forest of eastern white pine, eastern hemlock, and mountain laurel. The wetland itself is dominated by Sphagnum moss. Surveys in 1997 located a **population of the state threatened G5 S3 bog sedge, *Carex paupercula***.
5	HARTS CREEK HEADWATERS	8	162, 166	Jackson, Lawrence	Hart's Creek Headwaters lies to the east of the Lawrenceville. The sloping hills surrounding the creek have been cleared for agriculture with only small, fragmented pockets of forest. Some small orchards are found in these fields. There are a few marshy openings to the east and northeast of the site. Breeding pairs of **a G5 S3BS3N species of concern** were noted from this location in 1994.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
5	HILLS CREEK STATE PARK RESERVOIR	32	108	Charleston	Among the plant species that inhabit this site are a **plant species of special concern, the G5 S2 marsh bedstraw (*Galium trifidum*)**, the **G5 S2 threatened lesser panicled sedge (*Carex diandra*)**, and the **G5 S3 PA-rare soft-leaved sedge (*Carex disperma*)**. These wetland plants have northerly distributions in North America, and in Pennsylvania they appear to be most frequent in the northern counties. Surveys of the site in 2004 uncovered a population of **a species of concern, the G5T4 S1 Broad-winged Skipper (*Poanes viator viator*).**
5	KNOXVILLE SLOPES	2	126	Deerfield	From the base of the slopes at Troups Creek, a nearly one thousand foot rise in less than half a mile is the gateway to a large contiguous forested block known as Knoxville Slopes. With its dark ravines and dry slopes, the site supports a variety of plant communities. During a survey of site in 2005, a population of the **G5 S3 species of concern, slender wheatgrass (*Elymus trachycaulus*)** was found on one of the steep dry slopes.
5	LAKE LARD SLOPES	24	200	Shippen	This site lies to the southwest of the Lake Lard Pools site. Along the hillside, a **population of the G5 S1 state endangered cranesbill (*Geranium bicknellii*)** was discovered in 2002.
5	LAWRENCEVILLE ROOKERY	5	166	Lawrence, New York State	In 2002, a nest site of **a G5 S3S4B,S4N species of concern** was found just to the west of the borough of Lawrenceville along the Cowanesque River.
5	LONG RUN HEADWATERS	46	171	Liberty	This site is a very large, open canopied wetland that was created by, or has been modified by beavers. The wetland is dominated by cattail, with marsh fern, soft rush, and sensitive fern as associates. The wetland is fringed by eastern hemlock. Surveys during 2005 located a **population of a G5 S3 species of concern, the Long Dash (*Polites mystic*)**.
5	MIDDLE RIDGE VERNALS	18	118, 200	Clymer, Shippen	These fluctuating wetlands sit high atop the ridge and are dependent on rainfall for their sole source of water input. There is a dense shrub layer of highbush blueberry, mountain holly, and leatherleaf. A forest of tall trees, including eastern white pine, black gum, red maple, and yellow birch surrounds the wetlands. During a 1993 survey of the site, a population of the **G5 S2 threatened plant species, the few-seeded sedge (*Carex oligosperma*),** was located at this site.
5	MILLS CREEK HEADWATERS	49	98	Bloss	Mills Creek Headwaters is a small, relatively isolated wetland meadow. The vegetation is dominated by graminoids and herbs with a surrounding forest of eastern white pine, red maple, and black cherry. During a 2005 survey, **a G5 S3S4B,S4N species of concern,** was located at Mills Creek Headwaters.
5	MITCHELL CREEK SLOPES	10	166, 214	Lawrence, Tioga	The Mitchell Creek Slopes site is a wooded ravine which overlooks the Tioga River and the Town of Mitchell Creek. During several 2003 surveys of this site, **a population of the G4 S3B,S3N species of concern, the Northern Myotis (*Myotis septentrionalis*)** was found feeding along the open areas at this site. While the relationship of this location to a maternity site or roost is unknown, the multiple individuals captured here on several different nights show that this population uses this site for foraging.
5	MORRIS MEADOWS	68	180	Morris	This open area to the northwest of the village of Morris is nestled between the steep valley walls along Wilson Creek. A population of the **G4 S3 Harris' Checkerspot (*Chlonsyne harrisii*)** was found at Morris Meadows.

County Rank	Site Name	Site #	Page #	Municipality (ies)	PA Heritage Ranks and Site Importance
5	PINE CREEK AT GAINES	21	154	Gaines	Surveys along Pine Creek in 1980 found a **population of the Pennsylvania state endangered G5 S1 broad-leaved water plantain (*Alisma trivale*)**.
5	RATTLER MINE ROAD WETLANDS	67	130, 181	Delmar, Morris	This site is a high elevation open canopied natural depression wetland. Dominant species within the wetland include woolgrass, sedges, and Sphagnum moss. Surrounding the wetland is a forest of birch, red pine, and eastern white pine. In 1991, a population of a **G5 S2 species of concern, the Ski-tailed Emerald (*Somatochlora elongata*)** was found at this site, and in 1993, a survey of the site uncovered a population of a **G4 S1 species of concern, the Incurvate Emerald (*Somatochlora incurvata*)**.
5	SAND RUN HEADWATERS	53	122	Covington	Sand Run Headwaters are part of a large complex of wetlands surrounding the town of Arnot. This site was formerly inhabited by beavers. Now drained, the site is now an open meadow surrounded by Tioga State Forest Land. In 2005, **an Amber-winged Spreadwing (*Lestes eurinus*), a G4 S3 species of concern** was captured at the site.
5	SHINGLEBURY WETLANDS	13	150, 175	Farmington, Middlebury	The Shinglebury Wetlands are composed of an open canopied wet meadow and a hemlock-mixed hardwood palustrine forest. During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located in the open wet meadow. In the hemlock-mixed hardwood palustrine forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.
5	STONY FORK SLOPE	58	130	Delmar	This site consists of a small open seepage at the base of a cliff, just north of the road ditch. Recent surveys of the site uncovered a population of the **PA-endangered G5 S1 Bebb's sedge (*Carex bebbii*)**.
5	TIOGA RIVER AT BEAR RUN	42	217	Union	This site is a scoured stony river bed which appears to flood violently periodically. The cobble scour and open canopy support vegetative communities that support a unique suite of animals. A 2005 survey of the site located **a population of the G5 S3 Ski-tailed Emerald (*Somatochlora elongata*)** and **a population of the G5 S3 Ocellated Darner (*Boyeria grafiana*).**
5	WETLAND NORTH OF ARNOT	52	98	Bloss	This wetland, perched on a hill overlooking the town of Arnot, supports a **population of the G5 S3 state threatened bog sedge (*Carex paupercula*)**. The wetland is dominated by leatherleaf, low sweet blueberry, sedges, and Sphagnum moss. Some short shrubs are interspersed throughout the wetland but the overall canopy is rather open. The forest surrounding the wetland is composed of red maple, American beech, and eastern white pine.
5	WHITNEYVILLE MEADOW	35	108, 195	Charleston, Richmond	This site is a wet meadow along a small stream. At the time of the survey, the site was used as a cow pasture. A population of the **G5 S2 threatened species, Torrey's rush (*Juncus torreyi*)** was found within the pasture.
5	WOODRUFF HOLLOW WETLANDS	22	155, 201	Gaines, Shippen	The Plateau in this area is primarily covered in a dry oak – heath forest underlain by shrubs in the heath family. Several small isolated wetlands also occur in this habitat and provide important habitat for wetland dependent plants and animals. A population of **the G5, S3 PA-rare creeping snowberry (*Gaultheria hispidula*)** was documented in a shrub and sedge dominated acidic wetland on this plateau.

Table 3. Areas of Local Significance in Tioga County based on size, diversity of wildlife and plant life, water quality protection, and recreation potential (these sites do not have documented populations of species of special concern although most of these areas have potential for rare species to occur).

County Rank	Site Name	Site #	Page #	Municipality (ies)	Natural Feature and Importance
High	Armenia Mountain Wetlands	37	210, 220	Sullivan, Ward	This expansive wetland complex has portions of open canopied wet meadows while other wetlands in the system are completely forested. The site lies on private property and Tioga State Forest land and may be slated for future timbering operations. Numerous forestry roads are throughout the site. A 100 meter no-cut forested buffer should be established around this wetland in order to maintain the character of the site. Future biological surveys should be conducted at this site.
High	East Creek Headwaters	41	122, 220	Covington, Ward	This cluster of high altitude wetlands sits atop of Pine Hill and feeds East Creek. This site contains a mixture of wetlands, some are forested while others include some open water with sections of shrubs and open marshy areas. This site may hold biological significance for Tioga County. Future surveys should be conducted at this site. A 100 meter no-cut forested buffer should be established around this site to maintain the integrity of this site.
High	Slate Run Headwaters	62	142	Elk, Lycoming County	This site is a large, unfragmented block of forest. A number of species rely on large forested tracts and this site with its varied topography creates a mix of habitats for both flora and fauna. Future biological surveys should be conducted at this site. This site is within state forest land with portions of the site currently being timbered. The disturbance along logging roads can provide vectors for exotic invasive species to penetrate large forested areas. A 100 meter no-cut forested buffer should be established around the ravines to protect the habitats. The creation of logging roads should be kept to a minimum to slow the spread of invasive exotic species along these disturbed corridors.
Med	Babb Creek Headwaters	56	108, 171	Charleston	This series of wetlands contains some open water habitat, wet meadow marshy areas, meandering streams, and clusters of forested wetlands. This site is surrounded by high concentrations of agricultural land. It is likely that runoff from these fields is affecting the wetlands by creating unnaturally high amounts of nutrients as well as leading to siltation from erosion. This concentration of wetlands may hold biological significance and future surveys should be conducted at this site.
Med	Blacks Creek Headwaters Swamp	45	171	Liberty	This expansive forested wetland has portions dominated by marsh graminoids interspersed with wetland shrubs. The shrubs become dominant to the western half of the wetland. Future biological surveys should be conducted at this site. A 100 meter no-cut forested buffer should be established around this wetland in order to maintain the character of the site.
Med	Charleston School Wetlands	57	108	Charleston	This group of wetlands includes forested wetlands and open graminoid meadows. This concentration of wetlands may hold biological significance and future surveys should be conducted at this site. The Charleston School Wetlands site is surrounded by high concentrations of agricultural land. It is likely that runoff from these fields is affecting the wetlands by creating unnaturally high amounts of nutrients as well as leading to siltation from erosion.

County Rank	Site Name	Site #	Page #	Municipality (ies)	Natural Feature and Importance
Med	Crooked Creek Headwaters	15	115	Chatham	This site contains some open water habitat and shallow water marshes dominated by cattail. The shallow marshlands at this site are of particular interest because these areas appear to be suitable habitat for a variety of bird species. Future surveys should be conducted at this site to determine if the wetland system indeed supports marsh birds. Forested buffers should be established around this site to improve the water quality and reduce the amount of erosion that is influencing these wetlands. If beavers begin to dam the meandering stream at this site, a trapping regimen should be employed to maintain the biological quality of this site.
Med	East Point Forested Wetlands	44	171, 217	Liberty, Union	The wetlands that make up this site include eastern hemlock palustrine forests with some portions having sedgy openings. A 100 meter no-cut forested buffer should be established around the site to maintain the character of these wetlands. Future biological surveys should be conducted at this site.
Low	Marshlands Slopes	61	142, 154	Elk, Gaines	The hills surrounding Elk Run contain habitat for grassland birds, which in recent years have been in decline. Future surveys of this site should be conducted to determine if these habitats could support populations of grassland species. It is critical to induce disturbance at the appropriate time to ensure that breeding of grassland species is not disrupted. This may require mowing to occur later in the season.
Low	State Game Lands #208 Vernal Pools	20	154	Gaines	The vernal pools at this site are moderately sized and have vegetated bottoms. Vernal pools provide critical habitat for a number of amphibian species and are frequently used by many other organisms. Unfortunately, the recent surveys of this site occurred later in the season, long after vernal pool amphibians breed. Future surveys should be conducted at this site to determine the importance of these pools for the vernal pool obligate species.
Low	West Branch Painter Run Headwaters	9	214	Tioga	The wetland at this site is forested in sections with the vast majority of the wetland composed of a variety of other wetland shrubs and graminoids. This wetland may hold biological significance for Tioga County and future surveys should be conducted at this site. This site is surrounded by forested land on private property and State Game Lands #37. The forest surrounding this site may be marked for future timbering practices. A 100 meter no-cut forested buffer should be established around this site to maintain the integrity of this site.

- notes -

BLOSS TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
ARNOT BOG COMPLEX (3)	bog sedge (*Carex paupercula*)	G5	S3	PT	1993-6-21	C
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2004-6-30	E
	Dion Skipper (*Euphyes dion*)	G4	S1	N	1986-7-15	A
	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2005-7-14	BC
	Torrey's bulrush (*Schoenoplectus torreyi*)	G5	S1	PE	2005-8-23	B
	Bog Copper (*Lycaena epixanthe*)	G4G5	S2	N	2005-7-14	E
FLOWER RUN HEADWATERS (5)	Torrey's bulrush (*Schoenoplectus torreyi*)	G5	S1	PE	2005-7-26	AB
MILLS CREEK HEADWATERS (5)	Animal species of concern	G5	S3S4B,S4N	N	2005-7-14	E
RED RUN HEADWATERS (2)	bog sedge (*Carex paupercula*)	G5	S3	PT	2004-8-3	BC
	Leatherleaf – Sedge Wetland	GNR	S3	N	2004-7-1	E
	Animal species of concern	G5	S3B,S4N	N	2004-7-1	E
	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2004-8-3	B
	Incurvate Emerald (*Somatochlora incurvata*)	G4	S1	N	2004-7-1	E
	Gray Comma (*Polygonia progne*)	G5	SU	N	2004-7-1	E
WETLAND NORTH OF ARNOT (5)	bog sedge (*Carex paupercula*)	G5	S3	PT	2005-7-6	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.

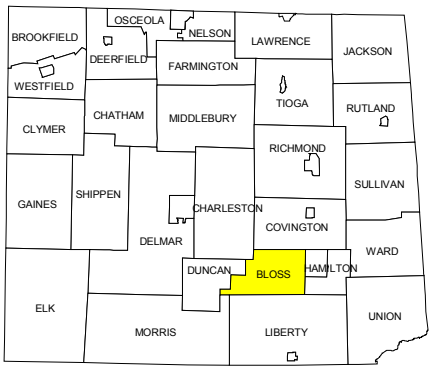
**Please refer to Appendix V for an explanation of Quality Ranks

Locally Significant: none

Managed Lands: Tioga State Forest

Exceptional Value Stream: Nickel Run

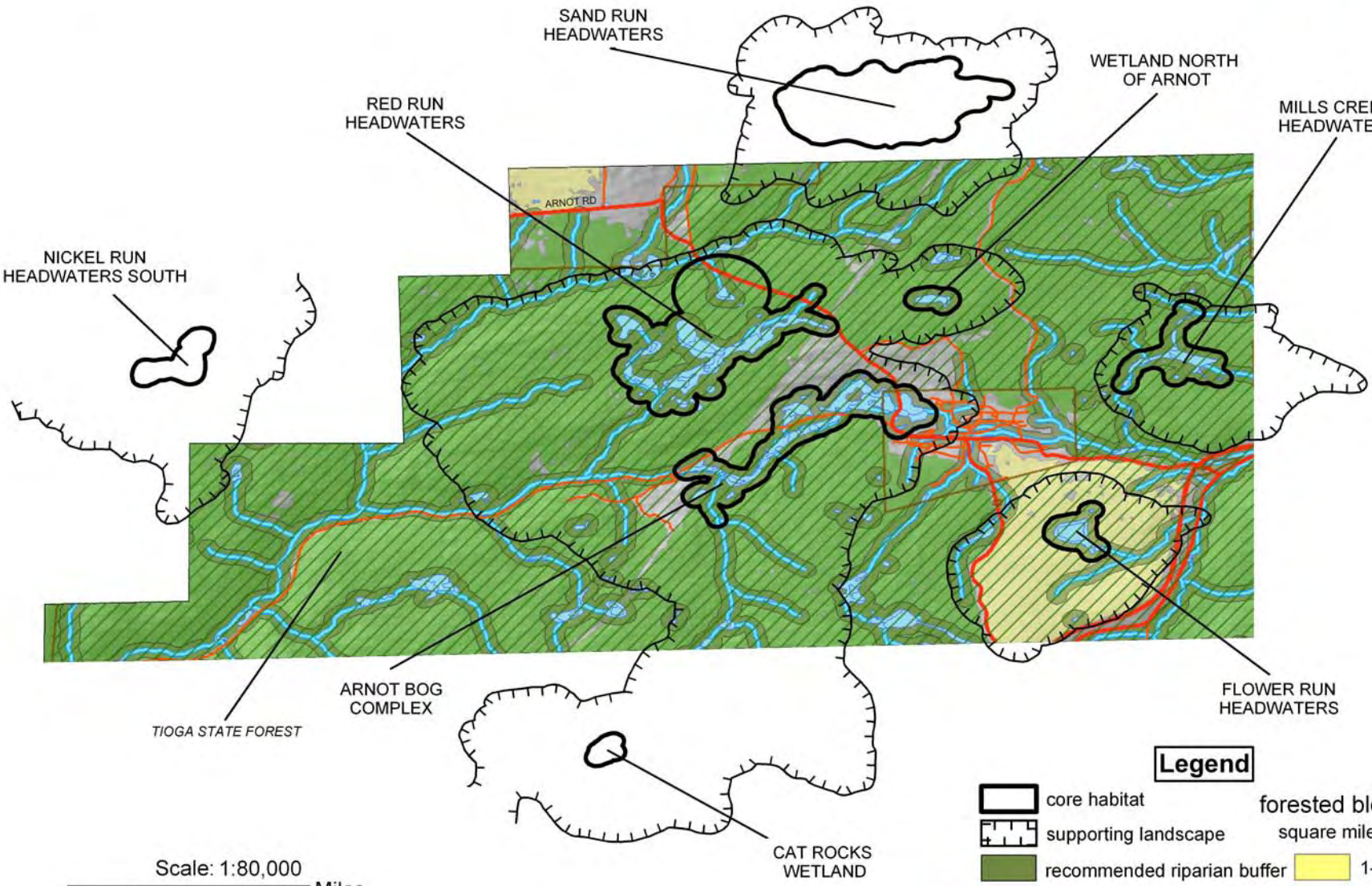
Aquatic Classification Project Results:
Cool Water Community 1—Johnson Creek
Cold Water Community—Babb Creek-Long Creek
Little Plain Brown Sedge / Slender Winter Stonefly—Johnson Creek



BLOSS TOWNSHIP MAP

Bloss Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Bloss Township is primarily within the Glaciated High Plateau Section of the Appalachian Plateaus but includes the edges of the Deep Valley Section of the Ridge and Valley geographic province. The township is almost entirely forested and forms part of a forested finger stretching across the whole county. These significantly sized forest blocks are largely managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The township is primarily drained by Babb Creek and its tributaries, including a portion of the Exceptional Value-designated Nickel Run. Much of the biodiversity of the

Arnot Bog Complex with a robust population of Torrey's bulrush (*Schoenoplectus torreyi*)

township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, in particular along the path of Nickel Run. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of and removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Water quality should be monitored and restored in formerly mined portions of the township.

ARNOT BOG COMPLEX (Bloss Township)

Arnot Bog Complex is a very expansive series of wetlands that house several plant communities including some rare, threatened, and endangered species. Some of the wetlands in this series have been previously modified by beavers and are now open wet meadows with marsh graminoids and wetland shrubs. Other sections of the wetland complex currently support beaver populations and have portions of standing water. Populations of a **threatened G5 S3 plant, the bog sedge (*Carex paupercula*)**, a **PA-rare G5 S3 plant, creeping snowberry (*Gaultheria hispidula*)**, the **G5 S3 PA-rare soft-leaved sedge (*Carex disperma*)**, and an **endangered G5 S1 plant, Torrey's bulrush (*Schoenoplectus torreyi*)** all occur within the Arnot Bog Complex. In a 2005 survey of the site a population of a **G4G5 S2 species of concern, the Bog Copper (*Lycaena epixanthe*)** was located. This species of moth primarily resides in bogs and fens. Additionally, **a population of the G4 S1 Dion Skipper (*Euphyes dion*), a species of concern**, was documented at Arnot Bog Complex in 1986. This species uses wetlands as its primary habitat.

Threats and Disturbances:

Although the site currently appears to be relatively stable, there are many potential threats that could alter the integrity of this wetland system. There is a strip mine located just north of the wetland. Measures have been taken to curb the effects of the acid mine drainage as evidenced by the retention treatment pools that are adjacent to the wetland. If untreated acid mine drainage were to enter the wetland system, the floral and faunal composition of the wetland would greatly suffer. The quality of the Arnot Bog Complex could also be degraded from trash dumping that has occurred at the site.

Logging the area surrounding the Arnot Bog Complex could also disrupt the wetland. The surrounding forest plays a large roll in the fabric of this wetland system. Forest buffers around wetlands can protect the unique species of the site and logging within this area could negatively alter the characteristics of this wetland.

Photo Source: PNHP

A portion of the Arnot Bog Complex

Changes in the hydrology of the site could also damage the structure of the current natural communities found within the wetland system. Although beavers can create natural changes via damming and flooding, this species has the ability to greatly alter the structure of the natural communities of the Arnot Bog Complex.

The town of Arnot is immediately to the east of this wetland and small drainages track through the town and are connected to Arnot Bog. Runoff from various sources including septic

systems, lawn fertilizers and solvents could potentially enter the wetland through these small rivulets.

The Bog Copper population could be threatened by pesticide spraying for gypsy moths.

Conservation Recommendations:
Monitoring of the acid mine drainage should continue to ensure that the structures are functioning properly. Additionally, dumping should be discouraged at this site and any previously discarded refuse should be properly disposed of. A no-cut 100 meter forested buffer should be established around the margins of the wetlands. Major alterations to hydrology should be avoided, whether via humans or beavers. Disturbance of beaver structures and thinning of the beaver population should occur if the beavers begin to make drastic changes to the hydrology of the wetland. The water quality should be monitored to limit the possibility of nutrient and chemical influx from the town of Arnot. The use of pesticides to control gypsy moth population should avoid the area surrounding this site.

FLOWER RUN HEADWATERS (Bloss Township)
Flower Run Headwaters is a long established, but currently inactive beaver pond. During a 2005 survey, the pond had very little water due to dry weather. This wetland has rather distinct zones of vegetation, primarily composed of a variety of graminoids inclucing a population of a **G5 S1 state endangered plant, Torrey's bulrush (*Schoenoplectus torreyi*)**.

Threats and Disturbances
During the recent survey, no active threats were noted. However, the site does occur on Tioga State Forest property and could be marked for timber harvest in the future.

Conservation Recommendations
The establishment of a no-cut 100 meter forested buffer around the site would help protect the site and promote the success of the rare species that inhabits this site.

MILLS CREEK HEADWATERS (Bloss Township)
Mills Creek Headwaters is a small, relatively isolated wetland to the east of the town of Arnot. This site is a long established open beaver meadow. Currently, the beavers are no longer active at the site. The meadow has a spongy/marshy bed in the eastern part and a more boggy/marshy bed in the western part. The vegetation is dominated by graminoids and herbs with a surrounding forest of eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*). During a 2005 survey, **a G5 S3S4B,S4N species of concern,** was located at Mills Creek Headwaters. This species selects nest sites where access by mammalian and reptilian predators would be difficult. This means that nests are usually located in tall trees, often on islands. Interestingly, the recovery of beavers in the state may be improving habitat for this species because beavers flooding areas may create nesting sites.

Threats and Disturbances
Currently the habitat for the inhabiting species appears to be stable but should be monitored so that any threats that may arise could be swiftly addressed. The Mill Creek Headwaters site does occur within the Tioga State Forest and could potentially be slated for forestry practices in the future.

Conservation Recommendations
The establishment of a no-cut 100 meter forested buffer around the site would help protect the site and promote the success of the rare species that inhabit this wetland.

RED RUN HEADWATERS (Bloss Township)
The headwaters of Red Run are a part of a large wetland complex around the town of Arnot. This complex is a sphagnus bog with a forested buffer of eastern hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), eastern white pine (*Pinus strobus*), and yellow birch (*Betula alleghaniensis*). Tioga State Forest and private property with residences surround the site. This complex of wetlands supports several different plant communities. Portions of the site are dry shrub openings

dominated by leatherleaf (*Chamaedaphne calyculata*) and fringed with sedges with an adjacent upland of eastern hemlock and northern hardwoods. Surveys that occurred on site in 2004 revealed a population of a **G5 S3 threatened species, the bog sedge (*Carex paupercula*)**, a **Leatherleaf – sedge wetland which is a GNR S3 tracked community**, a **G5 S3 PA-rare species, creeping snowberry (*Gaultheria hispidula*)**, **a population of a G4 S1 species of concern the Incurvate Emerald (*Somatochlora incurvata*),** a **population of the Gray Comma (*Polygonia progne*), a G5 SU species of concern**, and confirmed nesting of **a G5 S3BS4N species of concern**.

Threats and Disturbances

No immediate threats were noted in the recent surveys. However, because the site is at least partially surrounded by Tioga State Forest, forestry practices could threaten the site in the future. Hydrologic changes, such as flooding by beavers, could also be considered a potential threat. Because of the marked trail to the site, human use via ATVs could damage the habitat and rare species at this site and vehicle use should be discouraged.

Conservation Recommendations

The establishment of a no-cut 100 meter forested buffer would help protect the character of the site and support the habitat for the rare species that inhabit the area. A large, marked trail leads to the site which could make to easily accessible to ATV use. This should be discouraged to avoid disturbance of the wetlands. The creation of trails that lead to these wetlands should also be discouraged.

Gray Comma

WETLAND NORTH OF ARNOT (Bloss Township)

This wetland, perched on a hill overlooking the town of Arnot, supports a **population of the G5 S3 state threatened bog sedge (*Carex paupercula*)**. The wetland is dominated by leatherleaf (*Chamaedaphne calyculata*), low sweet blueberry (*Vaccinium angustifolium*), sedge (*Carex canescens*), and peat moss (*Sphagnum* spp.). Some short shrubs are interspersed throughout the wetland but the overall canopy is rather open. The forest surrounding the wetland is composed of red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and eastern white pine (*Pinus strobus*).

Threats and Disturbances

This site lies on Tioga State Forest land and the surrounding forest could be marked for timbering in the future.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around this wetland to protect the habitat for the rare species that occur at this site.

BROOKFIELD TOWNSHIP

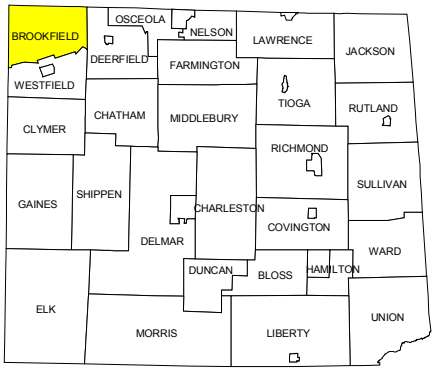
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
TROUPS CREEK GRAVEL BARS AND OXBOWS (3)	broad-leaved water-plantain (*Alisma triviale*)	G5	S1	PE	2005-8-25	E
	backward sedge (*Carex retrorsa*)	G5	S1	PE	2005-8-25	E
	stalked bulrush (*Scirpus pedicellatus*)	G4	S1	PT	2005-8-25	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River, Troups Creek, North Fork Cowanesque River
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River
Nemourid Broadback Stonefly / Ameletid Mayfly Community—North Fork Cowanesque River

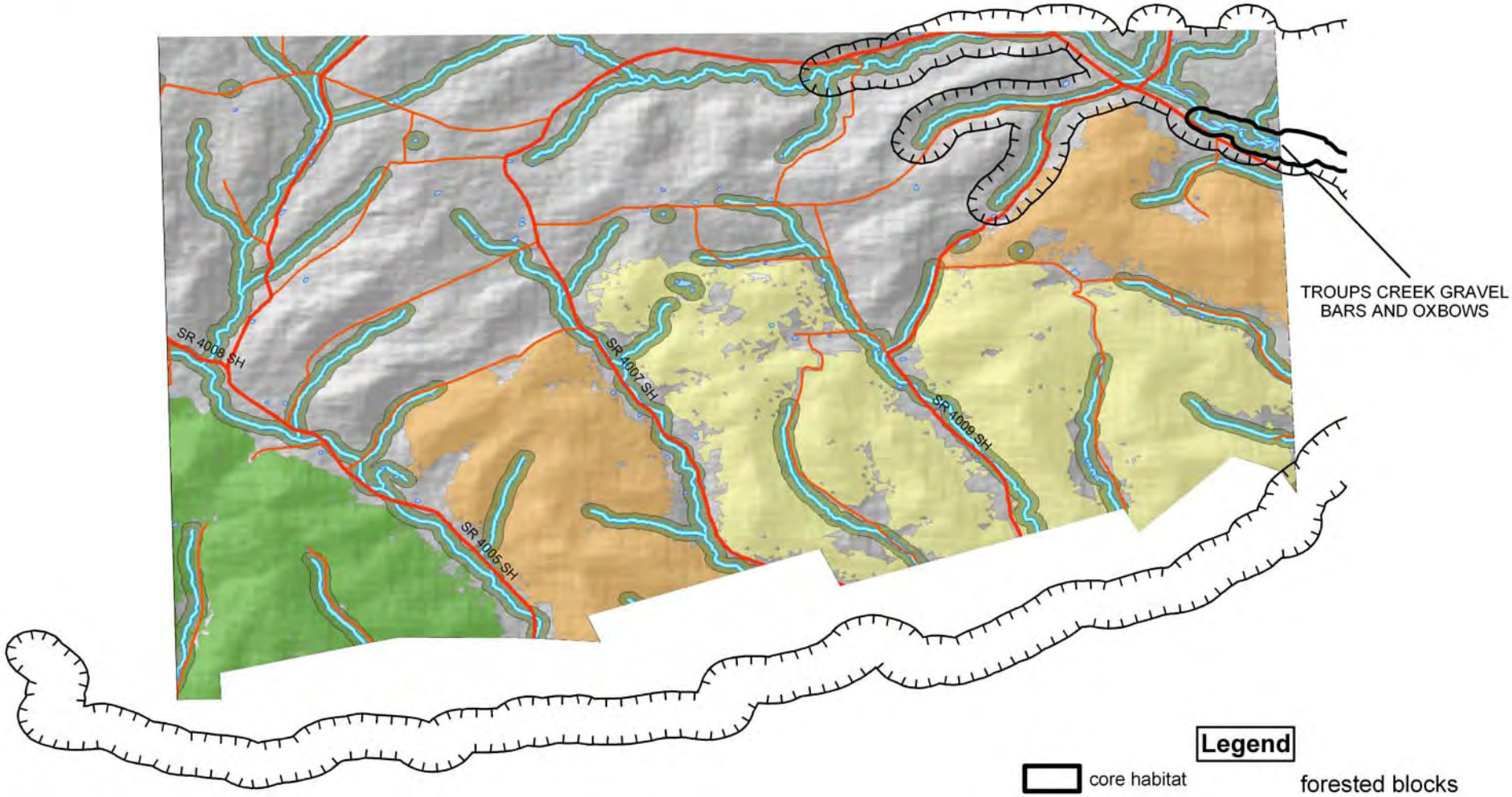


Brookfield Township lies in the extreme northwestern corner of the county and is of mixed land uses, including agriculture and forestry. Drainage is to the Cowanesque River just beyond the southern township border. Several tributaries to the Cowanesque River have their headwaters within the northern valleys of Brookfield Township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of and removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Several large forested blocks follow the topography of the drainages towards the river and provide riparian buffers for some of the smaller tributary streams. Protection of these forest blocks will help to protect the water quality of the many headwater streams originating within them. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. The forested tracts in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts.

BROOKFIELD TOWNSHIP MAP

Brookfield Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Scale: 1:80,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

TROUPS CREEK GRAVEL BARS AND OXBOWS (Brookfield and Deerfield Townships)

This site is a mosaic of different habitats all found within close proximity to one another. The creek channel has abundant gravel beds which support and array of species, most of which tolerate a high degree of disturbance due to the periodic flooding of the habitat. The creek's floodplain is forested in parts with sycamore (*Platanus occidentalis*) and cottonwood (*Populus deltoides*).

Adjacent to the creek channel is a steep bank with several seeps that drain into the creek. The bank is readily eroding, providing habitat for early successional plants. As the channel of the creek has changed over time, previous channels have been cut off from the main channel of Troups Creek. This action has created oxbow wetlands, which are small wetlands adjacent to the main creek channel that are no longer tied to the flow of the creek. These wetlands can be suitable for an interesting collection of organisms because of the still water conditions and less frequent disturbance of floods.

A 2005 survey of this site revealed a population of a **G5 S1 Pennsylvania endangered broad-leaved water-plantain (*Alisma triviale*)**, a population of the **G5 S1 state endangered backward sedge (*Carex retrorsa*)**, and the **Pennsylvania threatened G4 S1 stalked bulrush (*Scirpus pedicellatus*)**.

Threats and Disturbances

This site is under considerable threat due to invasive plant species. Several were noted during the most recent site visit and although Japanese knotweed (*Polygonum cuspidatum*) was not found at this site in 2005, this particularly aggressive species can be found nearby and will likely show up at this site in the near future. This species tends to exclude small herbaceous vegetation and would be a threat to all of the rare species found at this site.

Just downstream from this site, gravel excavation was observed during the 2005 surveys. This disturbance caused by the excavation could speed the spread of colonizing invasive exotics.

Large sections of the floodplain of Troups Creek are used as pasture land for livestock and agricultural land. The runoff from pasture lands and agricultural lands degrade the water quality of the wetlands in the vicinity. Also, beaver activity has been observed just downstream from this site.

Conservation Recommendations

Invasive exotic species are proving to stress Pennsylvania's native flora and fauna. Certain sites are considered to be more susceptible to exotic plant invasions because of their degree of connectedness to other sites. Frequent disturbance, via floods, can set back succession and enable periodic flushing and recolonization of plants. Therefore, waterways can serve as vectors for the spread of invasive plants. As a result, the floodplains associated with the County's waterways may serve as corridors for these invasions and are therefore under a heightened threat from exotic species. The spread of aggressive invasives should be monitored and controlled to maintain the unique native plant communities that occur along the County's waterways.

The excavation of river gravel downstream from the site could facilitate the spread of invasive species, many of which thrive in areas of high disturbance. Excavation could also directly harm the rare organisms inhabiting this site. To avoid disturbance of the rare species at this site, excavation practices should be moved elsewhere.

The water quality of the Troups Creek wetlands could be improved if forested buffers were created along the creek's floodplain to minimize the amount of agricultural runoff. Improvement of the water quality at this site would help maintain the rare species that occur at this site.

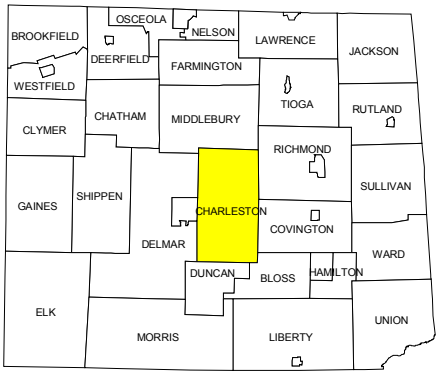
The beaver activity downstream from this site should be monitored so that dramatic changes in the hydrology of the site could be quickly detected and appropriate management implemented. Beaver impoundments have the potential to exclude plants that rely on shallower conditions. If beavers would begin to modify this site dramatically, beaver removal should be considered to protect the rare organisms that occur at this site.

- notes -

CHARLESTON TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
FOSSIL FARM (5)	Brush-tipped Emerald (*Somatochlora walshii*)	G5	S2	N	2005-8-4	E
HILLS CREEK STATE PARK RESERVOIR (5)	marsh bedstraw (*Galium trifidum*)	G5	S2	N	1995-9-19	E
	Broad-winged Skipper (*Poanes viator viator*)	G5T4	S1	N	2004-7-21	E
	lesser panicled sedge (*Carex diandra*)	G5	S2	PT	2006-6-1	BC
	Soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2006-6-1	C
NICKEL RUN HEADWATERS NORTH (4)	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-7	BC
TAUCHER POND (4)	Animal species of concern	G5	S2S3B	N	2005-8-3	E
	Green-striped Darner (*Aeshna verticalis*)	G5	S3S4	N	2005-8-3	E
WHITEHOUSE HOLLOW (4)	Animal species of concern	G5	S3	N	2004-8-25	E
WHITNEYVILLE MEADOW (5)	Torrey's rush (*Juncus torreyi*)	G5	S2	PT	1985-8-22	C

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Babb Creek Headwaters, Charleston School Wetlands

Managed Lands: Hills Creek State Park, State Game Lands #37, Tioga State Forest

Exceptional Value Stream: Nickel Run

Aquatic Classification Project Results:
Cold Water Community—Elk Run, Babb Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Marsh Creek-Charlestown Creek
Green Stonefly / Giant Black Stonefly—Catlin Hollow

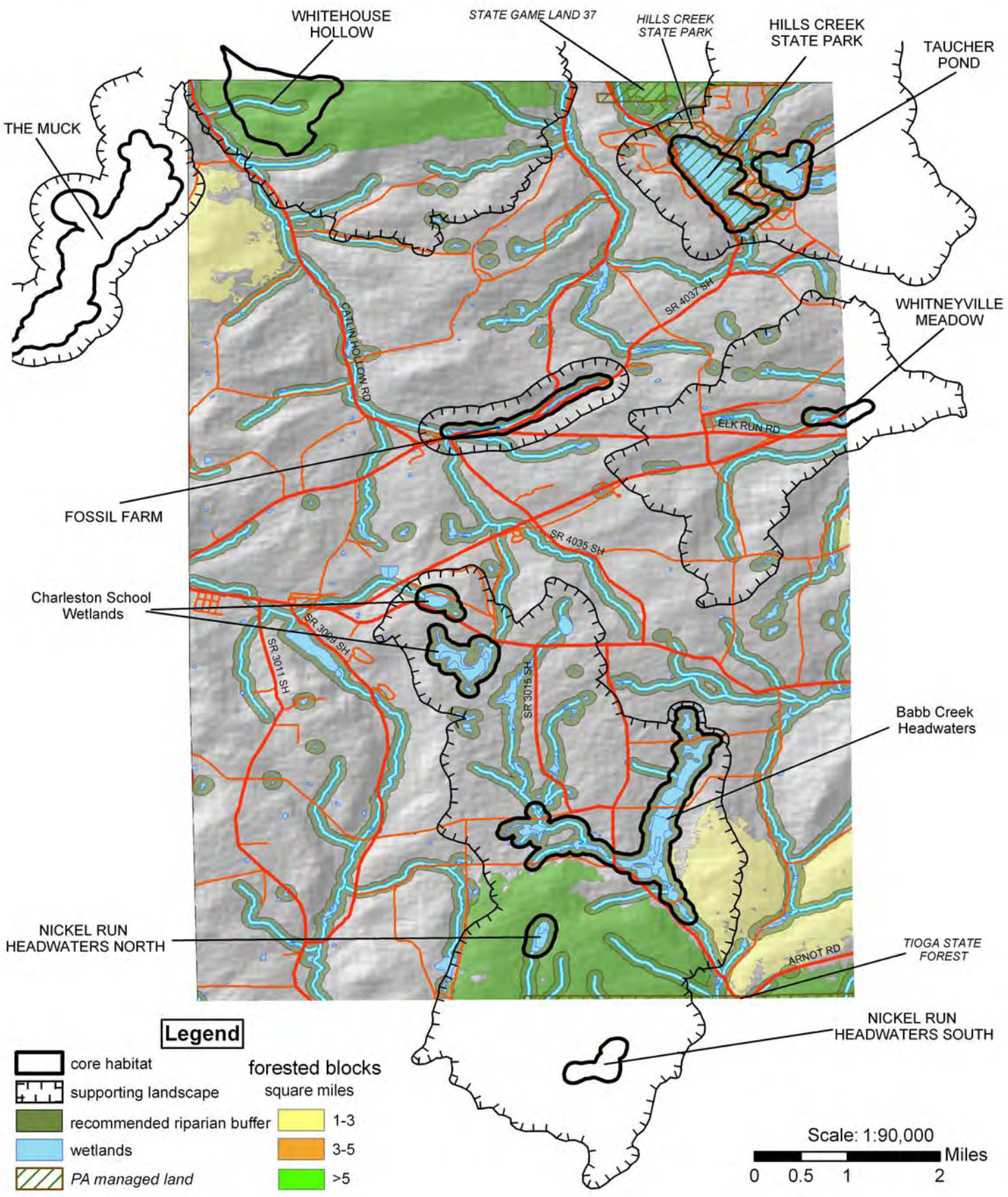
Charleston Township includes portions of three physiographic sections: the Deep Valley Section of the Ridge and Valley in the north, the Glaciated Low Plateau Section of the Appalachian Plateaus in the central area, and the Glaciated High Plateau in the south. The divisions between these provinces define the land use in the township—primarily forested in the Deep Valley and the High Plateau and agricultural in the more fertile Low Plateau. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. The low

plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams, characteristic of the formerly glaciated regions of the state. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

The delta wetland at Hills Creek State Park Reservoir

CharlestonTownship
Tioga County, PA

Pennsylvania Natural Heritage Program



FOSSIL FARM (Charleston Township)

This site lies just east of the village of Charleston along the northern branch of the Catlin Hollow. Here a small steam has been modified by beavers, creating some small open ponds. Throughout the floodplain of this small stream are a variety of wetland plants. These small open water wetlands, the creek, and floodplain provide habitat for many plant and animal species. A **G5 S2 species of special concern, the Brush-tipped Emerald (*Somatochlora walshii*)** was captured at this site in 2005. This species relies upon wetlands for its primary habitat.

Threats and Disturbances

The floodplain at Fossil Farm has been previously modified by beavers. The small pools created by beavers have likely formed some of the habitat used by the rare species at the site; however, beavers have the capacity to drastically alter their environment and further activity could jeopardize the rare organisms that inhabit Fossil Farm. Although the long-term cyclic pattern of beaver activity followed by abandonment of their created habitats can be beneficial, in the short term, beavers can destroy the delicate habitats used by unique wetland species.

Conservation Recommendations:

To date, the beavers that have inhabited this small stream have not severely altered the structure of the habitat. However, there is potential for drastic changes due to beaver activity. For this reason, any major community changes due to beavers should be monitored. If massive changes due to beaver activity begin to occur, beaver populations may need to be controlled to maintain and promote habitat for the rare species located at this site.

HILLS CREEK STATE PARK RESERVOIR (Charleston Township)

The park is dominated by the presence of Hills Creek Lake, an artificial impoundment of approximately 137 acres. Originally a swamp, the site was flooded into a large lake in the 1950s. Today the site is used for recreation including boating, fishing and swimming. The site likely supported a more biologically diverse suite of organisms before the construction of the dam. The upland portion of the park that surrounds the impoundment contains a mixture of natural woodlands, plantations, thickets, fields, lawns, and developed areas.

A portion of the shoreline at northern end of Hills Creek Lake contains a boggy area that extends a short distance into the water and has a delta-like aspect because several rivulets and springs enter the impoundment at this point. Based on the plant species that are present, the rivulets and springs appear to be somewhat calcareous in chemistry, and have produced an interesting mixture of plant species. The vegetation of the area includes shrubs and small trees, as well as many herbaceous species such as sphagnum moss (*Sphagnum* spp.), cattail (*Typha latifolia*), cinnamon fern (*Osmunda cinnamomea*), and marsh fern (*Thelypteris palustris*). Among the plant species that inhabit this area are a **plant species of special concern, the G5 S2 marsh**

the lesser panicled sedge (*Carex diandra*) from Hills Creek State Park Reservoir

bedstraw (*Galium trifidum*), the **G5 S2 threatened lesser panicled sedge (*Carex diandra*)**, and the **G5 S3 PA-rare soft-leaved sedge (*Carex disperma*)**. These wetland plants have northerly distributions in North America, and in Pennsylvania they appear to be most frequent in the northern counties. Surveys of the site in 2004 uncovered a population of **a species of concern, the G5T4 S1 Broad-winged Skipper (*Poanes viator viator*).** Hills Creek State Park has also been designated by the Mammal Technical Committee of the Pennsylvania Biological Survey as an Important Mammal Area (IMA) in the state.

Green-striped Darner

Threats and Disturbances

The boggy area contains a number of exotic plant species that lower the quality of the site, but currently the exotics do not appear to be a major threat to the marsh bedstraw.

Conservation Recommendations

It is recommended that the wooded slope that contains the rivulets and springs be left in a forested condition and that the hydrology of the area be retained in its current form.

NICKEL RUN HEADWATERS NORTH
(Charleston Township)

This wetland is dominated by marsh graminoids, primarily the sedges *Carex utriculata* and *Carex lacustris*. Small patches of Sphagnum moss occur within the wetland with a surrounding forest of eastern hemlock (*Tsuga canadensis*), yellow birch (*Betula alleghaniensis*) red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and eastern white pine (*Pinus strobus*). The wetland has a very open aspect with very few woody species and has a history of beaver activity. A small but healthy population of the **G5 S3 PA-rare plant species, the soft-leaved sedge (*Carex disperma*)** was found in 2005. This species inhabits shaded wetland margins.

Threats and Disturbances

During the recent surveys, no current threats were noted, but there was evidence of past beaver disturbance.

Conservation Recommendations

This site is owned by the borough of Wellsboro and is protected as a watershed. The current management for water quality is suitable for the protection of the rare species occurring at this site.

TAUCHER POND (Charleston Township)

Taucher Pond has a history of hydrologic modification. In the past, humans have altered the site through damming. Currently the beavers present on the site have added to and/or repaired these manmade alterations. The site is markedly different from the adjacent reservoir of Hills Creek State Park. Expansive stands of wetland plants throughout the site attest to the relatively shallow

depth of the wetland. The margins of the wetland support the most variety of wetland plant species.

Several bird species that are specialized to wetland habitats were observed at the site in 2005, including a **G5 S2S3B bird species of concern**. This species requires shallow wetlands that support tall marsh plants in which they build their nests. Nest building usually occurs in cattails (*Typha spp.*) and bulrushes (*Scirpus* spp.). During the same survey in 2005, **a Green-striped Darner (*Aeshna verticalis*), a G5 S3S4 species of concern** was captured at Taucher Pond. This species primarily resides in wetlands.

Threats and Disturbances

Hydrologic alterations have been made by humans in the past and the site is currently inhabited by beavers. The agricultural practices and residences adjacent to the wetland could be resulting in nutrient influx. An unpaved road comes within a few meters of the wetland which may be causing silt inputs to the wetland. Additionally, exotic shrubs are found in the margins of the wetland. There is also a lack of a vegetated buffer around the east side of the wetland which could be encouraging the above noted threats.

Conservation Recommendations

Hydrologic conditions should be maintained to promote the shallower waters that support marsh plants. Beaver activity could severely impact the habitat by increasing water depth so that the marsh plants are excluded. Beavers should be monitored and removed if they would begin to drastically alter the wetland.

Surrounding shrubs include some exotics, which should be controlled to maintain the native plant communities surrounding the wetland. Viburnum leaf miner has severely defoliated the surrounding *Viburnum* sp. and could possibly exclude this native shrub from the wetland margins. Unfortunately, many of the other shrubs surrounding the wetland are exotic species, including multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), and Russian olive (*Elaeagnus umbellata*). Potentially these exotics could displace the Viburnums in their depressed condition due to leaf miner infestation. While no invasive exotic marsh plants were found at this site (i.e. purple loosestrife *Lythrum salicaria* and common reed *Phragmites australis*), these plants do occur in other portions of the county and could potentially show up at Taucher Pond. A watchful eye should be kept open for the potential arrival of these exotics so that management could take place before the invasives overwhelm the marsh.

A gravel road and some agriculture lie directly to the east of the wetland. A vegetated buffer of native plants should be put in place to reduce the amount of nutrient and sediment influx from these sources into the wetland.

WHITEHOUSE HOLLOW (Charleston and Middlebury Townships)

The site at Whitehouse Hollow is a southwest facing hillside that abruptly rises 900 feet from the base of the valley. The slope has large hardwoods and softwoods in the overstory with notable regeneration occurring. A small stream meanders down the slope to the floor of the ravine. While this site is interesting vegetatively, in 2004 a population of a **G5 S3 species of concern** was found at Whitehouse Hollow.

Threats and Disturbances

The species of concern at this site generally utilizes moist locations within overall dry sites. Habitats for this species may often include nearby streams housed within dry, rocky forests and woodlands. Because these organisms may use open, sunny areas to bask, forestry practices could potentially provide basking locations for the species. However, the cutting and removing of timber could increase the solar exposure and dry up the microhabitats preferred by these organisms.

Conservation Recommendations

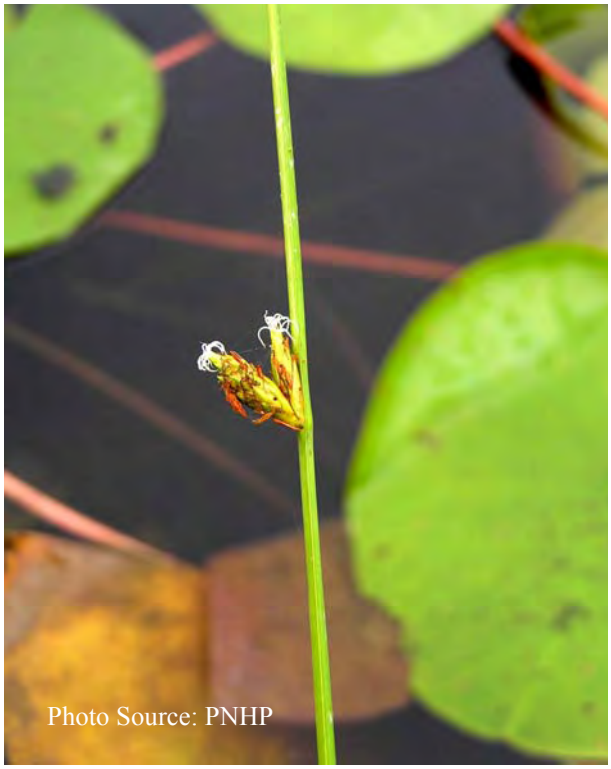
Forestry practices should be avoided at Whitehouse Hollow to maintain the habitat and avoid disrupting the rare species that occur at this site.

WHITNEYVILLE MEADOW (Charleston and Richmond Townships)

This site is a wet meadow along a small stream. At the time of the survey, the site was used as a cow pasture. A population of the **G5 S2 threatened species, Torrey's rush (*Juncus torreyi*)** was found within the pasture.

Threats and Disturbances

The Torrey's rush population is in danger of being trampled because the habitat is actively being used by livestock. There is also much manure runoff that will affect the makeup of the wetland.



Torry's bulrush (*Shoenoplectus torreyi*)

Conservation Recommendations

Fencing should be erected to keep the livestock in this pasture from trampling this population of Torrey's rush. There should also be a vegetated buffer established around the wetland to minimize the negative effects of the manure runoff. Beaver activity has been documented in the surrounding area and any beaver activity in the vicinity of the wetland should be monitored. If the Torrey's rush population is threatened by flooding due to beavers, a trapping regimen should be employed to sustain the hydrologic conditions of Whitneyville Meadow.

Locally Significant Sites:

Babb Creek Headwaters (Charleston Township)

This series of wetlands contains some open water habitat, wet meadow marshy areas, meandering streams, and clusters of forested wetlands. This concentration of wetlands may hold biological significance and future surveys should be conducted at this site.

Threats and Disturbances

This site is surrounded by high concentrations of agricultural land. It is likely that runoff from these fields is affecting the wetlands by creating unnaturally high amounts of nutrients as well as leading to siltation from erosion. Beavers could flood the plant communities surrounding this wetland complex and damage the integrity of the system.

Conservation Recommendations

Forested buffers should be established around this site to improve the water quality and reduce the amount of erosion that is influencing these wetlands. If beavers begin to dam the meandering stream at this site, a trapping regimen should be employed to maintain the biological quality of this site.

Charleston School Wetlands (Charleston Township)

This group of wetlands includes forested wetlands and open graminoid meadows. This concentration of wetlands may hold biological significance and future surveys should be conducted at this site.

Threats and Disturbances

This site is surrounded by high concentrations of agricultural land. It is likely that runoff from these fields is affecting the wetlands by creating unnaturally high amounts of nutrients as well as leading to siltation from erosion.

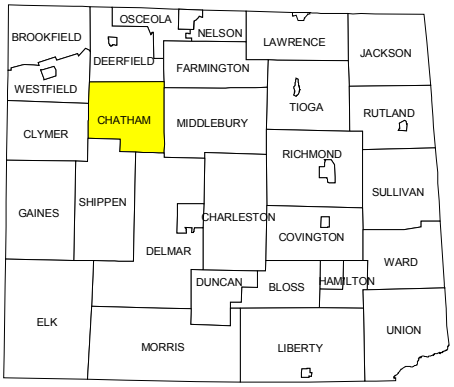
Conservation Recommendations

Forested buffers should be established around this site to improve the water quality and reduce the amount of erosion that is influencing these wetlands.

CHATHAM TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CANADA RUN BOG (2)	few-seeded sedge (*Carex oligosperma*)	G5	S2	PT	1993-6-21	A
	Acidic Glacial Peatland Complex	GNR	SNR	N	2005-9-16	E
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	1987-7-6	A
	northeastern bulrush (*Scirpus ancistrochaetus*)	G3	S3	PE	2002-6-27	B

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Crooked Creek Headwaters

Managed Lands: Tioga State Forest

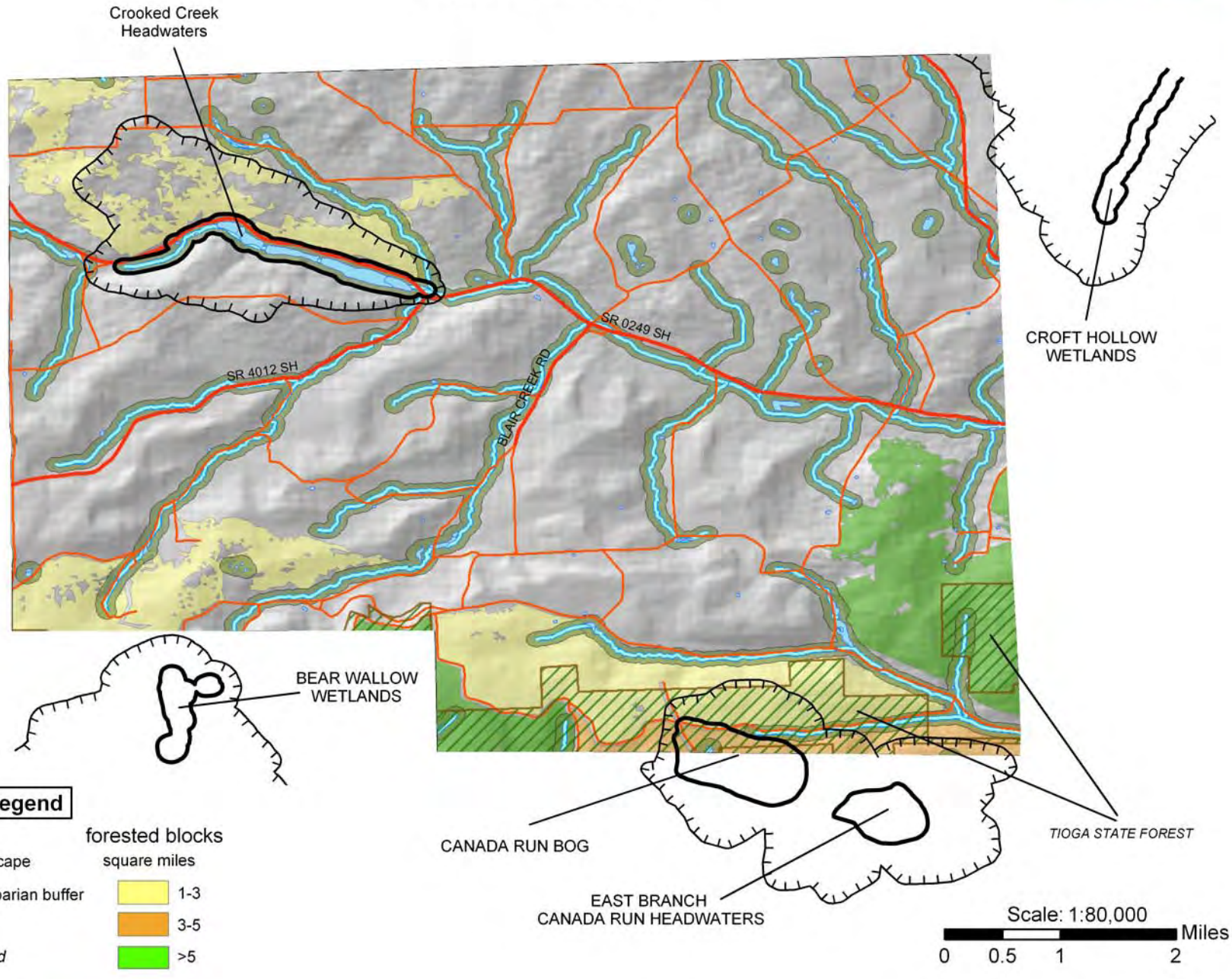
Aquatic Classification Project Results:
Warm Water Community 1—Crooked Creek-Catlin Hollow
Cool Water Community 1—Jemison Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Crooked Creek-Catlin Hollow
Green Stonefly / Giant Black Stonefly—Catlin Hollow

Chatham Township is primarily within the Glaciated High Plateau Section of the Appalachian Plateaus but includes the boundary to the Deep Valley Section of the Ridge and Valley geographic province along the southern portion of the township. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The township is primarily drained by Crooked Creek and its tributaries through a heavily used landscape of agriculture and scattered woodlots. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, in particular along the path of Crooked Creek and its tributaries. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

CHATHAM TOWNSHIP MAP

Chatham Township
Tioga County, PA

Pennsylvania Natural Heritage Program



CANADA RUN BOG (Chatham and Delmar Townships)

Canada Run Bog is a high elevation **Acidic Glacial Peatland Complex, a GNR SNR tracked community** at the headwaters of Canada Run. Surrounding the bog is a northern hardwood forest with a wooded swamp along the southwestern and western side. The northern half of the bog is a scrub/shrub bog while the southern half is an open sedge mat bog. A rather robust population of the **G5 S2 state threatened few-seeded sedge (*Carex oligosperma*)** covers much of the open portion of the bog. Additionally, the **northeastern bulrush (*Scirpus ancistrochaetus*), a G3 S3 federally endangered plant** can be found at the site. The site also houses a population of the **G5 S3 PA-rare plant, the soft-leaved sedge (*Carex disperma*)**. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area.

Threats and Disturbances

A pipeline was constructed in 1986, bisecting the bog. The maintenance of this pipeline right-of-way is disturbing the habitat at Canada Run Bog and future right-of-way maintenance must be conducted with care.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the bog to preserve the habitats for the rare species at this site. Maintenance crews should be informed of the rare species that are within Canada Run Bog so that unnecessary disturbance of the habitat due to mowing is avoided. Additionally, the use of herbicides in the right-of-way surrounding the bog should be prohibited.

Locally Significant Site:

Crooked Creek Headwaters (Chatham Township)

This site contains some open water habitat and shallow water marshes dominated by cattail (*Typha latifolia*). The shallow marshlands at this site are of particular interest because these areas appear to be suitable habitat for a variety of bird species. Future surveys should be conducted at this site to determine if the wetland system indeed supports marsh birds.

Threats and Disturbances

This site is surrounded by steep forested hills. Atop of these hills are high concentrations of agricultural land. It is likely that runoff from these fields is affecting the wetlands by creating unnaturally high amounts of nutrients as well as leading to siltation from erosion. Beavers could flood the marsh plants in this wetland complex and exclude the unique bird habitat at this site.

Conservation Recommendations

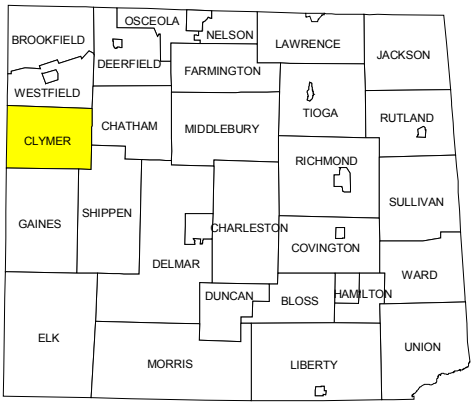
Forested buffers should be established around this site to improve the water quality and reduce the amount of erosion that is influencing these wetlands. If beavers begin to dam the meandering stream at this site, a trapping regimen should be employed to maintain the biological quality of this site.

few-seeded sedge (*Carex oligosperma*)

CLYMER TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
BLACK ASH SWAMP (5)	Graminoid Marsh	GNR	S3	N	1985-8-21	D
	Baltimore Checkerspot (*Euphydryas phaeton*)	G4	S2S4	N	2005-7-7	E
MIDDLE RIDGE VERNALS (5)	few-seeded sedge (*Carex oligosperma*)	G5	S2	PT	1993-6-24	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

Managed Lands: Tioga State Forest – Asaph Wild Area, Tioga State Forest – Black Ash Swamp Natural Area, Tioga State Forest, State Game Lands #64/208

High Quality Cold Water Fishery: Jemison Creek Source toT-559 Bridge at Azelta, Baker Branch

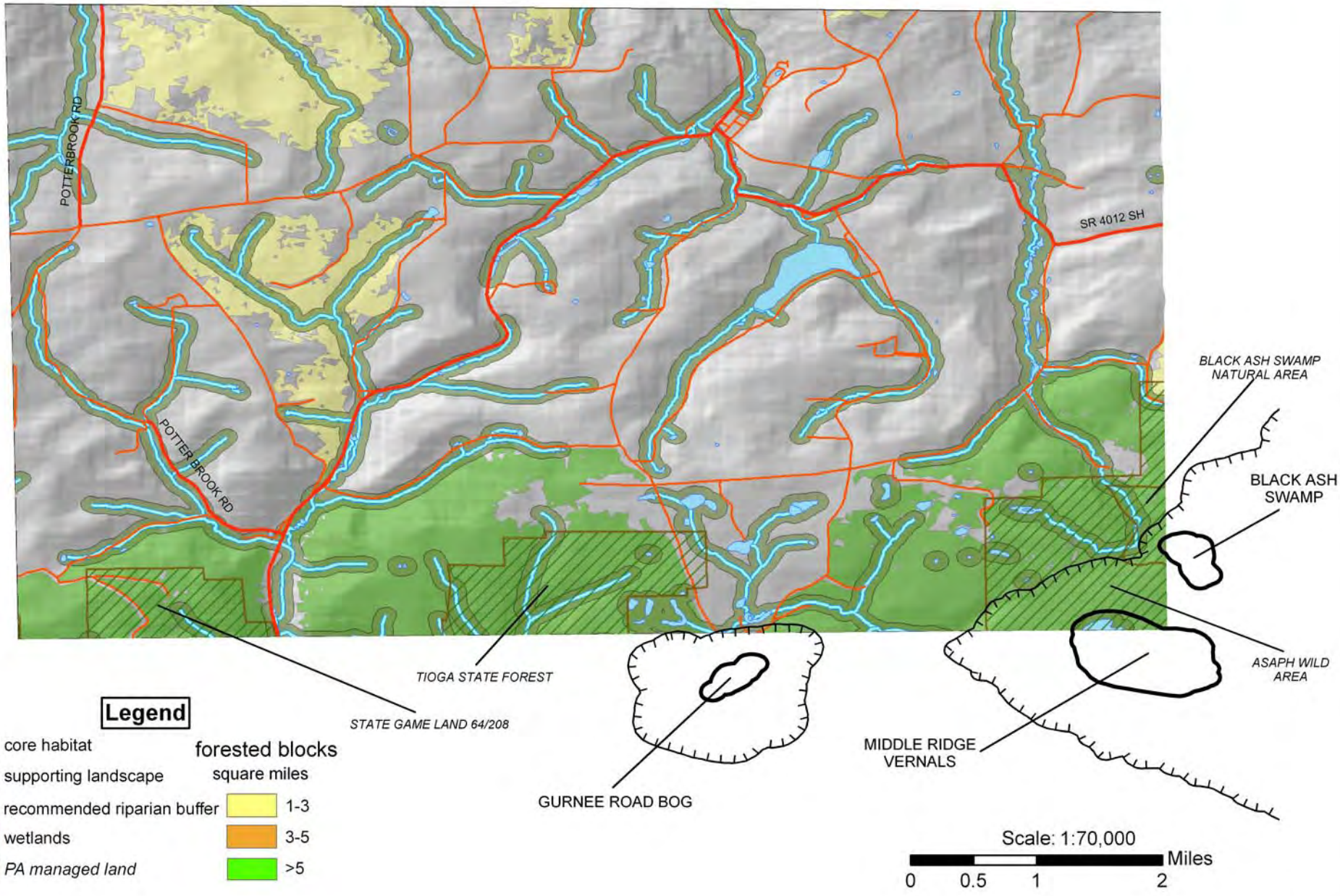
Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River, Mill Creek, Long Run
Cool Water Community 1—Jemison Creek
Cold Water Community—Asaph Run
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River, Mill Creek

Clymer Township is primarily within the Glaciated High Plateau Section of the Appalachian Plateaus but includes the boundary to the Deep Valley Section of the Ridge and Valley geographic province along the southern portion of the township. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by State Game Lands #208 and the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, in particular along the path of Long Run and its tributaries. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

CLYMER TOWNSHIP MAP

Clymer Township
Tioga County, PA

Pennsylvania Natural Heritage Program



BLACK ASH SWAMP (Clymer and Shippen Townships)

Black Ash Swamp is a 25-30 acre, high elevation marsh dominated by cutgrass (*Leersia oryzoides*) and woolgrass (*Scirpus cyperinus*) with a mixture of cattail (*Typha latifolia*) and sedges (*Carex* spp.). This site is a graminoid marsh, the result of previous beaver activity as evidenced by numerous dead trees and the remnants of a beaver dam. **Graminoid marshes are a tracked community in Pennsylvania and are ranked GNR S3**. Surveys in 2005 located a **population of Baltimore Checkerspot (*Euphydryas phaeton*), a G4 S2S4 species of concern**. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area.

Threats and Disturbances

Beavers have previously modified this site.

Conservation Recommendations

This site occurs on Tioga State Forest property and is part of the Black Ash Swamp Natural Area. No management is necessary as the site is already protected, but spraying for gypsy moth control should steer clear of the area around Black Ash Swamp to avoid harming the Baltimore Checkerspot population at this site.

MIDDLE RIDGE VERNALS (Clymer and Shippen Townships)

These fluctuating wetlands sit high atop the ridge and are dependent on rainfall for their sole source of water input. There is a dense shrub layer of highbush blueberry (*Vaccinium corymbosum*), mountain holly (*Nemopanthus mucronatus*), and leatherleaf (*Chamaedaphne calyculata*). A forest of tall trees, including eastern white pine (*Pinus strobus*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), and yellow birch (*Betula alleghaniensis*) surrounds the wetlands. During a 1993 survey of the site, a population of the **G5 S2 threatened plant species, the few-seeded sedge (*Carex oligosperma*),** was located at this site. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area.

Threats and Disturbances

This site is within the Black Ash Swamp Natural Area. No apparent threats were noted during a recent site visit.

Conservation Recommendations

The Middle Ridge Vernals are within the Black Ash Swamp Natural Area. The current protection of the forest is sufficient for the protection of the wetlands at this site.

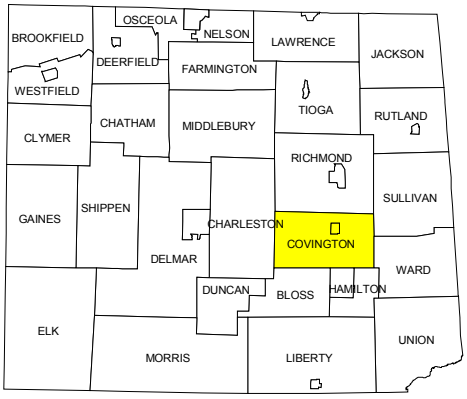
Baltimore Checkerspot (*Euphydryas phaeton*)

- notes -

COVINGTON TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
SAND RUN HEADWATERS (5)	Amber-winged Spreadwing (*Lestes eurinus*)	G4	S3	N	2005-6-29	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks



Locally Significant: East Creek Headwaters

Managed Lands: Tioga State Forest

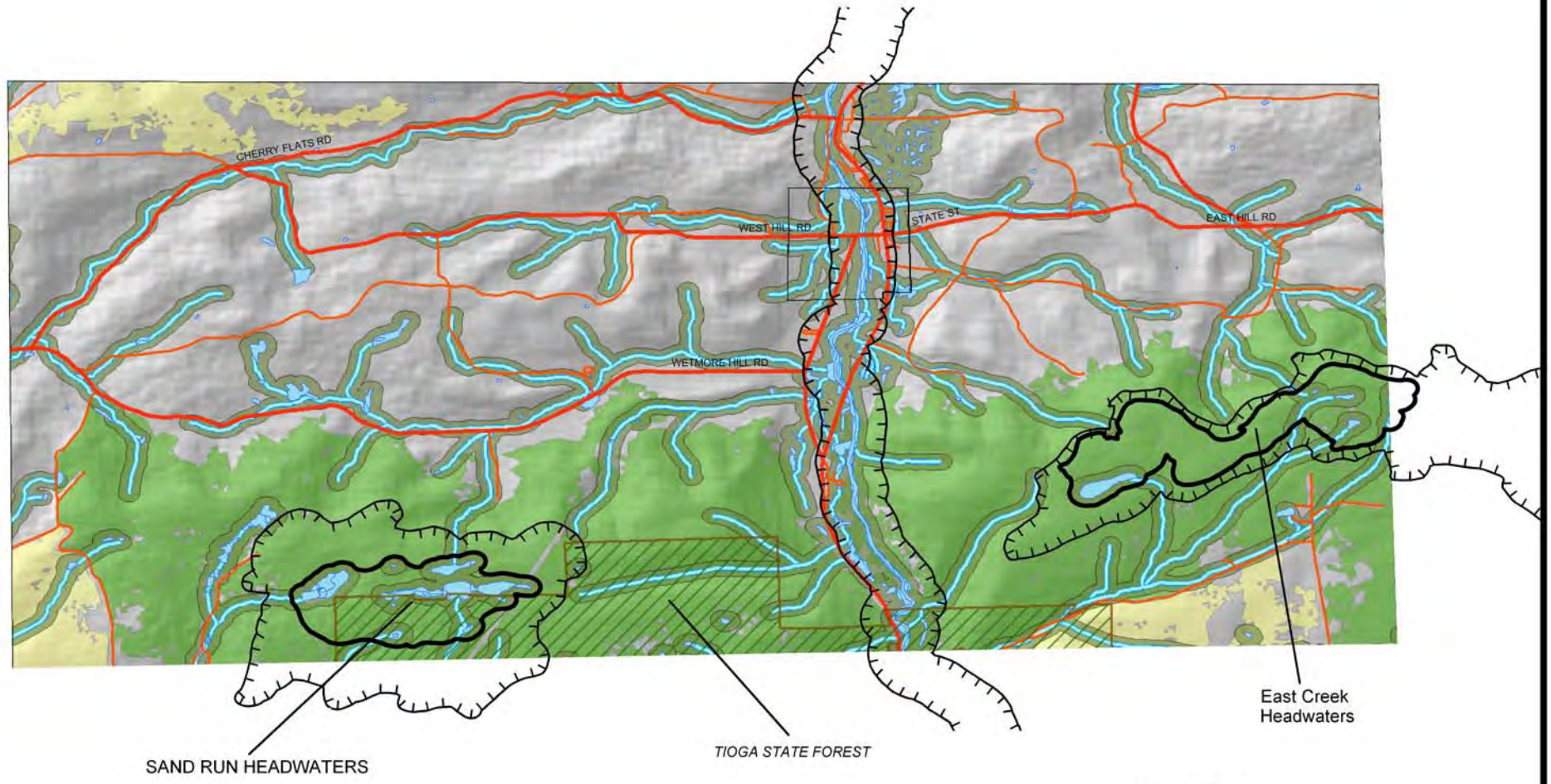
Aquatic Classification Project Results:
Cool Water Community 1—Tioga River-Corey Creek
Cold Water Community—Elk Run, Babb Creek-Long Creek;
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Corey Creek, Canoe Camp Creek

Covington Township includes portions of two physiographic sections: the Glaciated Low Plateau Section of the Appalachian Plateaus in the northern portions, and the Glaciated High Plateau in the south. The divisions between these provinces define the land use in the township—primarily forested in the High Plateau and agricultural in the more fertile Low Plateau. The High Plateau portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The Low Plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams. The township is bisected by the Tioga River and Route 15 running from south to north. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, and exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

COVINGTON TOWNSHIP MAP

Covington Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

Scale: 1:80,000

0 0.5 1 2 Miles

SAND RUN HEADWATERS (Covington Township)

Sand Run Headwaters are part of a large complex of wetlands surrounding the town of Arnot. This site was formerly inhabited by beavers. Now drained, the site is now an open meadow surrounded by Tioga State Forest Land. In 2005, **an Amber-winged Spreadwing (*Lestes eurinus*), a G4 S3 species of concern** was captured at the site.

Photo Source: PNHP

Sand Run Headwaters

Threats and Disturbances

The site appeared to be stable during the 2005 survey, however there is potential for disturbance at this site. Because Sand Run Headwaters are part of the Tioga State Forest, the area surrounding the site could be slated for forestry practices in the future. Additionally, hydrologic changes such as flooding by beavers could alter the site and disturb the rare species found here.

Conservation Recommendations

In order to maintain the habitat for the rare species at Sand Run Headwaters, a no-cut 100 meter forested buffer should be established surrounding the wetland. Additionally, if beavers were to recolonize the site, the habitat could be altered to a degree that would compromise the rare species located at the site. Beaver activity should be monitored and if dramatic changes to the habitat begin, the removal of the beavers is recommended.

Locally Significant Sites:

East Creek Headwaters (Covington and Ward Townships)

This cluster of high altitude wetlands sits atop of Pine Hill and feeds East Creek. This site contains a mixture of wetlands, some are forested while others include some open water with sections of shrubs and open marshy areas. This site may hold biological significance for Tioga County. Future surveys should be conducted at this site.

Threats and Disturbances

This site is surrounded by forested land and the forest surrounding this site may be marked for future timbering practices.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the integrity of this site.

Photo Souce: Rick Koval

the Amber-winged Spreadwing (*Lestes eurinus*)

- notes -

DEERFIELD TOWNSHIP **and Knoxville Borough**

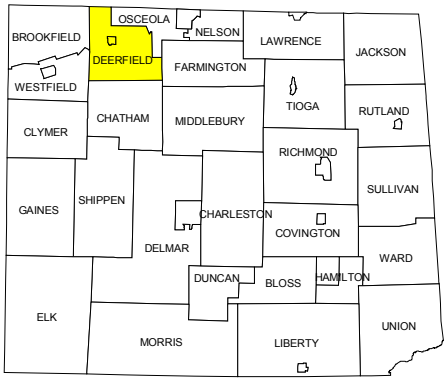
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
COWANESQUE RIVER (5)	Animal species of concern	G5	S2B	PT	2000	E
KNOXVILLE SLOPES (5)	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2005-9-15	E
TROUPS CREEK GRAVEL BARS AND OXBOWS (3)	broad-leaved water-plantain (*Alisma triviale*)	G5	S1	PE	2005-8-25	E
	backward sedge (*Carex retrorsa*)	G5	S1	PE	2005-8-25	E
	stalked bulrush (*Scirpus pedicellatus*)	G4	S1	PT	2005-8-25	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River-Troups Creek, Camp Brook, Crooked Creek-Catlin Hollow
Cool Water Community 1—Jemison Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River-Camp Brook, Crooked Creek-Catlin Hollow

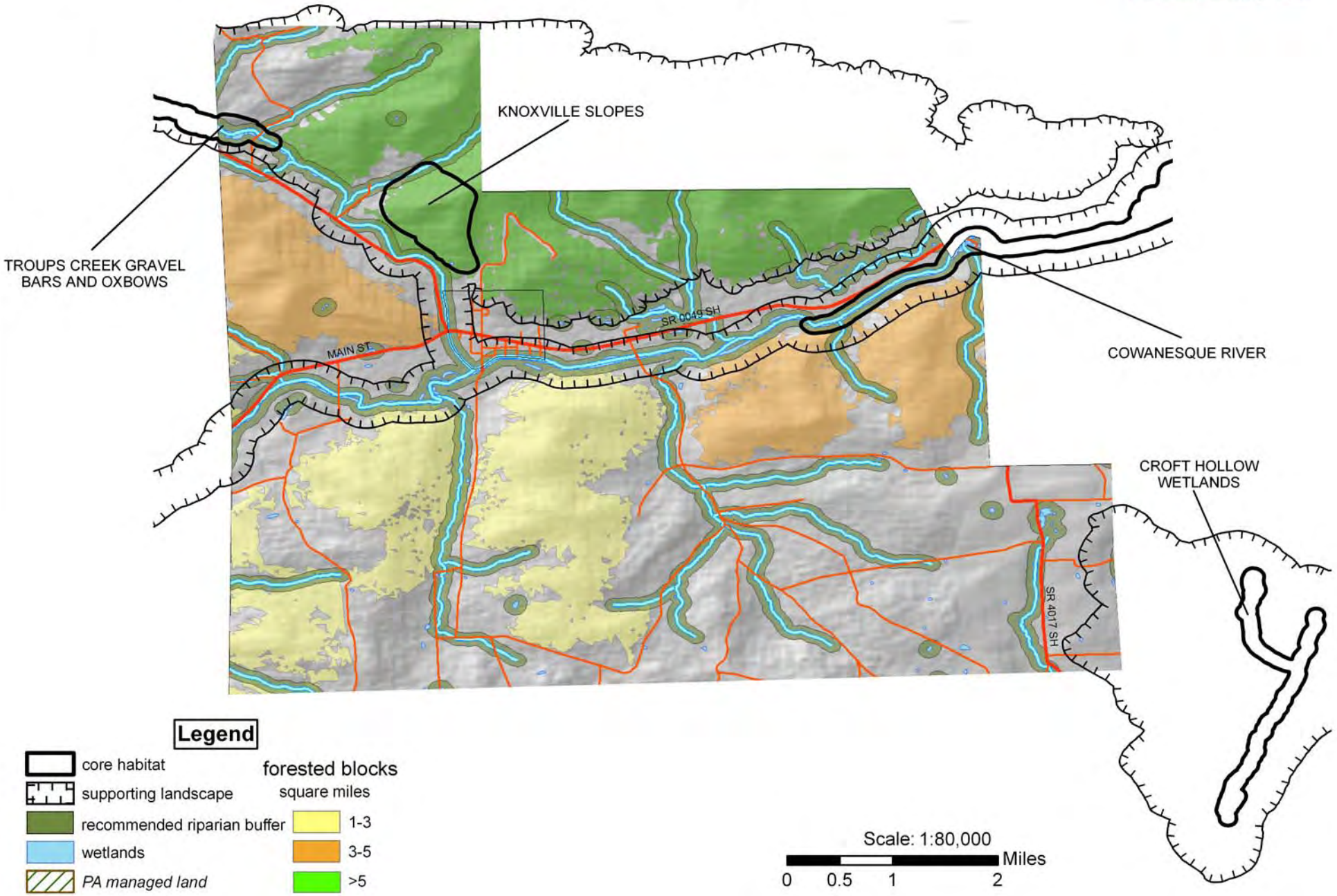


Deerfield Township is divided by the Cowanesque River and is of mixed land uses, including agriculture and forestry. The entire township lies within the Glaciated High Plateau of the Appalachian Plateaus geographic province. Several tributaries to the Cowanesque River have their headwaters within the valleys of Deerfield Township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Several large forested blocks follow the topography of the drainages towards the river and provide riparian buffers for some of the smaller tributary streams. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Protection of these forest blocks will help to protect the water quality of the many headwater streams originating within them. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. A large forest block in the northeast corner of the township should be protected to maintain connectivity with forested areas in neighboring townships and New York State.

DEERFIELD TOWNSHIP MAP

Deerfield Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

Scale: 1:80,000

0 0.5 1 2 Miles

COWANESQUE RIVER (Deerfield, Osceola and Nelson Townships)

The Cowanesque River supports breeding pairs of **a G5, S2B Pennsylvania threatened species**. This species requires healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This species exhibits strong nest fidelity.

Threats and Disturbances

No threats are presently known.

Conservation Recommendations

The tall trees along the Cowanesque River should be left intact to maintain nesting sites for these rare birds.

KNOXVILLE SLOPES (Deerfield Township)

From the base of the slopes at Troups Creek, a nearly one thousand foot rise in less than half a mile is the gateway to a large contiguous forested block known as Knoxville Slopes. With its dark ravines and dry slopes, the site supports a variety of plant communities. During a survey of site in 2005, a population of the **G5 S3 species of concern, slender wheatgrass (*Elymus trachycaulus*)** was found on one of the steep dry slopes.

Threats and Disturbances

During the 2005 site survey, active logging operations were being conducted at the site. Road creation or improvements had occurred and created a significant split of the continuous forested habitat. Disturbed road cuts provide corridors for the spread of invasive exotic plant species. Several of these plant species were noted along the recent road cuts.

Conservation Recommendations

One of the unique features of the Knoxville Slopes site are the dry rocky inclines that support specially adapted plant communities. For this reason, forestry practices should be avoided on the slopes at this site. Additionally, to prevent the spread of exotic invasive species and to foster species that require large contiguous forests such as some of the forest interior birds, the continuity of Knoxville slopes should be sustained.

TROUPS CREEK GRAVEL BARS AND OXBOWS (Brookfield and Deerfield Townships)

This site is a mosaic of different habitats all found within close proximity to one another. The creek channel has abundant gravel beds which support and array of species, most of which tolerate a high degree of disturbance due to the periodic flooding of the habitat. The creek's floodplain is forested in parts with sycamore (*Platanus occidentalis*) and cottonwood (*Populus deltoides*).

Adjacent to the creek channel is a steep bank with several seeps that drain into the creek. The bank is readily eroding, providing habitat for early successional plants. As the channel of the creek has changed over time, previous channels have been cut off from the main channel of Troups Creek. This action has created oxbow wetlands which are small wetlands adjacent to the main creek channel that are no longer tied to the flow of the creek. These wetlands can be suitable for an interesting collection of organisms because of the still water conditions and less frequent disturbance of floods.

A 2005 survey of this site revealed a population of a **G5 S1 Pennsylvania endangered broad-leaved water-plantain (*Alisma triviale*)**, a population of the **G5 S1 state endangered backward sedge (*Carex retrorsa*)**, and the **Pennsylvania threatened G4 S1 stalked bulrush (*Scirpus pedicellatus*)**.

Threats and Disturbances

This site is under considerable threat due to invasive plant species. Several were noted during the most recent site visit and although Japanese knotweed (*Polygonum cuspidatum*) was not found at this site in 2005, this particularly aggressive species can be found nearby and will likely show up at this site in the near future. This species tends to exclude small herbaceous vegetation and would be a threat to all of the rare species found at this site.

Just downstream from this site, gravel excavation was observed during the 2005 surveys. This disturbance caused by the excavation could speed the spread of colonizing invasive exotics.

Large sections of the floodplain of Troups Creek are used as pasture land for livestock and agricultural land. The runoff from pasture lands and agricultural lands degrade the water quality of the wetlands in the vicinity. Also, beaver activity has been observed just downstream from this site.

Conservation Recommendations

Invasive exotic species are proving to stress Pennsylvania's native flora and fauna. Certain sites are considered to be more susceptible to exotic plant invasions because of their degree of connectedness to other sites. Frequent disturbance, via floods, can set back succession and enable periodic flushing and recolonization of plants. Therefore, waterways can serve as vectors for the spread of invasive plants. As a result, the floodplains associated with the County's waterways may serve as corridors for these invasions and are therefore under a heightened threat from exotic species. The spread of aggressive invasives should be monitored and controlled to maintain the unique native plant communities that occur along the County's waterways.

Troups Creek

The excavation of river gravel downstream from the site could facilitate the spread of invasive species, many of which thrive in areas of high disturbance. Excavation could also directly harm the rare organisms inhabiting this site. To avoid disturbance of the rare species at this site, excavation practices should be moved elsewhere.

The water quality of the Troups Creek wetlands could be improved if buffers were created along the creek's floodplain to minimize the amount of agricultural runoff. Improvement of the water quality at this site would help maintain the rare species that occur at this site.

Oxbow wetland at Troups Creek

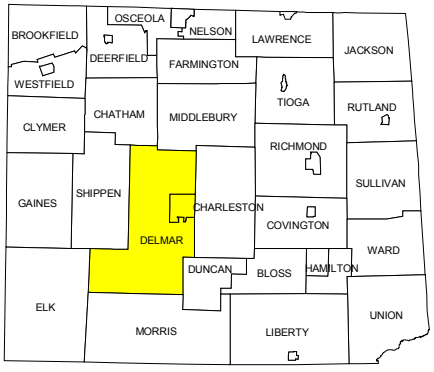
The beaver activity downstream from this site should be monitored so that dramatic changes in the hydrology of the site could be quickly detected and appropriate management implemented. Beaver impoundments have the potential to exclude plants that rely on shallower conditions. If beavers would begin to modify this site dramatically, beaver removal should be considered to protect the rare organisms that occur at this site.

DELMAR TOWNSHIP and Wellsboro Borough

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CANADA RUN BOG (2)	few-seeded sedge (*Carex oligosperma*)	G5	S2	PT	1993-6-21	A
	Acidic Glacial Peatland Complex	GNR	SNR	N	2005-9-16	E
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	1987-7-6	A
	northeastern bulrush (*Scirpus ancistrochaetus*)	G3	S3	PE	2002-6-27	B
EAST BRANCH CANADA RUN HEADWATERS (5)	Hemlock Palustrine Forest	GNR	S3	N	2005-6-29	E
MARSH CREEK FLOODPLAIN (2)	Animal species of concern	G5	S2S3B	N	2005-6-30	E
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Northern Bluet (*Enallagma annexum*)	G5	S3	N	2005-6-30	E
MIDDLE RIDGE SWAMP (4)	marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-8-18	BC
PINE CREEK GORGE (1)	Elktoe (*Alasmidonta marginata*)	G4	S4	N	1997	AB
	Brook Floater (*Alasmidonta varicosa*)	G3	S2	N	1997	AB
	Green Floater (*Lasmigona subviridis*)	G3	S2	N	1997	AB
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Earwig Scorpionfly (*Merope tuber*)	G3G5	SU	N	2000-8-3	C
	Sprengel's sedge (*Carex sprengelii*)	G5	S3	N	2005-5-17	C
	wild-pea (*Lathyrus ochroleucus*)	G4G5	S1	PT	2005-5-16	BC
	roundleaf serviceberry (*Amelanchier sanguinea*)	G5	S1	TU	2005-5-16	C
	Red-head Pondweed (*Potamogeton richardsonii*)	G5	S3	PT	2000-9-29	D
	Canada buffalo-berry (*Shepherdia canadensis*)	G5	S1	PE	2001-8-28	CD

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
PINE CREEK GORGE (1)	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2000-8-4	B
	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2001-5-15	C
	common juniper (*Juniperus communis*)	G5	S2	N	2001-10-3	C
	ebony sedge (*Carex eburnea*)	G5	S1	PE	2001-10-3	BC
	Allegheny Woodrat (*Neotoma magister*)	G3G4	S3	PT	1999-5-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
	Animal species of concern	G5	S2S3B,S3N	N	1988	E
	Erosional Remnant	GNR	SNR	N	1979	E
RATTLER MINE ROAD WETLANDS (5)	Ski-tailed Emerald (*Somatochlora elongata*)	G5	S2	N	1991-7-31	E
	Incurvate Emerald (*Somatochlora incurvata*)	G4	S1	N	1993-7-23	B
STONY FORK SLOPE (5)	Bebb's sedge (*Carex bebbii*)	G5	S1	PE	2004-6-29	E
THE MUCK (2)	Mixed Graminoid-Robust Emergent Marsh	GNR	S2S3	N	1985-8-22	C
	Animal species of concern	G5	S3S4B,S4N	N	2002	E
	Animal species of concern	G5	S2S3B	N	2005	E
	Animal species of concern	G5	S3B	N	2005-5-22	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

Managed Lands: Tioga State Forest, Pine Creek Gorge Natural Area, State Game Lands #268, State Game Lands #313

High Quality Cold Water Fishery: Canada Run, Baldwin Run, Horse Run, Pine Creek, Campbells Run, Stowell Run

Exceptional Value Stream: Pine Island Run

Aquatic Classification Project Results:
Warm Water Community 1—Stony Fork, East Branch Stony Fork
Cool Water Community 1—Marsh Creek, Wilson Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Marsh Creek-Charlestown Creek
Riffle Beetle / Water Penny Community—Marsh Creek
Eastern Elliptio Community—Pine Creek-Cedar Run, Marsh Creek

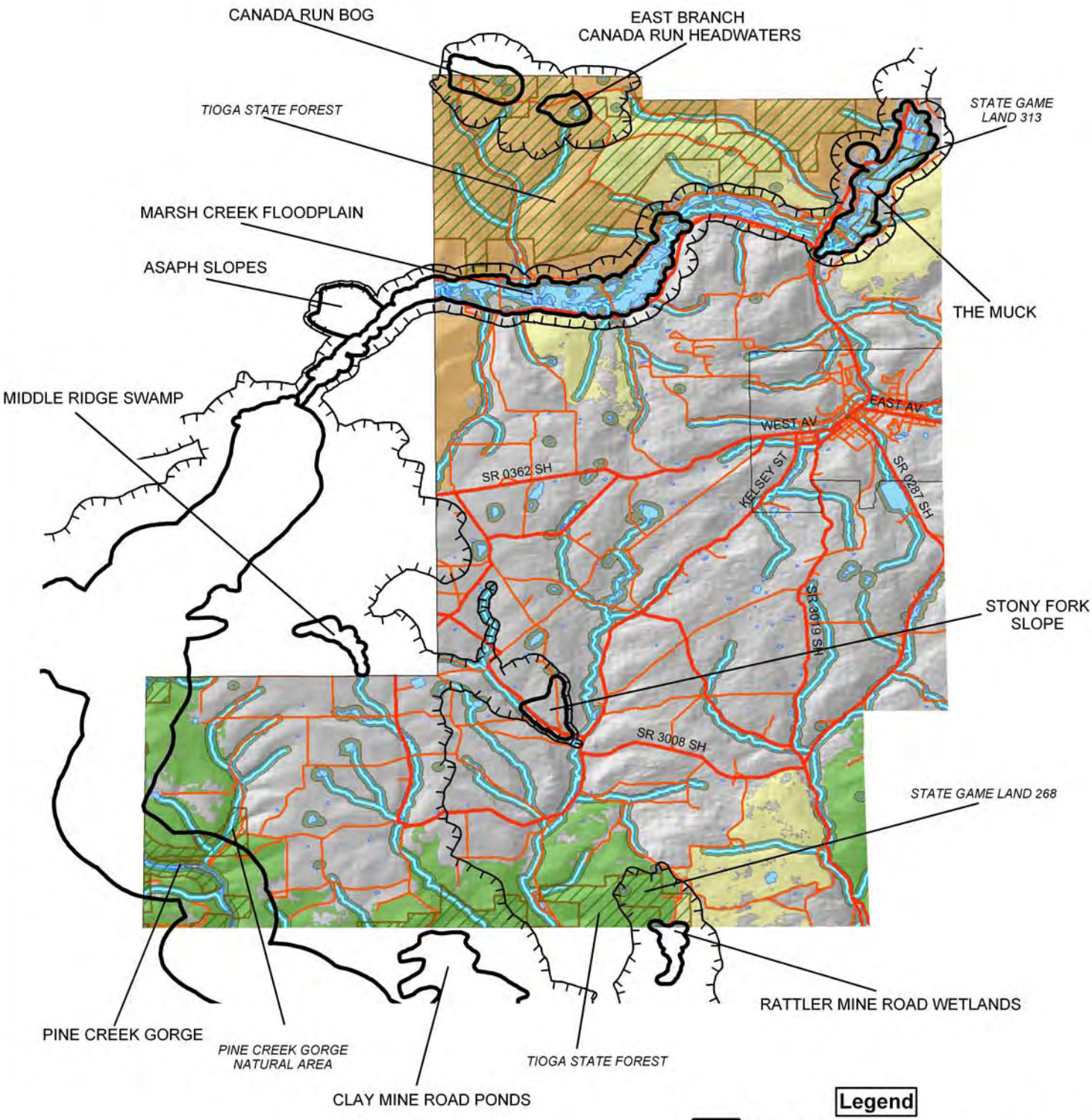
Delmar Township is divided by the boundary of the Glaciated Low Plateau Section of the Appalachian Plateaus and the Deep Valley Section of the Ridge and Valley geographic province to the north and south. The divisions between these provinces define the land use in the township—primarily forested in the Deep Valley and agricultural in the more fertile Plateau. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The Low Plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Photo Source: PNHP

northeastern bulrush (*Scirpus ancistrochaetus*)

Delmar Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Scale: 1:140,000

0 1 2 4 Miles

CANADA RUN BOG (Chatham and Delmar Townships)

Canada Run Bog is a high elevation **Acidic Glacial Peatland Complex, a GNR SNR tracked community** at the headwaters of Canada Run. Surrounding the bog is a northern hardwood forest with a wooded swamp along the southwestern and western side. The northern half of the bog is a scrub/shrub bog while the southern half is an open sedge mat bog. A rather robust population of the **G5 S2 state threatened few-seeded sedge (*Carex oligosperma*)** covers much of the open portion of the bog. Additionally, the **northeastern bulrush (*Scirpus ancistrochaetus*), a G3 S3 federally endangered plant** can be found at the site. The site also houses a population of the **G5 S3 PA-rare plant, the soft-leaved sedge (*Carex disperma*)**. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

A pipeline was constructed in 1986, bisecting the bog. The maintenance of this pipeline right-of-way is disturbing the habitat at Canada Run Bog and future right-of-way maintenance must be conducted with care.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the bog to preserve the habitats for the rare species at this site. Maintenance crews should be informed of the rare species that are within Canada Run Bog so that unnecessary disturbance of the habitat due to mowing is avoided. Additionally, the use of herbicides in the right-of-way surrounding the bog should be prohibited.

EAST BRANCH CANADA RUN HEADWATERS (Delmar Township)

This site is a relatively small **Hemlock Palustrine Forest, a GNR S3 tracked community** in the state. The site has an open eastern hemlock (*Tsuga canadensis*), eastern white pine (*Pinus strobus*), Sphagnum palustrine area with a dense cinnamon fern (*Osmunda cinnamomea*) understory. The swamp is surrounded by ridgetop mixed oak with mountian laurel (*Kalmia latifolia*) and some eastern white pine. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

This site lies on Tioga State Forest land and could be slated for future logging operations. Additionally, hydrology changes by beaver could be disasterous to the makeup of this natural community. The road to north of the site may heighten the threat of spreading invasive plants because several small rivulets drain away from the road and into this site. It is likely that invasives could spread into this site by way of these small drainages.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around this site to preserve the integrity of this natural community. If beavers colonize the area, their removal is recommended. The site should also be monitored so that any invasive plant introductions can be tackled before they become established.

MARSH CREEK FLOODPLAIN (Shippen and Delmar Townships)

This site is an expansive but rather narrow stretch of cattail (*Typha latifolia*) dominated marsh that stretches along Marsh Creek in an agricultural and rural housing setting. An old railroad bed trail is adjacent to the marsh (Norman 1994). A survey of the floodplain in 2005 revealed **a population of a G5 S2S3B bird species of concern**. This species requires shallow wetlands that support tall marsh plants in which they build their nests. Nest building usually occurs in cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.). Additionally, during the most recent site survey **a G5 S3 animal species of concern, the Northern Bluet (*Enallagma annexum*)** was captured and a **G4 S3S4 species of concern, the Triangle Floater**

(*Alasmidonta undulata*) was located at the site in 1997. Both of these species use wetlands as their primary habitats. This site overlaps the core boundary of the Marsh Creek Wetlands Important Bird Area #27 defined by the Pennsylvania Audubon Society.

Marsh Creek Floodplain

Threats and Disturbances

Hydrologic changes due to beavers or humans could negatively affect the current wetland community by reducing the shallower portions of floodplain. The tall marsh plants upon which the inhabiting rare species relies on for nest construction could be reduced or eliminated from an increase in water level. The residential areas and agriculture associated with the floodplain, could result in nutrient influx that may decrease the water quality and alter the floral makeup of the site. Invasive species, such as Purple loosestrife (*Lythrum salicaria*), are currently degrading the habitat at the site. By choking out the native plant species, the diversity of the entire site is reduced and the continual spread of the exotics could eventually lead to the exclusion of the rare species currently found at the site. Further draining of the wetlands for additional residential and commercial development would jeopardize the quality of the unique habitats at this site.

Conservation Recommendations

Hydrologic conditions should be maintained to promote the shallower waters that support marsh plants. Beaver activity could severely impact the habitat by increasing water depth so that the marsh plants are excluded. Beavers should be monitored and removed if they would begin to alter the structure of the wetland. Much of the floodplain is used as agricultural fields and a vegetated buffer of native species would help reduce the amount of nutrient and sediment influx from nonpoint sources into the wetland. The invasive species that are present on the site are threatening the native plant communities and action should be taken to reduce the spread or eliminate these aggressive invasives. The habitat for the rare species at this site could be improved if efforts were made to restore portions of the floodplain to their natural conditions. If land is to be converted from present agricultural use, a wide forested buffer should be developed along the length of the marsh to decrease contamination from non-point sources of pollution. Restoration efforts could eventually increase the habitat for the rare species that inhabit the floodplain.

MIDDLE RIDGE SWAMP (Delmar and Shippen Townships)

This site is a relatively undisturbed wetland dominated by cattails (*Typha* sp.) and other herbaceous plants. Occasional thickets of shrubs or small trees are present, particularly along the edges and at the eastern end. At least one active beaver dam was noted in the 2005 surveys. Some bog species were encountered at the site including leatherleaf (*Chamaedaphne calyculata*). The thick vegetation at the site provides good wildlife habitat. A recent survey of the site yielded **a population of a G5 S2 species of concern, marsh bedstraw (*Galium trifidum*)**. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances:

Agricultural practices are upslope of the site and runoff from these areas is likely decreasing the water quality of the wetland. Beaver activity was noted in the recent survey. Additionally, there are large portions of the wetland, mainly on the southern quarter, that are nearly exclusive monocultures of the invasive exotic, purple loosestrife (*Lythrum salicaria*).

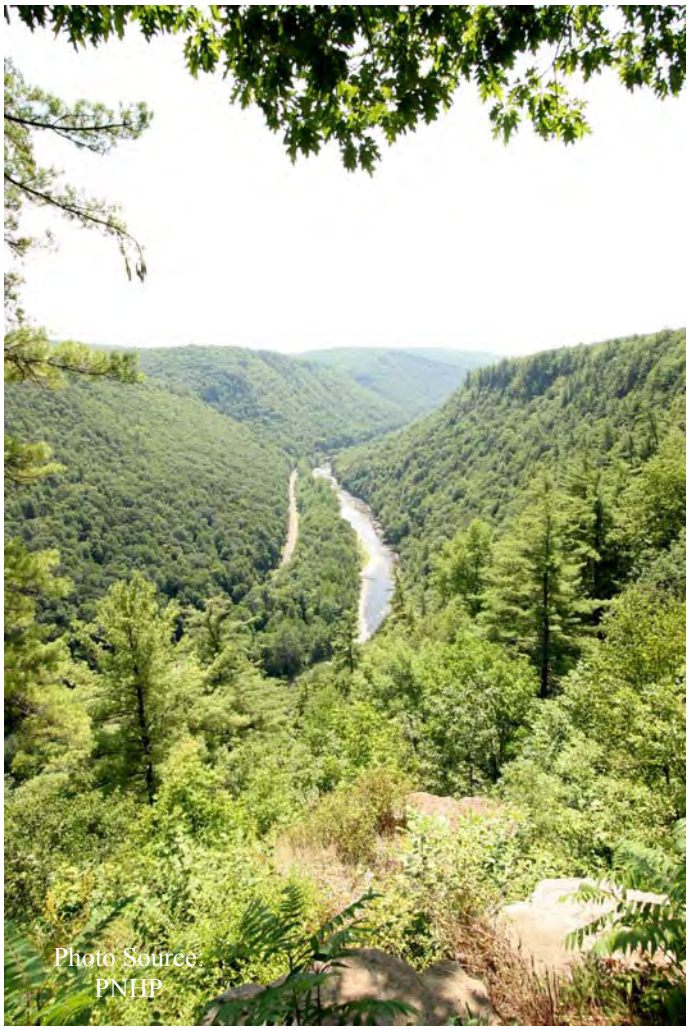
Conservation Recommendations:

A 100 meter no-cut forested buffer should be established around the wetland to minimize runoff from nearby agricultural practices. Beaver activity should be monitored so that control measures can be quickly employed if the beavers begin to dramatically alter the site. Progress of the purple loosestrife should be monitored and control measures should be implemented if the plant spreads further northward.

PINE CREEK GORGE (Delmar, Elk, Gaines, Morris and Shippen Townships)

This area encompasses an approximate sixteen mile stretch of Pine Creek Gorge, including the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. In addition, the gorge is very noteworthy from the standpoint of geology, as it illustrates to a remarkable extent the natural processes of glaciation and erosion.

The gorge also has major biodiversity significance. The slopes of the main gorge and its tributary streams have mesic hardwood forests on the more-protected lower and middle slopes, and eastern hemlock (*Tsuga canadensis*) dominated forests or mixed hardwood/conifer forests on the steeper, northerly-facing slopes. The extremely steep upper slopes and rims of the gorge, particularly where tributary streams have further dissected the terrain, often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various shrubs and herbaceous plants. The growing conditions on the upper slopes and rims are challenging, due to thin soil, outcroppings of sandstone and shale bedrock, exposure to winds, and occasional wildfire. These scrubby areas support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened**



Pine Creek Gorge

Allegheny Woodrat (*Neotoma magister*), and another **animal species of special concern ranked G5 S2S3B,S3N**.

The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5 S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*)** and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked G3 S2,** the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked G3G5 SU**, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **Red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge. Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Exotic and weedy native species are well established in the base of the gorge, particularly along the former railroad bed (now Pine Creek Trail) and Pine Creek. Japanese knotweed (*Polygonum cuspidatum*) and reed canary grass (*Phalaris arundinacea*), which are particularly invasive, represent a threat to the species diversity along the margins of Pine Creek.

Maintaining high water quality is necessary for the continued viability of the aquatic animal and plant life in Pine Creek.

Conservation Recommendations

This tract of land is almost completely owned by the Bureau of Forestry of the Pennsylvania Department of Conservation and Natural Resources, and is included in the Pine Creek Gorge Natural Area. The utilization of this area for outdoor recreation would appear to be compatible with maintaining the significant biodiversity features.

The major recommendations would be taking steps to control invasive plant species along Pine Creek and safeguarding the water quality in the surrounding watershed.

In order to protect the delicate communities and species that inhabit the Pine Creek Gorge, private land inholdings around the rim of the gorge should be managed to preserve the integrity of this unique natural feature.

RATTLER MINE ROAD WETLANDS (Delmar and Morris Townships)

This site is a high elevation open canopied natural depression wetland. Dominant species within the wetland include woolgrass (*Scirpus cyperinus*), sedge (*Carex canescens*), and peat moss (*Sphagnum* spp.). Surrounding the wetland is a forest of birch (*Betula* sp.) and red and eastern white pine (*Pinus rigida* and *P. strobus*). In 1991, a population of the **Ski-tailed Emerald (*Somatochlora elongata*), ranked G5 S2** was found at this site, and in 1993, a survey of the site uncovered a population of the **Incurvate Emerald (*Somatochlora incurvata*), a G4 S1 species of concern**. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

This site lies on Tioga State Forest Land and State Game Lands #268. During the 1990s surveys of the site, the forest surrounding the wetland was intact, however future forestry practices could threaten the quality of the habitat. An unpaved road bisects the wetland which has in turn altered the hydrology of the site. Because this wetland drains, the road construction has caused the water to pond in certain areas. As a result, the open water has altered the floral makeup of the wetland. Additionally, silt from the road material is likely entering the wetland

which may fill portions of the wetland and further degrade the habitat.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the wetland. The site would also likely be improved if the dirt road were maintained to minimize silt input into the wetland.

STONY FORK SLOPE (Delmar Township)

This site consists of a small open seepage at the base of a cliff, just north of the road ditch along State Road 3006. Recent surveys of the site uncovered a population of the **PA-endangered G5 S1 Bebb's sedge (*Carex bebbii*)**.

Threats and Disturbances

The site has been disturbed by the creation of the road and is currently threatened by road runoff. Deicing agents and roadside herbicide application could harm the population of Bebb's sedge.

Conservation Recommendations

Application of deicing chemicals and herbicides should be eliminated from the area surrounding this site. The limestone cliff remains intact at this point and should remain so to allow the Bebb's sedge population to persist.

THE MUCK (Delmar Township)

This site has long been of interest in Tioga County. Botanical records for this site go back to the mid 1800's! Also known as "Stokesdale Marsh", this 500 plus acre marsh lies just north of Wellsboro along Route 287. This site was used extensively for celery farming in the past, but a flood that occurred in 1947 ended the farming practices and the wetland has been reverting back to its natural state since. The marsh is owned primarily by the Pennsylvania Game Commission with some private landowners holding the remaining marsh acerage (Norman 1994). The site is now a **mixed graminoid-robust emergent marsh, a GNR S2S3 tracked community**. This community type can house several species of rare birds. A **G5 S3S4B,S4N species of concern**, was found in 2002 and there are confirmed breeding records of both **a G5 S3B species of concern** and **a G5 S2S3B species of concern** at The Muck. This site overlaps the core boundary of the Marsh Creek Wetlands Important Bird Area #27 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Luckily, this site appears to have been naturally restored because of the flood that excluded the farming practices. The floral component of the marsh is likely similar, though less diverse, than what originally occurred, however recent searches for the sedge, *Carex chordorrhiza*, were not successful in locating this species. The Muck was believed to be the only known Pennsylvanian site for this plant, which was last observed in 1869. Maintenance of the water quality is critical to the makeup of the marsh. Efforts should be made to establish forested buffers along the waterways that drain into this wetland. These buffers would limit the runoff from farms and residences that are upstream of the marsh. The input of nutrients and pollutants from these sources will degrade the habitat found at The Muck. Certainly, hydrologic changes, whether via humans or beavers, should be avoided. This may require trapping regimes if beavers begin to drastically alter the site.

Photo Source: PNHP

The Muck

DUNCAN TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
NICKEL RUN HEADWATERS SOUTH (4)	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-27	C

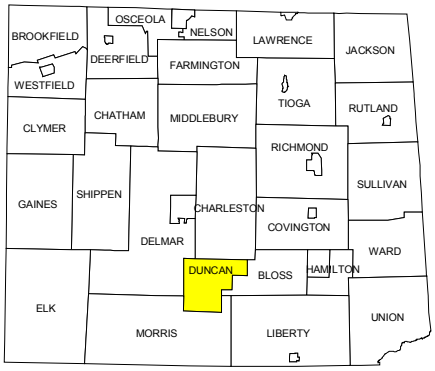
* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: Tioga State Forest

Exceptional Value Stream: Nickel Run

Aquatic Classification Project Results:
Cool Water Community 1—Wilson Creek
Cold Water Community—Babb Creek-Long Creek

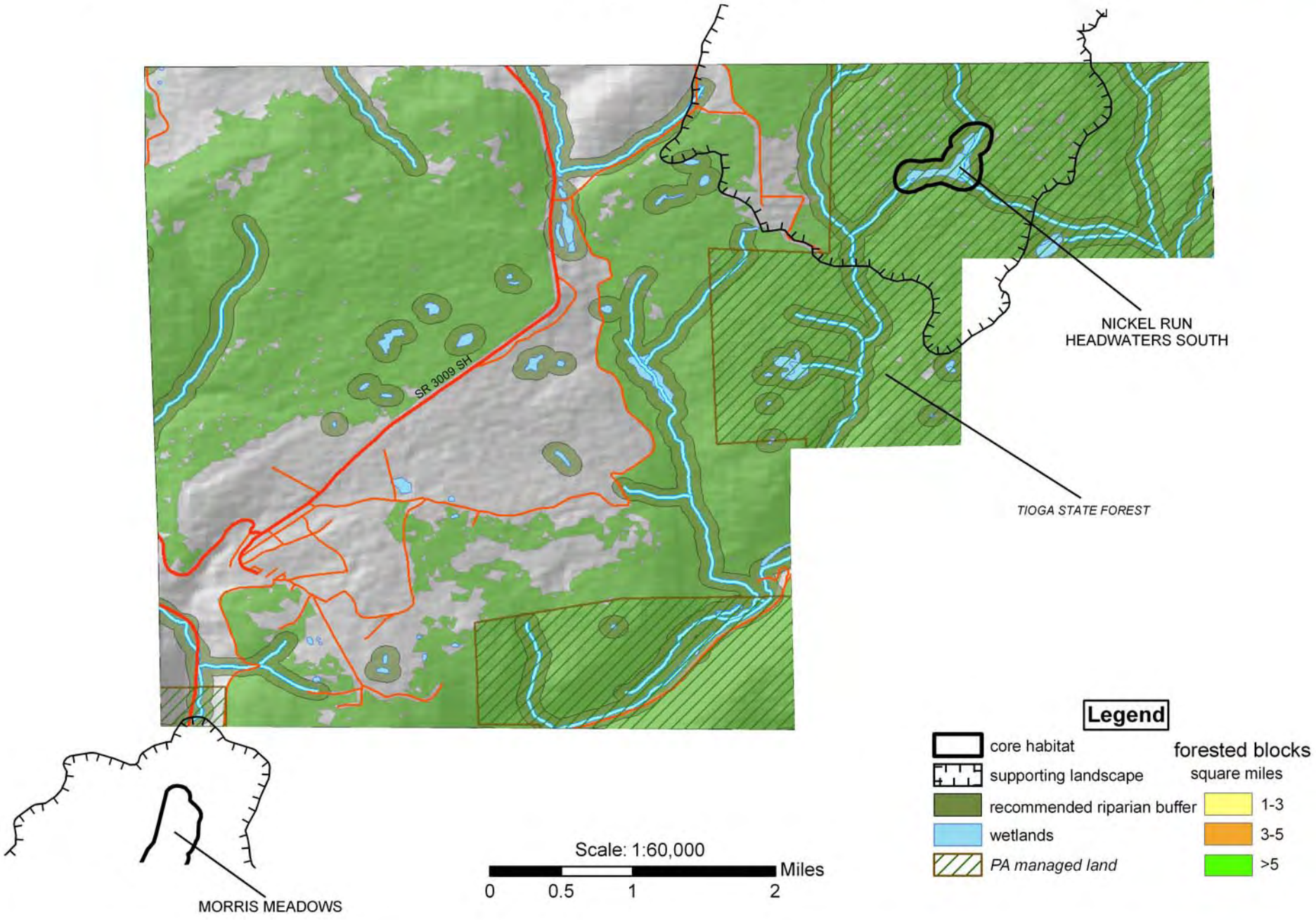


Duncan Township is primarily within the Glaciated High Plateau Section of the Appalachian Plateaus but includes the edges of the Deep Valley Section of the Ridge and Valley geographic province. The township is almost entirely forested and forms part of a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The township is primarily drained by Babb Creek and its tributaries, including a portion of the Exceptional Value-designated Nickel Run. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, in particular along the path of Nickel Run. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Water quality should be monitored and restored in mined portions of the township.

DUNCAN TOWNSHIP MAP

Duncan Township
Tioga County, PA

Pennsylvania Natural Heritage Program



NICKEL RUN HEADWATERS SOUTH
(Duncan Township)

This site, found on Tioga State Forest land, includes a seepy eastern hemlock (*Tsuga canadensis*), yellow birch (*Betula alleghaniensis*), and red maple (*Acer rubrum*) forest, which is drained by a diffuse streamlet. Sections of this wetland are drier, with hummocky spots and a moderately open canopy. The site has likely been created or modified by beavers in the past. During recent surveys, a population of a **G5 S3 PA-rare plant species, the soft-leaved sedge (*Carex disperma*)** was found at this site. Adjacent to the forest is an herbaceous and graminoid opening with a generally wet substrate. Although no species of special concern were located in this section of the site, the area provides excellent wildlife habitat.

Threats and Disturbances

During the recent site survey, no disturbances were noted. The site does lie on Tioga State Forest land, and it is possible that the forest surrounding the site would be slated for future timbering.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around this site to maintain characteristics of the habitat for the rare species that inhabit this wetland.

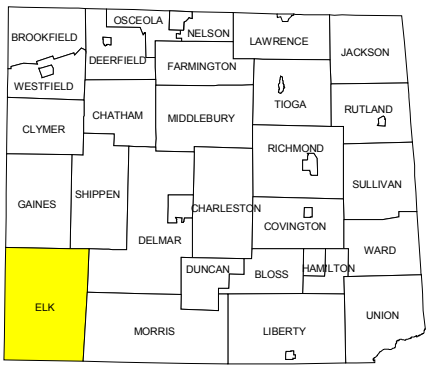
the soft leaved sedge (*Carex disperma*)

ELK TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
ALGERINE SWAMP/REYNOLDS SPRING NATURAL AREA (2)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2004-7-11	A
	bog sedge (*Carex paupercula*)	G5	S3	PT	2004-7-11	A
	Boreal Conifer Swamp	GNR	S3	N	1992-6-9	BC
	bog aster (*Oclemena nemoralis*)	G5	S1	PE	2004-7-11	B
	Bog Copper (*Lycaena epixanthe*)	G4G5	S2	N	2004-7-11	B
	Nonglacial Bog	GNR	S3	N	1992-6-9	D
	Green-striped Darner (*Aeshna verticalis*)	G5	S3S4	N	2004-7-21	E
	Band-winged Meadowhawk (*Sympetrum semicinctum*)	G5	S3S4	N	2004-7-21	E
	Brush-tipped Emerald (*Somatochlora walshii*)	G5	S2	N	2004-7-21	E
	Blueberry Sallow (*Apharetra (purpurea) dentata*)	G4	S2	N	2004-7-20	E
GLEASON HOLLOW (5)	mountain starwort (*Stellaria borealis*)	G5	S1S2	N	2005-6-8	E
PINE CREEK GORGE (1)	Elktoe (*Alasmidonta marginata*)	G4	S4	N	1997	AB
	Brook Floater (*Alasmidonta varicosa*)	G3	S2	N	1997	AB
	Green Floater (*Lasmigona subviridis*)	G3	S2	N	1997	AB
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Earwig Scorpionfly (*Merope tuber*)	G3G5	SU	N	2000-8-3	C
	Sprengel's sedge (*Carex sprengelii*)	G5	S3	N	2005-5-17	C
	wild-pea (*Lathyrus ochroleucus*)	G4G5	S1	PT	2005-5-16	BC
	roundleaf serviceberry (*Amelanchier sanguinea*)	G5	S1	TU	2005-5-16	C

PINE CREEK GORGE (1)	Red-head Pondweed (*Potamogeton richardsonii*)	G5	S3	PT	2000-9-29	D
	Canada buffalo-berry (*Shepherdia canadensis*)	G5	S1	PE	2001-8-28	CD
	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2000-8-4	B
	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2001-5-15	C
	common juniper (*Juniperus communis*)	G5	S2	N	2001-10-3	C
	ebony sedge (*Carex eburnea*)	G5	S1	PE	2001-10-3	BC
	Allegheny Woodrat (*Neotoma magister*)	G3G4	S3	PT	1999-5-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
	Animal species of concern	G5	S2S3B,S3N	N	1988	E
	Erosional Remnant	GNR	SNR	N	1979	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Marshlands Slopes, Slate Run Headwaters

Managed Lands: Tioga State Forest, Tioga State Forest – Pine Creek Gorge Natural Area, Tioga State Forest - Reynolds Spring Natural Area

High Quality Cold Water Fishery: Pine Creek, Elk Run, Bear Run, Fourmile Run, Horse Run, Tumbling Run, Little Slate Run, Burdic Run, Ice Break Run

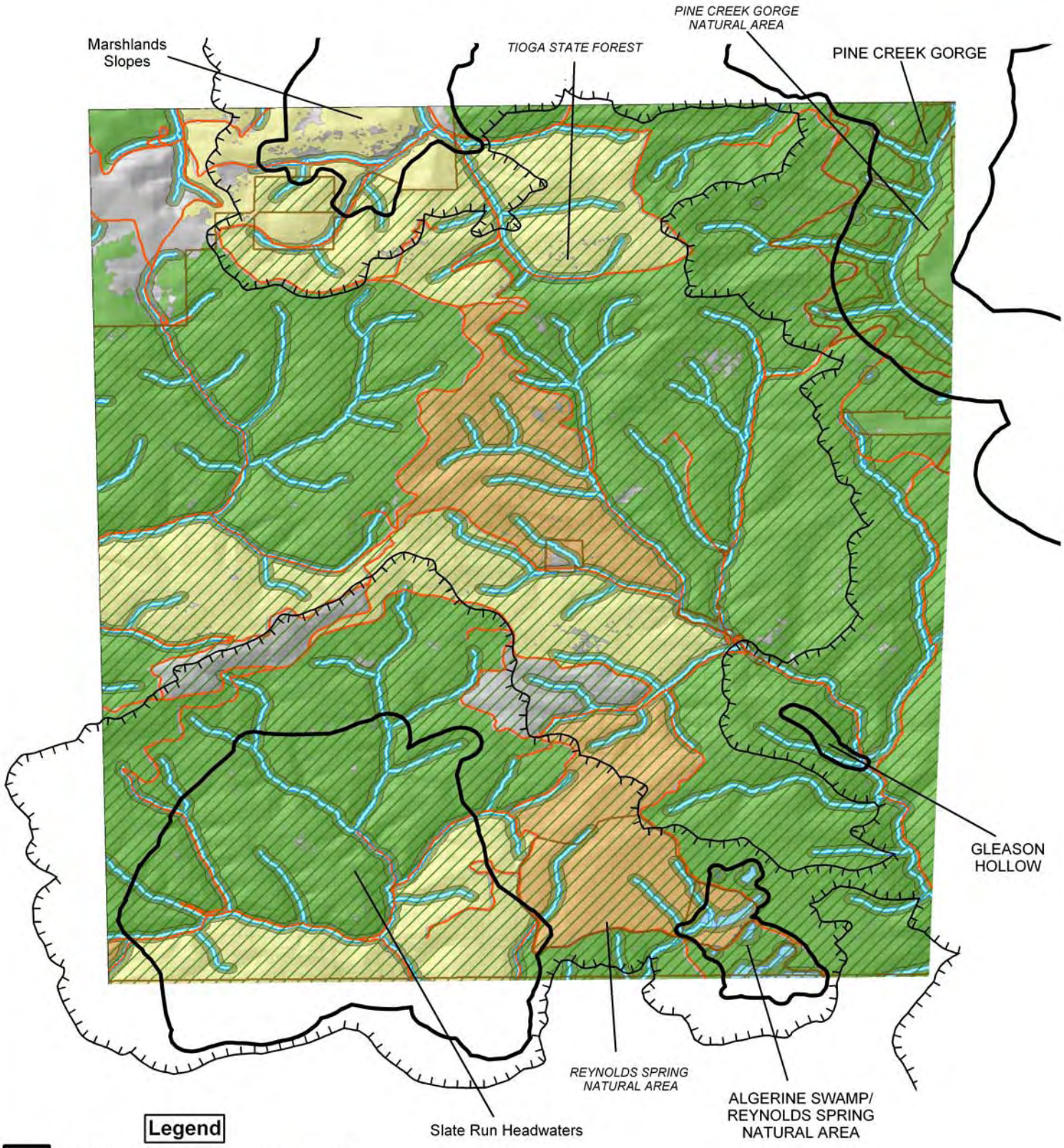
Exceptional Value Stream: Kettle Creek, Cedar Run

Aquatic Classification Project Results:
Cold Water Community—Cedar Run, Elk Run, Slate Run, Kettle Creek-Little Kettle Creek
Green Stonefly / Giant Black Stonefly—Kettle Creek-Little Kettle Creek
Eastern Elliptio Community—Pine Creek-Cedar Run

Elk Township is entirely within the Deep Valley Section of the Ridge and Valley geographic province as it stretches into Tioga County. The township is nearly entirely forested and is largely managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. Major watersheds in the township include Kettle Creek, Cedar Run, Slate Run, and a portion of Pine Creek. The numerous high quality waters designations are illustrative of the importance of water resources in this township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, maintaining forested buffers along watercourses, and avoiding fragmentation of the largest forest

Elk Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

Scale: 1:100,000

0 0.5 1 2 Miles

blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Protection of the continuity of the forested corridor through the county is critical to maintaining this area as a wildlife corridor and to protecting the water quality of the Pine Creek watershed. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

the Bog Copper (*Lycaena epixanthe*)

ALGERINE SWAMP/REYNOLDS SPRING NATURAL AREA (Elk Township and Lycoming County)

Algerine Swamp and Reynolds Spring are expansive, open, high elevation wetlands. While these wetlands are markedly different from one another, they have been clustered into one site in this report because of they close proximately to one another. Both wetlands are greater than 100 acres.

bog sedge (*Carex paupercula*)

Algerine Swamp is surrounded by a northern hardwoods forest with the wetland being dominated by balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*). The entire plant community at Algerine Swamp, the **GNR S3 Boreal Conifer Swamp**, is a tracked community in Pennsylvania. The presence of balsam fir is significant, as this species has limited distribution in Pennsylvania. This wetland has a deep layer of Sphagnum mosses and a shrub layer dominated by leatherleaf (*Chamaedaphne calyculata*). Several small stream channels can be found throughout the wetland. The open areas of this site support a variety of herbaceous species, including some rare plant species as well as a rare animal species. Recent surveys uncovered populations of the **state endangered G5 S1 bog aster (*Oclemena nemoralis*)**, the **state threatened G5 S3 bog sedge (*Carex paupercula*)**, the **PA-rare G5 S3 creeping snowberry (*Gaultheria hispidula*)**, as well as the **G4G5 S2 Bog Copper (*Lycaena epixanthe*)**.

Reynolds Spring is a **nonglacial bog, a GNR S3 tracked community** in Pennsylvania. Rather than having the thick continuous mats of Sphagnum moss that are present at Algerine Swamp, the peat moss is limited to elevated hummocks between areas of soupy muck. In spots where the canopy is open, the hummocks support the sedge *Carex folliculata*, white beak rush (*Rhynchospora alba*), pitcher plant (*Sarracenia purpurea*), and bogbean (*Menyanthes trifoliata*). Reynolds Spring has a thick shrub layer of highbush blueberry (*Vaccinium corymbosum*) and speckled alder (*Alnus incana*). The wetland also has scattered eastern white pine (*Pinus strobus*) and pitch pine (*Pinus ridgida*) in spots. This site supports a population of the **state endangered G5 S1 bog aster (*Oclemena nemoralis*)**, the **Pennsylvania rare G5 S3 creeping snowberry (*Gaultheria hispidula*)**, and the **G4G5 S2 Bog Copper (*Lycaena epixanthe*)**. Surveys in 2004 uncovered **a population of the G5 S3S4 Green-striped Darner (*Aeshna verticalis*), a population of the G5 S3S4 Band-winged Meadowhawk (*Sympetrum semicinctum*),** and **a population of a G5 S2 Brush-tipped Emerald (*Somatochlora walshii*)**. These species are primarily found in wetlands. Additionally, a population of the **Blueberry Sallow (*Apharetra (purpurea) dentata*), a G4 S2 species of concern** was found at Reynolds Spring. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

the Band-winged Meadowhawk (*Sympetrum semicinctum*)

Threats and Disturbances

Because half of Algerine Swamp is owned by a private hunting club, the forest could be marked for timbering in the future. This site also has evidence of past beaver activity and they could potentially recolonize the area and begin to modify the hydrology.

Conservation Recommendations

Because both Algerine Swamp and Reynolds Spring contain populations of bog coppers, gypsy moth spraying should be avoided in the area surrounding this site. No-cut 100 meter forested buffers should be established around these sites to maintain the wetland plant communities.

Nearly half of Algerine Swamp is owned by a local hunting club. Though the site appears to be stable, the hunt club should be made aware of this unique natural feature and how they could help maintain the site.

Reynolds Spring has evidence of past disturbance by beaver and though the recent surveys of the site did not note current activity, this site should be monitored for beavers so that management practices may be enacted if they begin to alter the wetland to a degree that it is no longer suitable for the rare species that inhabit the wetland.

GLEASON HOLLOW (Elk Township)

The Gleason Hollow site sits on Tioga State Forest land. A shallow wet depression on a forested hogback houses a population of a **G5 S1S2 plant species of special concern, the mountain starwort (*Stellaria borealis*)**. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Currently, Norway spruce (*Picea abies*) appears to be naturalizing in this area and may alter the microhabitat of this rare plant. Because the site lies on State Forest Land, future forestry practices could pose a threat to the habitat for the mountain starwort.

Conservation Recommendations

Introduced to Tioga County in conifer plantations, the Norway spruce has begun to naturalize and

mountain starwort (*Stellaria borealis*)

spread throughout the County's forests. While not as rapidly spreading as some of the more aggressive invasive exotics, the species does show up rather frequently outside of plantations. By infiltrating the native forests, the Norway spruce is altering the composition of the County's forests and thereby altering the habitats used by Pennsylvania's native flora and fauna. For this reason, conifer plantations should be harvested and allowed to regenerate naturally, with native species. This may require that sprouting Norway spruce already in the seed bank be selectively eliminated from regenerating forests. At Gleason Hollow, any future tree harvesting should avoid the native tree species to maintain the habitat for the rare plant population at this site.

PINE CREEK GORGE (Delmar, Elk, Gaines, Morris and Shippen Townships)

This area encompasses an approximate sixteen mile stretch of Pine Creek Gorge, including the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. In addition, the gorge is very noteworthy from the standpoint of geology, as it illustrates to a remarkable extent the natural processes of glaciation and erosion.

The gorge also has major biodiversity significance. The slopes of the main gorge and its tributary streams have mesic hardwood forests on the more-protected lower and middle slopes, and eastern hemlock (*Tsuga canadensis*) dominated forests or mixed hardwood/conifer forests on the steeper, northerly-facing slopes. The extremely steep upper slopes and rims of the gorge, particularly where tributary streams have further dissected the terrain, often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various shrubs and herbaceous plants. The growing conditions on the upper slopes and rims are challenging, due to thin soil, outcroppings of sandstone and shale bedrock, exposure to winds, and occasional wildfire. These scrubby areas support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened Allegheny Woodrat (*Neotoma magister*),** and another **animal species of special concern ranked G5 S2S3B,S3N**.

common juniper (*Juniperus communis*)

The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5 S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*)** and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked G3 S2,** the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked**

G3G5 SU, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **Red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge. Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Exotic and weedy native species are well established in the base of the gorge, particularly along the former railroad bed (now Pine Creek Trail) and Pine Creek. Japanese knotweed (*Polygonum cuspidatum*) and reed canary grass (*Phalaris arundinacea*), which are particularly invasive, represent a threat to the species diversity along the margins of Pine Creek.

Maintaining high water quality is necessary for the continued viability of the aquatic animal and plant life in Pine Creek.

Conservation Recommendations

This tract of land is almost completely owned by the Bureau of Forestry of the Pennsylvania Department of Conservation and Natural Resources, and is included in the Pine Creek Gorge Natural Area. The utilization of this area for outdoor recreation would appear to be compatible with maintaining the significant biodiversity features.

The major recommendations would be taking steps to control invasive plant species along Pine Creek and safeguarding the water quality in the surrounding watershed.

In order to protect the delicate communities and species that inhabit the Pine Creek Gorge, private land inholdings around the rim of the gorge should be managed to preserve the integrity of this unique natural feature.

Locally Significant Sites:

Marshlands Slopes (Elk and Gaines Townships)

The hills surrounding Elk Run contain habitat for grassland birds, which in recent years have been in decline. Future surveys of this site should be conducted to determine if these habitats could support populations of grassland species.

Threats and Disturbances

This land is used for agricultural purposes and disturbance due to mowing may actually maintain the habitat. Grassland species are adapted to periodic disturbance of habitat, either through prescribed burns or mowing. However, it is critical to induce disturbance at the appropriate time to ensure that breeding of grassland species is not disrupted. This may require mowing to occur later in the season.

Slate Run Headwaters (Elk Township and Lycoming County)

This site lies on Tioga State Forest land and is a large, unfragmented block of forest. A number of species rely on large forested tracts and this site with its varied topography creates a mix of habitats for both flora and fauna. The steep ravines of Slate Run Headwaters are of particular interest because these areas can provide habitat for numerous species. Future biological surveys should be conducted at this site.

Threats and Disturbances

This site is within state forest land with portions of the site currently being timbered. The disturbance along logging roads can provide vectors for exotic invasive species to penetrate large forested areas.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around the ravines to protect the habitats. The creation of logging roads should be kept to a minimum to slow the spread of invasive exotic species along these disturbed corridors.

FARMINGTON TOWNSHIP

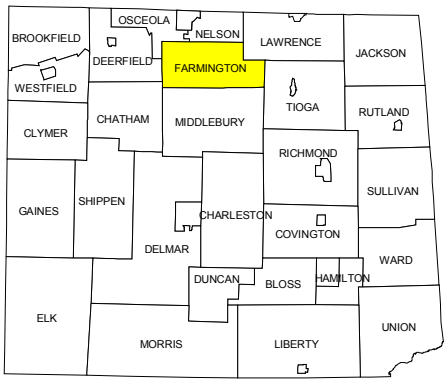
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CROFT HOLLOW WETLANDS (5)	downy willow-herb (*Epilobium strictum*)	G5	S3	PE	2005-8-4	E
ELBRIDGE WETLANDS (5)	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-8-4	E
	larger Canadian St. John's-wort (*Hypericum majus*)	G5	S2	PT	2005-8-4	E
SHINGLEBURY WETLANDS (5)	downy willow-herb (*Epilobium strictum*)	G5	S3	PE	2005-8-3	E
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-8-3	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Crooked Creek, Catlin Hollow
Rolledwinged Stonefly / Small Minnow Mayfly—Crooked Creek, Catlin Hollow
Green Stonefly / Giant Black Stonefly—Cowanesque River-Mapes Creek
Eastern Floater Community—Crooked Creek

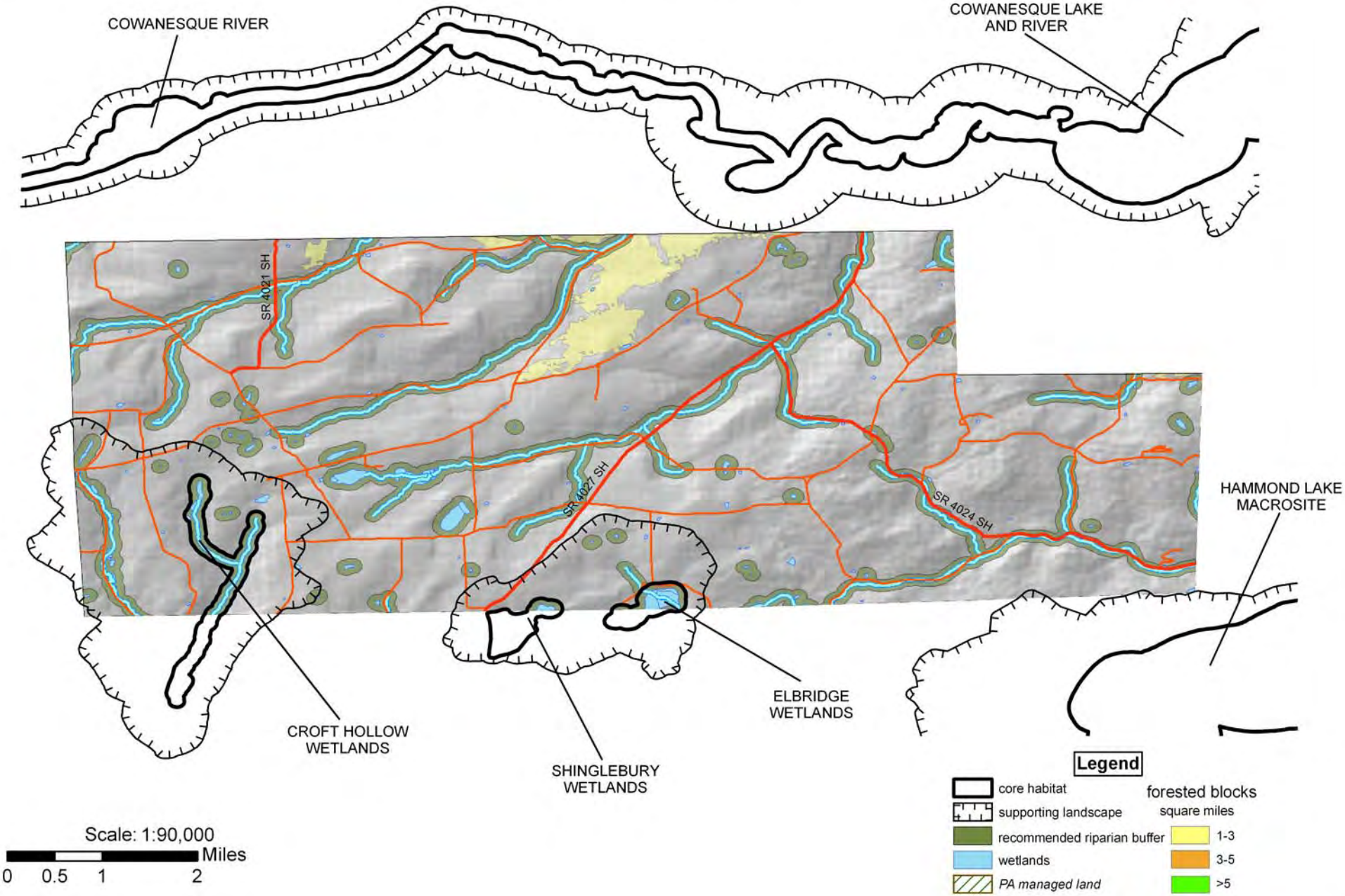


Farmington Township is primarily within the Glaciated Low Plateau Section of the Appalachian Plateaus, a fertile land dominated by agriculture. The low plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Though the forests of the township are highly fragmented, many of the remaining woodlots follow the banks of the creeks and should be maintained. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of 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.

FARMINGTON TOWNSHIP MAP

Farmington Township
Tioga County, PA

Pennsylvania Natural Heritage Program



CROFT HOLLOW WETLANDS (Farmington and Middlebury Townships)

The Croft Hollow Wetlands have been modified or created by past beaver activity. Multiple breeched beaver dams are present at this site and the former beaver ponds have shrunk, with much of the area becoming open wet meadows. A thick herbaceous layer has developed as the pond waters have lowered. Dominant species at this site include woolgrass (*Scirpus cyperinus*) and burreed (*Sparganium sp.*). During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located.

Threats and Disturbances

Beavers have modified the wetland system in the past.

Conservation Recommendations

The open wet meadow where the downy willow-herb resides has been created by beaver activity. Recolonization by beaver could threaten the willow-herb by drowning much of the herbaceous plant species. If beavers begin to flood the meadows again, a trapping regime should be employed to sustain the rare species that inhabit this site.

ELBRIDGE WETLANDS (Farmington and Middlebury Townships)

The Elbridge Wetlands site is composed of a variety of habitats surrounding an open water pond. Portions of the pond are bordered by shallow marshlands and a hemlock forest. The shallow marsh is composed of a mix of marsh graminoids including a variety of sedges (*Carex* spp.). Surveys of this area in 2005 revealed **a population of larger Canadian St. Johns-wort (*Hypericum majus*), a G5 S2 state threatened species**. At the margins of the hemlock forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.

Threats and Disturbances

The whole wetland complex has been modified by beavers in the past. It is unknown if they still inhabit this site.

Conservation Recommendations

It is often recommended that beavers be removed to maintain habitat for rare plants. However, at this site, it is unlikely that beavers will be able to flood out the rare species because of the wetland's massive size. Beaver presence may actually maintain the open marsh area used by the larger Canadian St. Johns-wort. Still, monitoring of beaver activities is recommended so that any massive changes to the hydrology can be addressed swiftly. Additionally, a no-cut 100 meter forested buffer should be established around the entire wetland to maintain habitat for the rare species found at this site.

larger Canadian St. Johns-wort (*Hypericum majus*) at Elbridge Wetlands

SHINGLEBURY WETLANDS (Farmington and Middlebury Townships)

The Shinglebury Wetlands are composed of an open canopied wet meadow and a hemlock-mixed hardwood palustrine forest. During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located in the open wet meadow. In the hemlock-mixed hardwood palustrine forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.

Threats and Disturbances

The adjacent meadows to the wetland appear to have been mowed but no threats to the rare species were noted during the surveys.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the Shinglebury Wetlands to maintain habitat for the rare species that occur at this site.

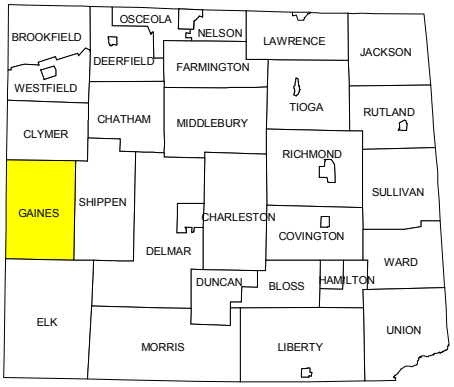
- notes -

GAINES TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
GURNEE ROAD BOG (5)	bog sedge (*Carex paupercula*)	G5	S3	PT	1997-9-5	B
PINE CREEK AT GAINES (5)	broad-leaved water-plantain (*Alisma triviale*)	G5	S1	PE	1980-7-10	H
PINE CREEK GORGE (1)	Elktoe (*Alasmidonta marginata*)	G4	S4	N	1997	AB
	Brook Floater (*Alasmidonta varicosa*)	G3	S2	N	1997	AB
	Green Floater (*Lasmigona subviridis*)	G3	S2	N	1997	AB
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Earwig Scorpionfly (*Merope tuber*)	G3G5	SU	N	2000-8-3	C
	Sprengel's sedge (*Carex sprengelii*)	G5	S3	N	2005-5-17	C
	wild-pea (*Lathyrus ochroleucus*)	G4G5	S1	PT	2005-5-16	BC
	roundleaf serviceberry (*Amelanchier sanguinea*)	G5	S1	TU	2005-5-16	C
	Red-head Pondweed (*Potamogeton richardsonii*)	G5	S3	PT	2000-9-29	D
	Canada buffalo-berry (*Shepherdia canadensis*)	G5	S1	PE	2001-8-28	CD
	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2000-8-4	B
	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2001-5-15	C
	common juniper (*Juniperus communis*)	G5	S2	N	2001-10-3	C
	ebony sedge (*Carex eburnea*)	G5	S1	PE	2001-10-3	BC
	Allegheny Woodrat (*Neotoma magister*)	G3G4	S3	PT	1999-5-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
	Animal species of concern	G5	S2S3B,S3N	N	1988	E

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
PINE CREEK GORGE (1)	Erosional Remnant	GNR	SNR	N	1979	E
WOODRUFF HOLLOW WETLANDS (5)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2005-7-7	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: Marshlands Slopes, State Game Lands #208 Vernal Pools

Managed Lands: Tioga State Forest, State Game Lands #64/208

High Quality Cold Water Fishery: Fourmile Run, Phoenix Run, Elk Run, Lick Run, Painter Run, Benaur Hollow, Shin Hollow

Exceptional Value Stream: Pine Creek Main Stem: South Branch Pine Creek to Marsh Creek

Aquatic Classification Project Results:
Warm Water Community 1—Long Run, Pine Creek-Marsh Creek
Cold Water Community—Phoenix Run, Elk Run, Asaph Run
Eastern Elliptio Community—Pine Creek-Cedar Run

Gaines Township is entirely within the Deep Valley Section of the Ridge and Valley geographic province as it stretches into Tioga County. The township is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are largely managed by State Game Lands #208 and the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. Pine Creek bisects the township and is designated Exceptional Value for most of its passage here. The many tributaries to the Pine Creek also carry quality designations and are representative of the importance of water resources in this township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, maintaining forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Protection of the continuity of the forested corridor through the county is critical to maintaining this area as a wildlife corridor and to protecting the water quality of the Pine Creek watershed. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Gaines Township
Tioga County, PA

Pennsylvania Natural Heritage Program

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

Scale: 1:80,000

0 0.5 1 2 Miles

GURNEE ROAD BOG (Gaines Township)

Gurnee Road Bog is surrounded by a forest of eastern white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), and mountain laurel (*Kalmia latifolia*). The wetland itself is dominated by Sphagnum moss. Surveys in 1997 located a **population of the state threatened G5 S3 bog sedge, *Carex paupercula***. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

A road bisects the wetland.

Conservation Recommendations

A no-cut forested buffer should be established around the wetland to preserve the habitat for the rare species at this site.

PINE CREEK AT GAINES (Gaines Township)

Surveys along Pine Creek in 1980 found a **population of the Pennsylvania state endangered G5 S1 broad-leaved water plantain (*Alisma trivale*)**. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

The water quality of the creek could be compromised by upstream non-point sources of pollution.

Conservation Recommendations

The water quality of Pine Creek must be maintained to preserve the species that depend on the creek. The establishment of vegetated buffers of native species along the creek would reduce the amount of runoff from agricultural lands and residences upstream. Runoff from these sources decreases the water quality by adding chemical pollutants and excessive levels of nitrogen and phosphorus to the creek.

PINE CREEK GORGE (Delmar, Elk, Gaines, Morris and Shippen Townships)

This area encompasses an approximate sixteen mile stretch of Pine Creek Gorge, including the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. In addition, the gorge is very noteworthy from the standpoint of geology, as it illustrates to a remarkable extent the natural processes of glaciation and erosion.

The gorge also has major biodiversity significance. The slopes of the main gorge and its tributary streams have mesic hardwood forests on the more-protected lower and middle slopes, and eastern hemlock (*Tsuga canadensis*) dominated forests or mixed hardwood/conifer forests on the steeper, northerly-facing slopes. The extremely steep upper slopes and rims of the gorge, particularly where tributary streams have further dissected the terrain, often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various

broad-leaved water plantain (*Alisma trivale*)

shrubs and herbaceous plants. The growing conditions on the upper slopes and rims are challenging, due to thin soil, outcroppings of sandstone and shale bedrock, exposure to winds, and occasional wildfire. These scrubby areas

support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened Allegheny Woodrat (*Neotoma magister*),** and another **animal species of special concern ranked G5 S2S3B,S3N**.

The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5 S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*)** and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked G3 S2,** the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked G3G5 SU**, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge. Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Exotic and weedy native species are well established in the base of the gorge, particularly along the former railroad bed (now Pine Creek Trail) and Pine Creek. Japanese knotweed (*Polygonum cuspidatum*) and reed canary grass (*Phalaris arundinacea*), which are particularly invasive, represent a threat to the species diversity along the margins of Pine Creek.

Maintaining high water quality is necessary for the continued viability of the aquatic animal and plant life in Pine Creek.

Conservation Recommendations

This tract of land is almost completely owned by the Bureau of Forestry of the Pennsylvania Department of Conservation and Natural Resources, and is included in the Pine Creek Gorge Natural Area. The utilization of this area for outdoor recreation would appear to be compatible with maintaining the significant biodiversity features.

The major recommendations would be taking steps to control invasive plant species along Pine Creek and safeguarding the water quality in the surrounding watershed.

In order to protect the delicate communities and species that inhabit the Pine Creek Gorge, private land inholdings around the rim of the gorge should be managed to preserve the integrity of this unique natural feature.

WOODRUFF HOLLOW WETLANDS (Gaines and Shippen Townships)

The Plateau in this area is primarily covered in a dry oak – heath forest dominated by black (*Quercus velutina*), red (*Q. rubra*), white (*Q. alba*) and chestnut (*Q. prinus*) oaks underlain by shrubs in the heath family including various low growing blueberries and huckleberries (*Vaccinium* spp.) and occasional thick tangles of mountain laurel (*Kalmia latifolia*). Several small isolated wetlands also occur in this habitat and provide important habitat for wetland dependent plants and animals. A population of **the G5, S3 PA-rare creeping snowberry (*Gaultheria hispidula*)** was documented in a shrub and sedge dominated acidic wetland on this plateau. Creeping snowberry is related to the common wintergreen and shares its

characteristic wintergreen aroma. It grows infrequently in Pennsylvania, occurring primarily in bogs and acidic wetlands in the northern portion of the state. This plant typically grows on elevated hummocks of deep sphagnum moss within saturated soils of a wetland or within the swamp forest edges of a wetland opening. This wetland is also noteworthy for a good diversity of lichens clinging to the trees and shrubs. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

the creeping snowberry (*Gaultheria hispidula*)

Threats and Disturbances:
There were no observed disturbances to this site. Logging of the forested buffer surrounding the wetland is a potential threat.

Conservation Recommendations:
Preservation of a 100-meter undisturbed forested buffer around all wetlands on this plateau will help provide isolation from potential external disturbances. Other isolated wetlands on this plateau should be the focus of future biological surveys.

Locally Significant Sites:

Marshlands Slopes (Elk and Gaines Townships)

The hills surrounding Elk Run contain habitat for grassland birds, which in recent years have been in decline. Future surveys of this site should be conducted to determine if these habitats could support populations of grassland species.

Threats and Disturbances
This land is used for agricultural purposes and disturbance due to mowing may actually maintain the habitat. Grassland species are adapted to periodic disturbance of habitat, either through prescribed burns or mowing. However, it is critical to induce disturbance at the appropriate time to ensure that breeding of grassland species is not disrupted. This ma require mowing to occur later in the season.

State Game Lands #208 Vernal Pools (Gaines Township)

The vernal pools at this site are moderately sized and have vegetated bottoms. Vernal pools provide critical habitat for a number of amphibian species and are frequently used by many other organisms. Unfortunately, the recent surveys of this site occurred later in the season, long after vernal pool amphibians breed. Future surveys should be conducted at this site to determine the importance of these pools for the vernal pool obligate species.

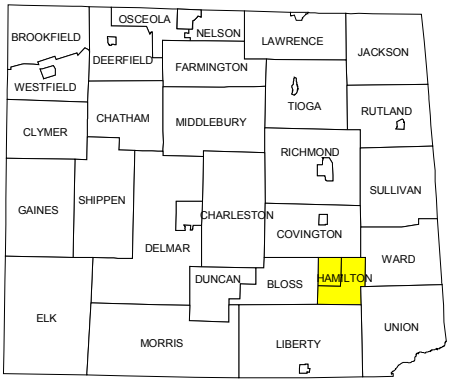
Threats and Disturbances
A pipeline right-of-way abuts the margin of one of the pools in this system.

Conservation Recommendations
A 100 meter no-cut forested buffer should be established around the vernal pools at this site.

HAMILTON TOWNSHIP **and Blossburg Borough**

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
none						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

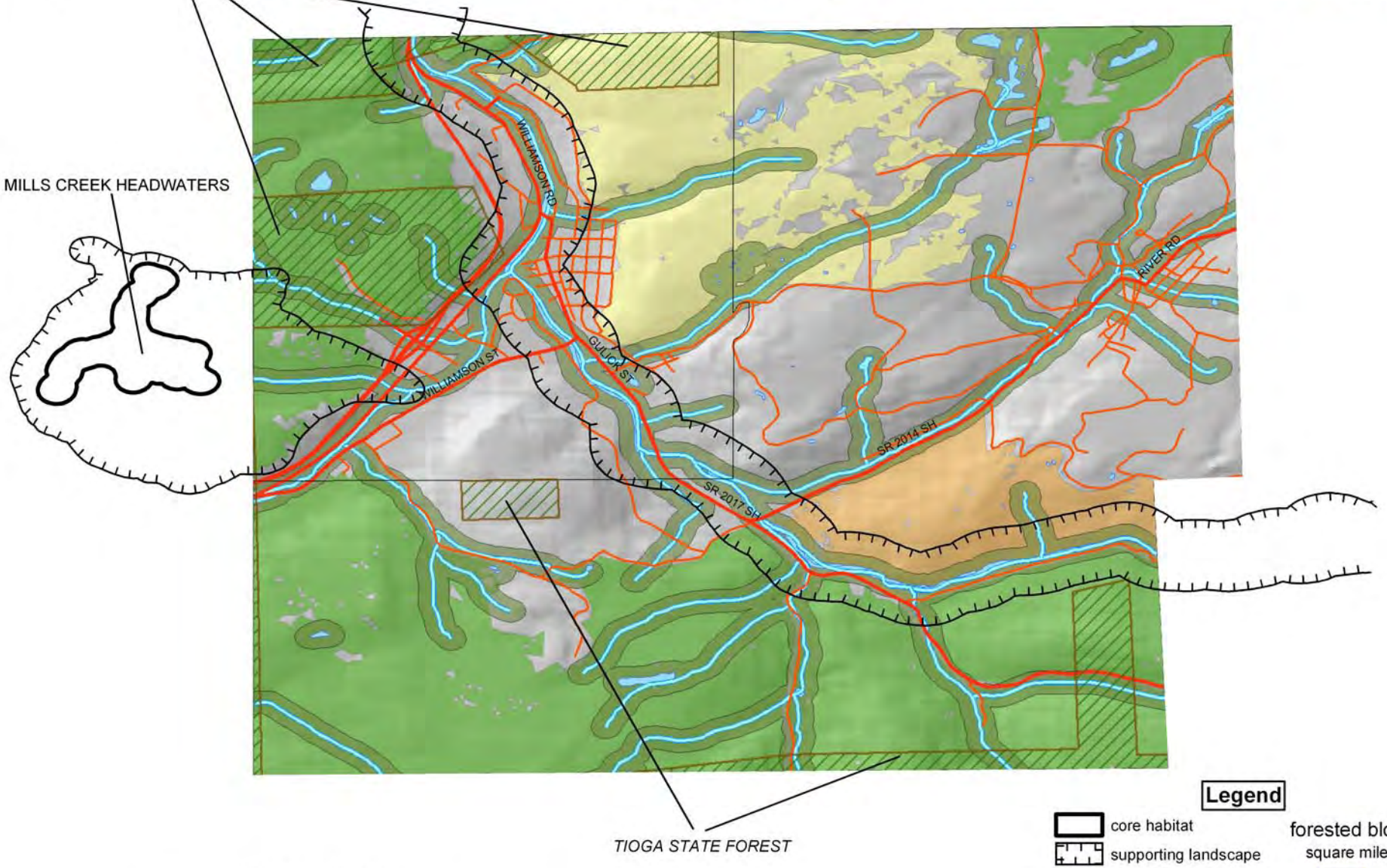
Managed Lands: Tioga State Forest

Aquatic Classification Project Results:
Cool Water Community 1—Tioga River-Corey Creek, Johnson Creek
Cold Water Community—Tioga River-Taylor Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Corey Creek
Green Stonefly / Giant Black Stonefly—Tioga River-Taylor Creek
Little Plain Brown Sedge / Slender Winter Stonefly—Johnson Creek

Hamilton Township is entirely within the Glaciated High Plateau Section of the Appalachian Plateaus. The township is predominantly forested and forms part of a forested finger stretching across the whole county. The township is primarily drained by the Tioga River and been heavily impacted by strip mining. Much of the remaining biodiversity of the township can be maintained by avoiding draining or damming wetlands, restoring formerly mined lands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Water quality should be monitored and restored in formerly mined portions of the township.

Hamilton Township
Tioga County, PA

Pennsylvania Natural Heritage Program



JACKSON TOWNSHIP

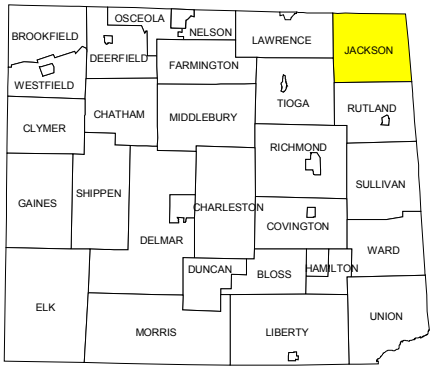
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
HARTS CREEK HEADWATERS (5)	Animal species of concern	G5	S3B,S3N	N	1994	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

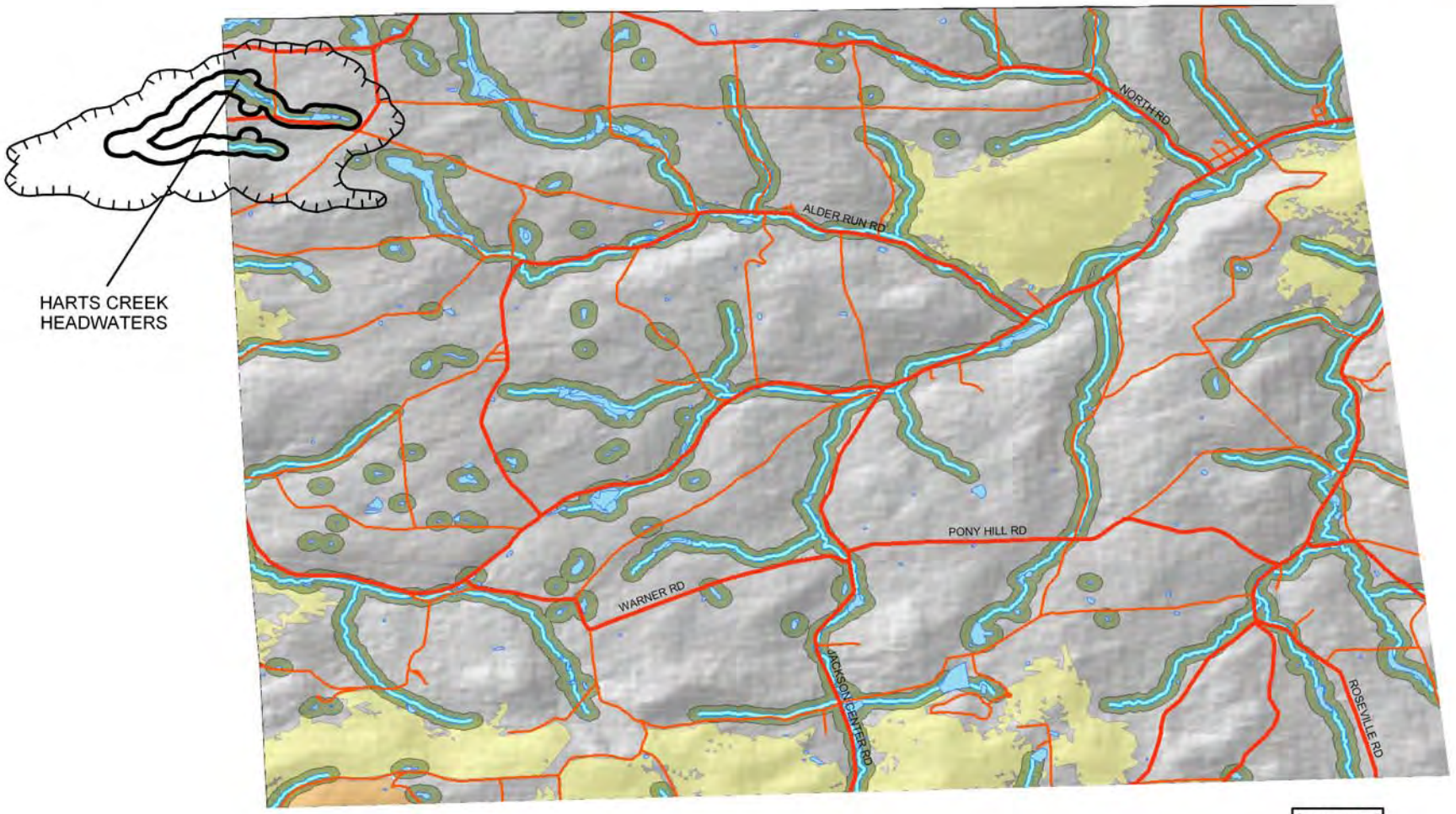
Aquatic Classification Project Results:
Warm Water Community 1—Seeley Creek
Warm Water Community 2—Tioga River-Cowanesque River
Rolledwinged Stonefly / Small Minnow Mayfly—Hammond Creek, Seeley Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Cowanesque River



Jackson Township is within the Glaciated Low Plateau Section of the Appalachian Plateaus with a small portion in the Deep Valley Section of the Ridge and Valley geographic province along the southern boundary. The township is dominated by agriculture in the Low Plateau. The low plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams, characteristic of the formerly glaciated regions of the state. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on restoring buffering and protection for the aquatic resources of the township. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Jackson Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Scale: 1:80,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

HARTS CREEK HEADWATERS (Lawrence and Jackson Townships)

Hart's Creek Headwaters lies to the east of the Lawrenceville. The sloping hills surrounding the creek have been cleared for agriculture with only small, fragmented pockets of forest remaining. Some small orchards are found in these fields. There are a few marshy openings to the east and northeast of the site. Breeding pairs of **a G5 S3BS3N species of concern** were noted from this location in 1994.

Threats and Disturbances

Intense agricultural practices may degrade the habitat at this site. Hydrologic changes, via man or beaver, could drain or flood the wet meadows used by rare birds at this site.

Conservation Recommendations

The rare bird at this site historically nested in shallow marshes, swamps, bogs, and mudflats. Over the years these habitats have declined due to wetland draining. Today, the species can be found using wet pastures and brushy marshes during the breeding season. These habitats often have open springy seeps that frequently flow into nearby open creeks. The bird record from this site was found in the fields surrounding the creek. This species prefers pastures that have been maintained either through mowing or grazing. The margins of the creek at this site should be maintained in their current condition.

- notes -

LAWRENCE TOWNSHIP and Lawrence Borough

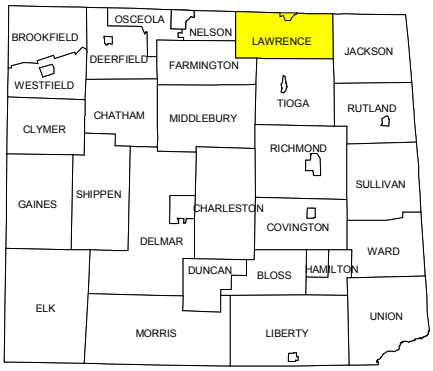
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
COWANESQUE LAKE AND RIVER (3)	Osprey (*Pandion haliaetus*)	G5	S2B	PT	2003	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
CV JUNCTION HILL (5)	Northern Myotis (*Myotis septentrionalis*)	G4	S3B,S3N	N	2003-8-5	E
HAMMOND LAKE MACROSITE (3)	Osprey (*Pandion haliaetus*)	G5	S2B	PT	2001-6-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2000	E
	Pied-billed Grebe (*Podilymbus podiceps*)	G5	S3B,S4N	N	1994	E
HARTS CREEK HEADWATERS (5)	Animal species of concern	G5	S3B,S3N	N	1994	E
LAWRENCEVILLE ROOKERY (5)	Animal species of concern	G5	S3S4B,S4N	N	2002	E
MITCHELL CREEK SLOPES (5)	Northern Myotis (*Myotis septentrionalis*)	G4	S3B,S3N	N	2003-8-5	E
TIOGA RIVER AT LAWRENCEVILLE (4)	Animal species of concern	G5	S2B	PT	2001	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

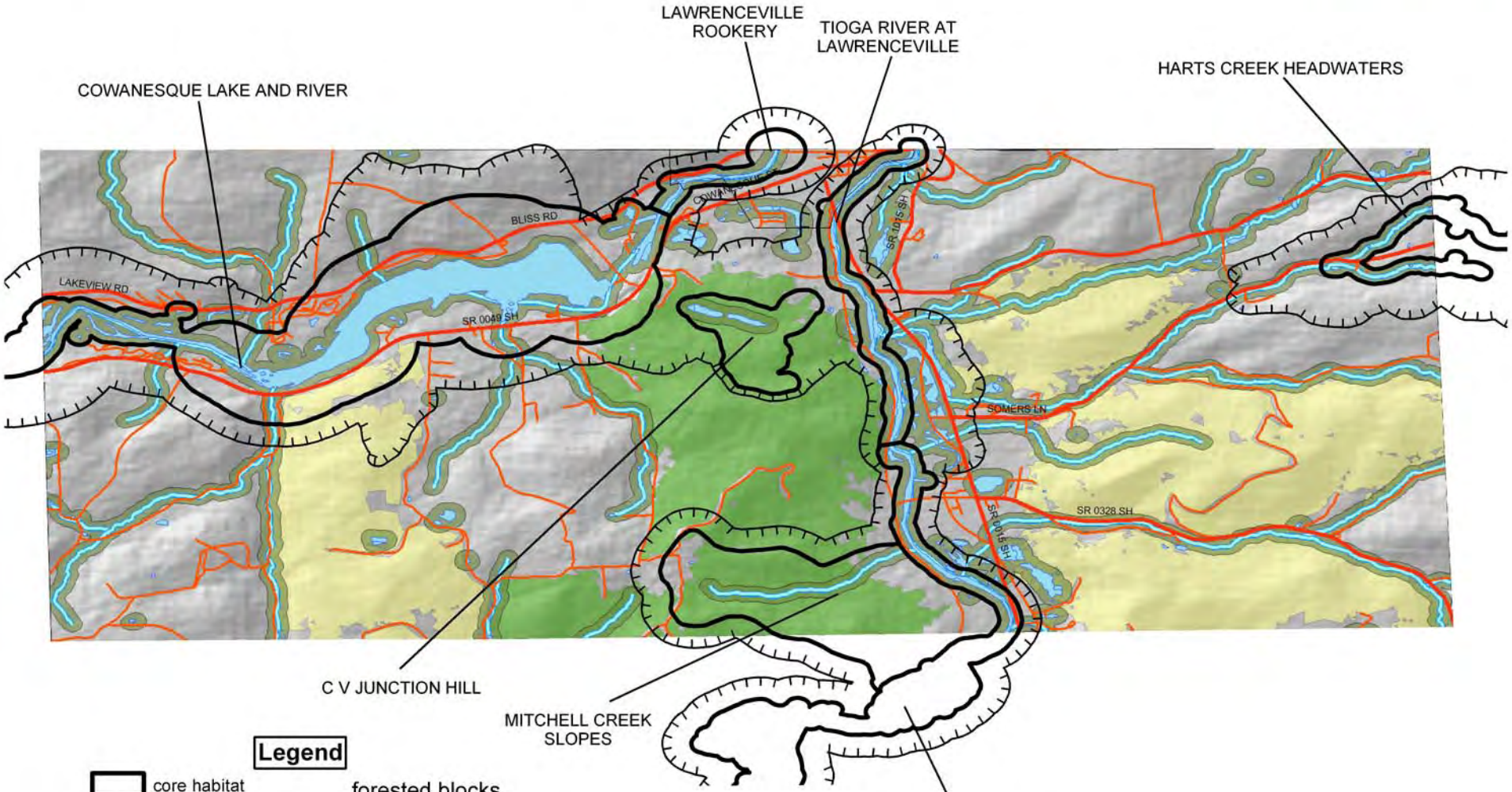
Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River;
Warm Water Community 2—Tioga River-Cowanesque River
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River
Green Stonefly / Giant Black Stonefly—Cowanesque River-Mapes Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Cowanesque River



Lawrence Township includes portions of two physiographic sections: the Glaciated Low Plateau Section of the Appalachian Plateaus in the central area, and the Glaciated High Plateau in the northwestern corner. Water resources in the township are dominated by the confluence of the Cowanesque River with the Tioga River, and Cowanesque Lake and dam. The township land uses are mixed, including agriculture, scattered woodlots, and road corridors. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing

Lawrence Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

Scale: 1:80,000

0 0.5 1 2 Miles

many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

the Northern Myotis (*Myotis septentrionalis*)

COWANESQUE LAKE AND RIVER (Lawrence and Nelson Townships)

The Cowanesque Lake reservoir has been built within the last 30 years, and despite its relatively young age, the lake and surrounding forest has become a hotspot for **Osprey (*Pandion haliaetus*), a G5, S2B threatened species**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the site has been used by a nesting pair of **Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B threatened** species. The lake itself creates over a thousand acres of open water. While created open water habitats are not typically very biologically diverse, there are some small coves jutting off of the lake creating a more varied landscape with some interesting shallow water habitats.

Threats and Disturbances

The rare species that use this site rely on the water quality of the reservoir and any decrease in water quality could negatively impact the persistence of these rare organisms. There are agricultural practices upstream from the reservoir and the runoff from animal waste and fertilizers along with soil erosion associated with agriculture could decrease the water quality of the reservoir. Additionally, the lake is used heavily for recreation and the use of 2-cycle engines increases water pollution.

Conservation Recommendations

The establishment of forested buffers along the banks of the Cowanesque River could help improve the water quality of the river and reservoir by limiting the input of agricultural wastes and reducing the amount of soil erosion. Because of the potential for water quality changes from upstream agricultural inputs and recreational use of the lake, water quality should be monitored.

CV JUNCTION HILL (Lawrence Township)

The forest at this site has a considerable canopy opening created by a gas and powerline right of way. Some small shallow wetlands also form an opening in the canopy. During several 2003 surveys of this site, **a population of the G4 S3B,S3N species of concern, the Northern Myotis (*Myotis septentrionalis*)** was found feeding along the open areas at this site. While the relationship of this location to a maternity site or roost is unknown, the multiple individuals captured here on several different nights show that this population uses this site for foraging.

HAMMOND LAKE MACROSITE (Lawrence, Tioga and Middlebury Townships)

The Hammond Lake reservoir was created within the last 30 years. Although created open water habitats are generally considered to have rather low biological diversity, some species tend to thrive in these habitats. Hammond Lake is one of two reservoirs in Tioga County that support the **G5 S2B threatened species, the Osprey (*Pandion haliaetus*)**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the **threatened Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B species** have nested around Hammond Lake. In 1994, **the G5 S3BS4N Pied-billed grebe (*Podilymbus podiceps*), a species of concern,** was found nesting at this site.

Threats and Disturbances

The rare species that use this site rely on the water quality of the reservoir and any decrease in water quality could negatively impact the persistence of these rare organisms. There are agricultural practices upstream from the reservoir and the runoff from animal waste and fertilizers along with soil erosion associated with agriculture could decrease the water quality of the reservoir. Additionally, the lake is used heavily for recreation and the use of 2-cycle engines increases water pollution.

Conservation Recommendations

The establishment of forested buffers along the banks of the Crooked Creek could help improve the water quality of the creek and reservoir by limiting the input of agricultural wastes and reducing the amount of soil erosion. Because of the potential for water quality changes from upstream agricultural

inputs and recreational use of the lake, water quality at this site should be monitored.

HARTS CREEK HEADWATERS (Lawrence and Jackson Townships)

Hart's Creek Headwaters lies to the east of the Lawrenceville. The sloping hills surrounding the creek have been cleared for agriculture with only small, fragmented pockets of forest remaining. Some small orchards are found in these fields. There are a few marshy openings to the east and northeast of the site. Breeding pairs of **a G5 S3BS3N species of concern** were noted from this location in 1994.

Threats and Disturbances

Intense agricultural practices may degrade the habitat at this site. Hydrologic changes, via man or beaver, could drain or flood the wet meadows used by rare birds at this site.

Conservation Recommendations

The rare bird at this site historically nested in shallow marshes, swamps, bogs, and mudflats. Over the years these habitats have declined due to wetland draining. Today, the species can be found using wet pastures and brushy marshes during the breeding season. These habitats often have open springy seeps that frequently flow into nearby open creeks. The bird record from this site was found in the fields surrounding the creek. This species prefers pastures that have been maintained either through mowing or grazing. The margins of the creek at this site should be maintained in their current condition.

LAWRENCEVILLE ROOKERY (Lawrenceville Borough and New York State)

In 2002, a nest site of **a G5 S3S4B,S4N species of concern** was found just to the west of the borough of Lawrenceville along the Cowanesque River.

Threats and Disturbances

No threats to the site were noted.

Conservation Recommendations

This rare bird species tends to nest in areas where it is difficult for predators to get to the nests. Nest sites are often located in tall trees along floodplains or on islands. The tall trees in these areas should be left intact to maintain nesting habitat for the birds.

MITCHELL CREEK SLOPES (Lawrence and Tioga Townships)

The Mitchell Creek Slopes site is a wooded ravine which overlooks the Tioga River and the Town of Mitchell Creek. During several 2003 surveys of this site, **a population of the G4 S3B,S3N species of concern, the Northern Myotis (*Myotis septentrionalis*)** was found feeding along the open areas at this site. While the relationship of this location to a maternity site or roost is unknown, the multiple individuals captured here on several different nights show that this population uses this site for foraging.

TIOGA RIVER AT LAWRENCEVILLE (Lawrenceville Township)

In 2001, several nests of a **G5 S2B Pennsylvania threatened species** were found along the edges of the Tioga River just south of Lawrenceville. This species requires high water quality and healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This bird species exhibits strong nest fidelity.

Threats and Disturbances

No threats are presently known.

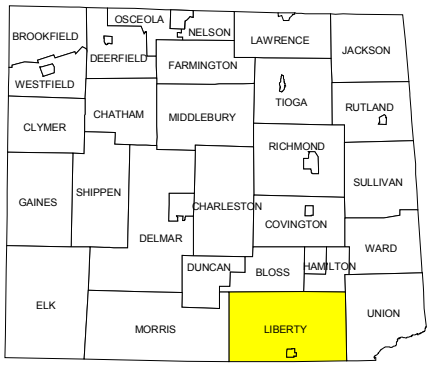
Conservation Recommendations

The tall trees along the Tioga River should be left intact to maintain nesting sites for these birds. The water quality of the Tioga River should be maintained to support the fish communities upon which this rare species relies.

LIBERTY TOWNSHIP **and Liberty Borough**

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CAT ROCKS WETLAND (5)	screw-stem (*Bartonia paniculata*)	G5	S3	N	2005-8-3	E
LONG RUN HEADWATERS (5)	Long Dash (*Polites mystic*)	G5	S3	N	2005-6-30	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: East Point Forested Wetlands, Blacks Creek Headwaters Swamp

Managed Lands: Tioga State Forest

High Quality Cold Water Fishery: Zimmerman Creek

Exceptional Value Stream: Long Run Source to Custard Run

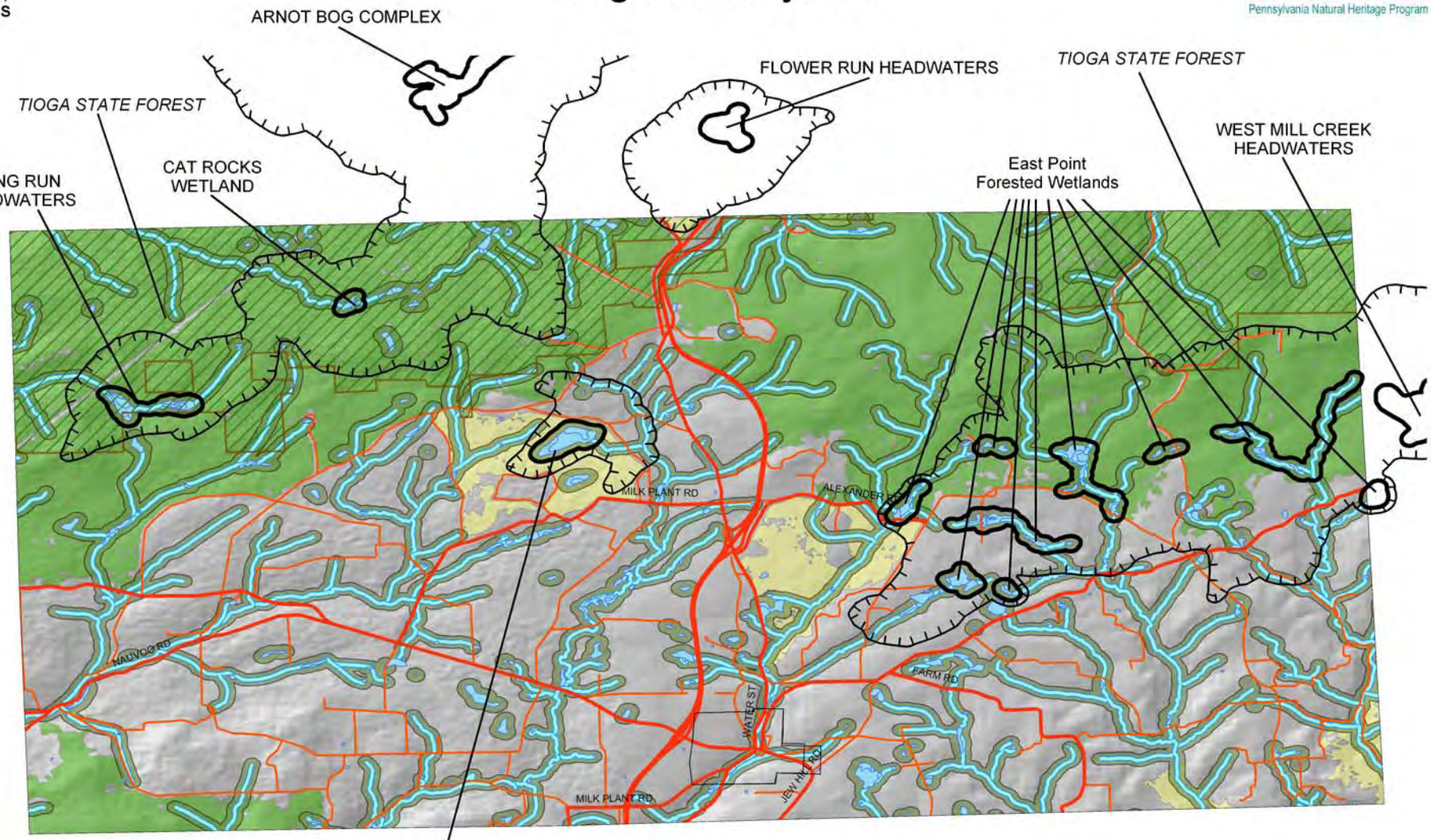
Aquatic Classification Project Results:
Warm Water Community 1—Blockhouse Creek
Cool Water Community 1—Tioga River-Corey Creek, Johnson Creek
Cool Water Community 2—Blacks Creek
Cold Water Community—Babb Creek, Babb Creek-Long Creek, Roaring Branch
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Corey Creek, Roaring Branch, Zimmerman Creek
Little Plain Brown Sedge / Sender Winter Stonefly—Johnson Creek

Liberty Township includes portions of three physiographic sections: the Deep Valley Section of the Ridge and Valley in the west, the Glaciated Low Plateau Section of the Appalachian Plateaus in the southern half, and the Glaciated High Plateau in the north. The divisions between these provinces define the land use in the township—primarily forested in the Deep Valley and the High Plateau and agricultural in the more fertile Low Plateau. The Deep Valley and High Plateau portions are almost entirely forested and form a forested finger stretching across the whole county. These significantly-sized forest blocks are largely managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The Low Plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams, characteristic of the formerly glaciated regions of the state. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

LIBERTY TOWNSHIP MAP

Liberty Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Scale: 1:100,000

0 1 2 4 Miles

CAT ROCKS WETLAND (Liberty Township)

Located on Tioga State Forest Land, Cat Rocks Wetland is part of a group of peatlands surrounded by eastern hemlocks (*Tsuga canadensis*). These wetlands are dominated by Sphagnum moss, tawny cotton-grass (*Eriophorum virginicum*), and cinnamon fern (*Osmunda cinnamomea*). In 2005, a population of **screw-stem (*Bartonia paniculata*), a G5 S3 species of special concern,** was found at the Cat Rocks Wetland.

Threats and Disturbances

These wetlands occur on Tioga State Forest land and are therefore susceptible to modification due to forestry practices. Evidence of recent timbering was seen within a hundred meters of this wetland during the 2005 survey. Though the trees directly around the wetlands were spared in the most recent round of cuts, they could be targeted in future forestry practices. The communities of the wetland system found in this area rely upon an intact surrounding forest.

Conservation Recommendations

The establishment of no-cut 100 meter forested buffers around the wetlands in this area would help protect the unique species and habitats that occur at this site. Additionally, any timbering around the immediate buffer should be conducted with utmost care to preserve the integrity of the Cat Rocks Wetland and the species that inhabit the site.

Cat Rocks Wetland

Cat Rocks Wetland

LONG RUN HEADWATERS (Liberty Township)

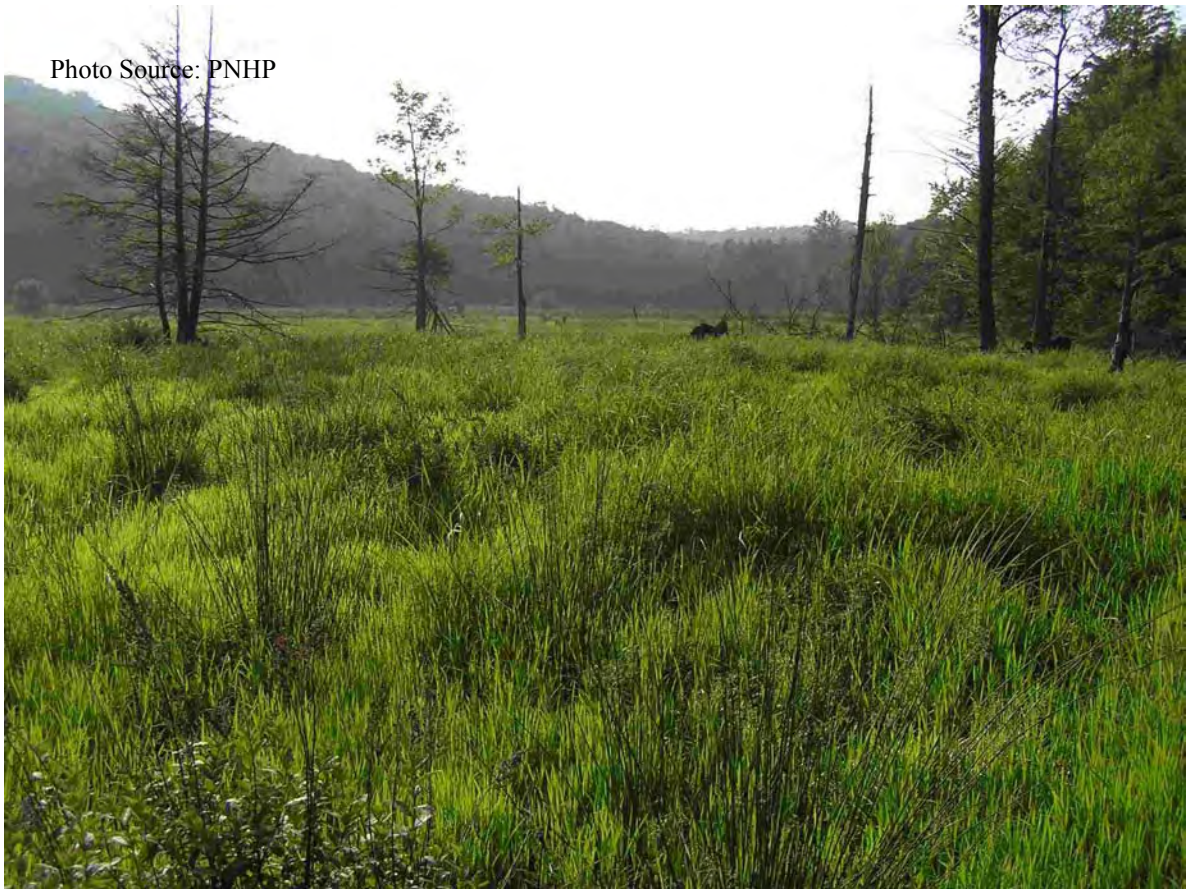
This site is a very large, open canopied wetland that was created by, or has been modified by beavers. The wetland is dominated by cattail (*Typha* sp.), with marsh fern (*Thelypteris palustris*), soft rush (*Juncus effusus*), and sensitive fern (*Onoclea sensibilis*) as associates. The wetland is fringed by eastern hemlock (*Tsuga canadensis*). Surveys during 2005 located a **population of a G5 S3 species of concern, the Long Dash (*Polites mystic*)**.

Threats and Disturbances

No threats were noted during the recent surveys, however beavers could recolonize the area and degrade the habitat used by the rare species at this site. The Long Run Headwaters site occurs on Tioga State Forest land and could be slated for timbering practices in the future.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around this site to preserve the



Long Run Headwaters

integrity of the community. Additionally, pesticide spraying for gypsy moth control should avoid the area surrounding the site to protect the Long Dash population.

Locally Significant Sites:

Blacks Creek Headwaters Swamp (Liberty Township)

This expansive forested wetland has portions dominated by marsh graminoids interspersed with wetland shrubs. The shrubs become dominant to the western half of the wetland. Future biological surveys should be conducted at this site.

Threats and Disturbances

The site lies on private property and may be slated for timbering operations.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this wetland in order to maintain the character of the site.

East Point Forested Wetlands (Liberty and Union Townships)

The wetlands that make up this site include eastern hemlock palustrine forests with some portions having sedgy openings. Future biological surveys should be conducted at this site.

Threats and Disturbances

Much of the area surrounding these wetlands is used for agriculture. It is likely that the runoff from these practices is decreasing the water quality of the wetlands by increasing the nutrient levels. The agricultural practices may also be adding to erosion which will further degrade the site.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around the site to maintain the character of these wetlands.

MIDDLEBURY TOWNSHIP

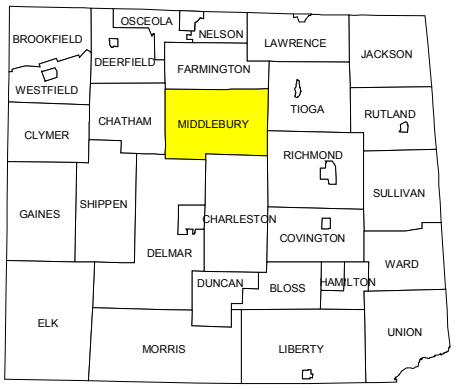
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CROFT HOLLOW WETLANDS (5)	downy willow-herb (*Epilobium strictum*)	G5	S3	PE	2005-8-4	E
ELBRIDGE WETLANDS (5)	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-8-4	E
	larger Canadian St. John's-wort (*Hypericum majus*)	G5	S2	PT	2005-8-4	E
SHINGLEBURY WETLANDS (5)	downy willow-herb (*Epilobium strictum*)	G5	S3	PE	2005-8-3	E
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-8-3	E
HAMMOND LAKE MACROSITE (3)	Osprey (*Pandion haliaetus*)	G5	S2B	PT	2001-6-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2000	E
	Pied-billed Grebe (*Podilymbus podiceps*)	G5	S3B,S4N	N	1994	E
WHITEHOUSE HOLLOW (4)	Animal species of concern	G5	S3	N	2004-8-25	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: Tioga State Forest, State Game Lands #37

Aquatic Classification Project Results:
Warm Water Community 1—Crooked Creek-Catlin Hollow, Crooked Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Crooked Creek-Catlin Hollow, Crooked Creek
Green Stonefly / Giant Black Stonefly—Catlin Hollow
Eastern Floater Community—Crooked Creek



Middlebury Township is within the Glaciated Low Plateau Section of the Appalachian Plateaus to the north and the Deep Valley Section of the Ridge and Valley geographic province along the southern portion of the township. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest and State Game Lands #37. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-

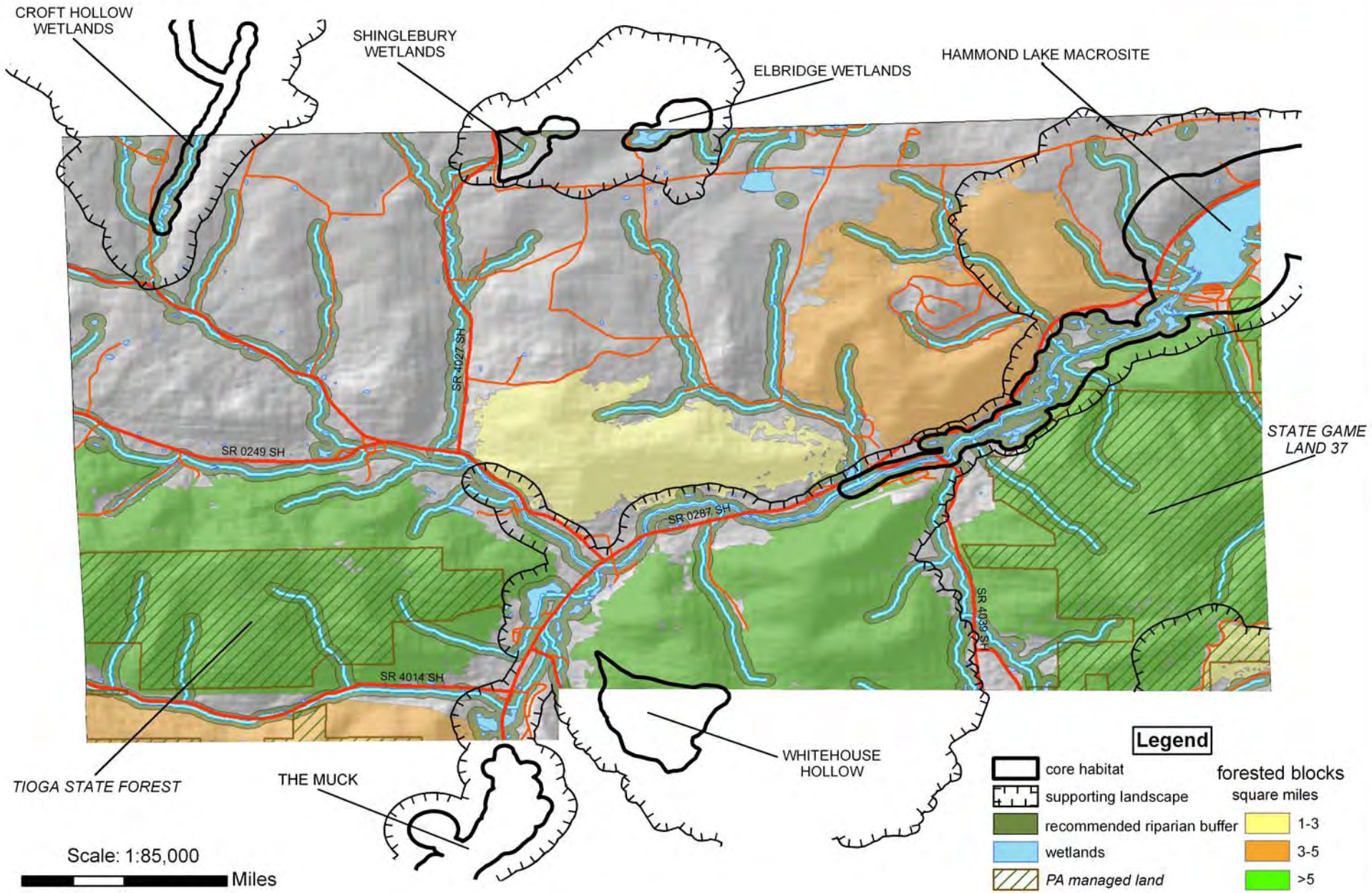
term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The township is primarily drained by Crooked Creek and its tributaries through a mosaic landscape of agriculture and scattered woodlots to the north and mixed-use forest to the south. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, in particular along the path of

A hemlock hardwood forest at Elbridge Wetlands

Crooked Creek and its tributaries. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Middlebury Township
Tioga County, PA

Pennsylvania Natural Heritage Program



CROFT HOLLOW WETLANDS (Farmington and Middlebury Townships)

The Croft Hollow Wetlands have been modified or created by past beaver activity. Multiple breeched beaver dams are present at this site and the former beaver ponds have shrunk, with much of the area becoming open wet meadows. A thick herbaceous layer has developed as the pond waters have lowered. Dominant species at this site include woolgrass (*Scirpus cyperinus*) and burreed (*Sparganium sp.*). During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located.

Threats and Disturbances

Beavers have modified the wetland system in the past.

Conservation Recommendations

The open wet meadow where the downy willow-herb resides has been created by beaver activity. Recolonization by beaver could threaten the willow-herb by drowning much of the herbaceous plant species. If beavers begin to flood the meadows again, a trapping regime should be employed to sustain the rare species that inhabit this site.

ELBRIDGE WETLANDS (Farmington and Middlebury Townships)

The Elbridge Wetlands site is composed of a variety of habitats surrounding an open water pond. Portions of the pond are bordered by shallow marshlands and a hemlock forest. The shallow marsh is composed of a mix of marsh graminoids including a variety of sedges (*Carex* spp.). Surveys of this area in 2005 revealed **a population of larger Canadian St. Johns-wort (*Hypericum majus*), a G5 S2 state threatened species**. At the margins of the hemlock forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.

Threats and Disturbances

The whole wetland complex has been modified by beavers in the past. It is unknown if they still inhabit this site.

Conservation Recommendations

It is often recommended that beavers be removed to maintain habitat for rare plants. However, at this site, it is unlikely that beavers will be able to flood out the rare species because of the wetland's massive size. Beaver presence may actually maintain the open marsh area used by the larger Canadian St. Johns-wort. Still, monitoring of beaver activities is recommended so that any massive changes to the hydrology can be addressed swiftly. Additionally, a no-cut 100 meter forested buffer should be established around the entire wetland to maintain habitat for the rare species found at this site

Photo Source: David Werier

an open water portion of Elbridge Wetlands

HAMMOND LAKE MACROSITE (Lawrence, Tioga and Middlebury Townships)

The Hammond Lake reservoir was created within the last 30 years. Although created open water habitats are generally considered to have rather low biological diversity, some species tend to thrive in these habitats. Hammond Lake is one of two reservoirs in Tioga County that support the **G5 S2B threatened species, the Osprey (*Pandion haliaetus*)**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the **threatened Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B species** have nested around Hammond Lake. In 1994, **the**

G5 S3BS4N Pied-billed grebe (*Podilymbus podiceps*), a species of concern, was found nesting at this site.

Threats and Disturbances

The rare species that use this site rely on the water quality of the reservoir and any decrease in water quality could negatively impact the persistence of these rare organisms. There are agricultural practices upstream from the reservoir and the runoff from animal waste and fertilizers along with soil erosion associated with agriculture could decrease the water quality of the reservoir. Additionally, the lake is used heavily for recreation and the use of 2-cycle engines increases water pollution.

Conservation Recommendations

The establishment of forested buffers along the banks of the Crooked Creek could help improve the water quality of the creek and reservoir by limiting the input of agricultural wastes and reducing the amount of soil erosion. Because of the potential for water quality changes from upstream agricultural inputs and recreational use of the lake, water quality at this site should be monitored.

SHINGLEBURY WETLANDS (Farmington and Middlebury Townships)

The Shinglebury Wetlands are composed of an open canopied wet meadow and a hemlock-mixed hardwood palustrine forest. During a 2005 survey of the site, **a population of downy willow-herb (*Epilobium strictum*), a G5 S3 Pennsylvania state endangered species**, was located in the open wet meadow. In the hemlock-mixed hardwood palustrine forest, **a population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species**, was found.

Threats and Disturbances

The adjacent meadows to the wetland appear to have been mowed but no threats to the rare species were noted during the surveys.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the Shinglebury Wetlands to maintain habitat for the rare species that occur at this site.

WHITEHOUSE HOLLOW (Charleston and Middlebury Townships)

The site at Whitehouse Hollow is a southwest facing hillside that abruptly rises 900 feet from the base of the valley. The slope has large hardwoods and softwoods in the overstory with notable regeneration occurring. A small stream meanders down the slope to the floor of the ravine. While this site is interesting vegetatively, in 2004 a population of a **G5 S3 species of concern** was found at Whitehouse Hollow.

the downy willow-herb (*Epilobium strictum*) from the Shinglebury Wetlands

Threats and Disturbances

The species of concern at this site generally utilizes moist locations within overall dry sites. Habitats for this species may often include nearby streams housed within dry, rocky forests and woodlands. Because these organisms may use open, sunny areas to bask, forestry practices could potentially provide basking locations for the species. However, the cutting and removing of timber could increase the solar exposure and dry up the microhabitats preferred by these organisms.

Conservation Recommendations

Forestry practices should be avoided at Whitehouse Hollow to maintain the habitat and avoid disrupting the rare species that occur at this site.

MORRIS TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
CLAY MINE ROAD POOLS (1)	Ephemeral/Fluctuating Natural Pool	GNR	S3	N	2004-7-20	D
	northeastern bulrush (*Scirpus ancistrochaetus*)	G3	S3	PE	2004-7-20	B
MORRIS MEADOWS (5)	Harris' Checkerspot (*Chlosyne harrisii*)	G4	S3	N	1980-6	H
PINE CREEK GORGE (1)	Elktoe (*Alasmidonta marginata*)	G4	S4	N	1997	AB
	Brook Floater (*Alasmidonta varicosa*)	G3	S2	N	1997	AB
	Green Floater (*Lasmigona subviridis*)	G3	S2	N	1997	AB
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Earwig Scorpionfly (*Merope tuber*)	G3G5	SU	N	2000-8-3	C
	Sprengel's sedge (*Carex sprengelii*)	G5	S3	N	2005-5-17	C
	wild-pea (*Lathyrus ochroleucus*)	G4G5	S1	PT	2005-5-16	BC
	roundleaf serviceberry (*Amelanchier sanguinea*)	G5	S1	TU	2005-5-16	C
	Red-head Pondweed (*Potamogeton richardsonii*)	G5	S3	PT	2000-9-29	D
	Canada buffalo-berry (*Shepherdia canadensis*)	G5	S1	PE	2001-8-28	CD
	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2000-8-4	E
	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2001-5-15	B
	common juniper (*Juniperus communis*)	G5	S2	N	2001-10-3	C
	ebony sedge (*Carex eburnea*)	G5	S1	PE	2001-10-3	CD
	Allegheny Woodrat (*Neotoma magister*)	G3G4	S3	PT	1999-5-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
PINE CREEK GORGE (1)	Animal species of concern	G5	S2S3B,S3N	N	1988	E
	Erosional Remnant	GNR	SNR	N	1979	E
RATTLER MINE ROAD WETLANDS (5)	Incurvate Emerald (*Somatochlora incurvata*)	G4	S1	N	1993-7-23	B
	Ski-tailed Emerald (*Somatochlora elongata*)	G5	S2	N	1991-7-31	E
WEST RIM VERNAL POOLS (1)	Hemlock Palustrine Forest	GNR	S3	N	2005-7-5	E
	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2005-7-5	E
	bog sedge (*Carex paupercula*)	G5	S3	PT	2004-6-29	E
	northeastern bulrush (*Scirpus ancistrochaetus*)	G3	S3	PE	2004-6-29	E
	Sweetflag Spreadwing (*Lestes forcipatus*)	G5	S3S4	N	2004-6-29	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

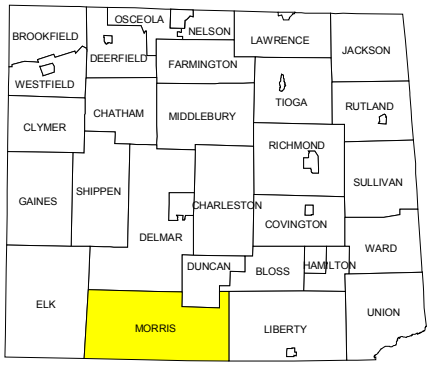
Locally Significant: none

Managed Lands: Tioga State Forest, Pine Creek Gorge Natural Area
Tiadaghton State Forest, State Game Lands #268

High Quality Cold Water Fishery: Zimmerman Creek, Pine Creek, Big Run, Bohen Run, Rail Island Run, Goodspring Hollow, Benjamin Hollow, Dillon Hollow, Clay Mine Run, Stone Quarry Run, Jerry Run, Water Tank Run

Exceptional Value Stream: Long Run Source to Custard Run, Pine Island Run, Mine Hole Run

Aquatic Classification Project Results:
Warm Water Community 1—Stony Fork
Cool Water Community 1—Wilson Creek
Cold Water Community—Cedar Run, Babb Creek, Babb Creek-Long Creek
Brushlegged Mayfly / Fingernet Caddisfly—Zimmerman Creek
Eastern Elliptio Community—Pine Creek-Cedar Run



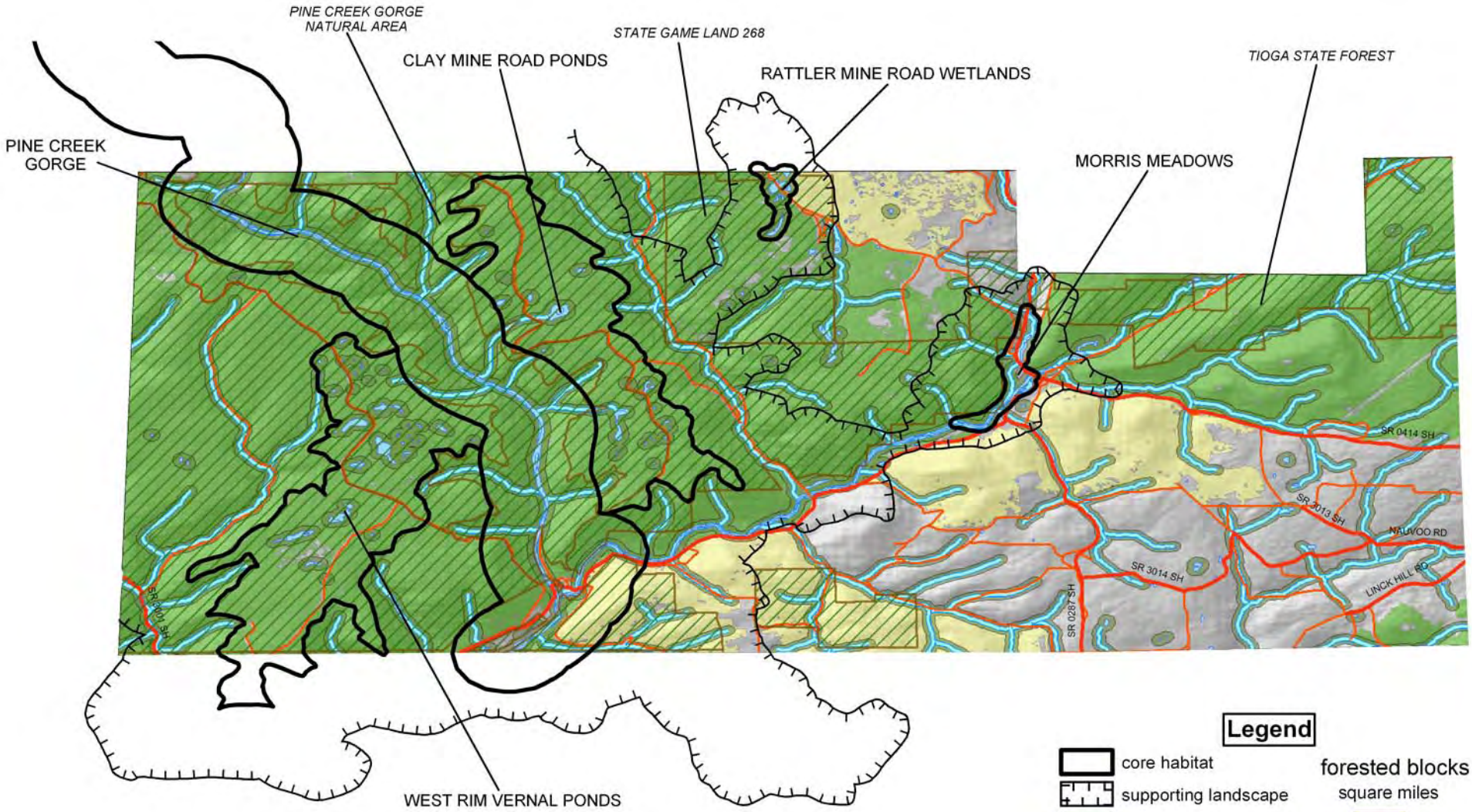
Morris Township is mostly within the Deep Valley Section of the Ridge and Valley geographic province as it stretches into Tioga County. The township is almost entirely forested and forms part of a forested finger stretching across the whole county. These significantly-sized forest blocks are largely managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The township is notable for the many high-quality forested creeks and headwater streams flowing into Pine and Babb Creeks. Much of the biodiversity of the township

can be maintained by avoiding draining or damming wetlands, maintaining forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Protection of the continuity of the forested corridor through the county is critical to maintaining this area as a wildlife corridor and to protecting the water quality of the Pine Creek watershed. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

the roundleaf serviceberry (*Amelanchier sanguinea*) from Pine Creek Gorge

Morris Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Scale: 1:120,000

0 1 2 4 Miles

CLAY MINE ROAD POOLS (Morris Township)

This site is a cluster of **GNR S3 Ephemeral/Fluctuating Natural Pools**, or vernal pools, a unique tracked community in the state. The forest surrounding the pools is composed of black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), and black cherry (*Prunus serotina*). Several of the pools at this site house healthy populations of the **federally endangered G3 S3 northeastern bulrush (*Scirpus ancistrochaetus*)**. This site overlaps the core and conservation boundries of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Portions of this site are within the Pine Creek Gorge Natural Area with the remainder being within Tioga State Forest. Potentially, sections of this site could be slated for future timbering.

Conservation Recommendations

At the very least, no-cut 100 meter forested buffers should be established around each of the pools. Isolated wetlands, are often thought of as being solitary entities, however the species inhabiting vernal pools rely on linkage between pools. Management practices should take into account the connectedness between pools to preserve the natural community.

MORRIS MEADOWS (Morris Township)

This open area to the northwest of the village of Morris is nestled between the steep valley walls along Wilson Creek. A population of the **G4 S3 Harris' Checkerspot (*Chlonsyne harrisii*)** was found at Morris Meadows. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Changes to the hydrology of Wilson Creek could degrade the habitat used by the Harris' Checkerspot.

Conservation Recommendations

The shorter shrub and herbaceous layer plants at Morris Meadows should be maintained. If beavers begin to flood the current vegetation, beaver removal is recommended.

Harris' Chekerspot

PINE CREEK GORGE (Delmar, Elk, Gaines, Morris and Shippen Townships)

This area encompasses an approximate sixteen mile stretch of Pine Creek Gorge, including the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. In addition, the gorge is very noteworthy from the standpoint of geology, as it illustrates to a remarkable extent the natural processes of glaciation and erosion.

The gorge also has major biodiversity significance. The slopes of the main gorge and its tributary streams have mesic hardwood forests on the more-protected lower and middle slopes, and eastern hemlock (*Tsuga canadensis*) dominated forests or mixed hardwood/conifer forests on the steeper, northerly-facing slopes. The extremely steep upper slopes and rims of the gorge, particularly where tributary streams have further dissected the terrain, often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various shrubs and herbaceous plants. The growing conditions on the upper slopes and rims are challenging, due to thin soil, outcroppings of

sandstone and shale bedrock, exposure to winds, and occasional wildfire. These scrubby areas support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened Allegheny Woodrat (*Neotoma magister*),** and another **animal species of special concern ranked G5 S2S3B,S3N**.

The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5 S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*)** and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked G3 S2,** the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked G3G5 SU**, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **Red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge. Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Exotic and weedy native species are well established in the base of the gorge, particularly along the former railroad bed (now Pine Creek Trail) and Pine Creek. Japanese knotweed (*Polygonum cuspidatum*) and reed canary grass (*Phalaris arundinacea*), which are particularly invasive, represent a threat to the species diversity along the margins of Pine Creek.

Maintaining high water quality is necessary for the continued viability of the aquatic animal and plant life in Pine Creek.

Conservation Recommendations

This tract of land is almost completely owned by the Bureau of Forestry of the Pennsylvania Department of Conservation and Natural Resources, and is included in the Pine Creek Gorge Natural Area. The utilization of this area for outdoor recreation would appear to be compatible with maintaining the significant biodiversity features.

The major recommendations would be taking steps to control invasive plant species along Pine Creek and safeguarding the water quality in the surrounding watershed.

In order to protect the delicate communities and species that inhabit the Pine Creek Gorge, private land inholdings around the rim of the gorge should be managed to preserve the integrity of this unique natural feature.

RATTLER MINE ROAD WETLANDS (Delmar and Morris Townships)

This site is a high elevation open canopied natural depression wetland. Dominant species within the wetland include woolgrass (*Scirpus cyperinus*), sedge (*Carex canescens*), and peat moss (*Sphagnum* spp.). Surrounding the wetland is a forest of birch (*Betula* sp.) and red and eastern white pine (*Pinus rigida* and *P. strobus*). In 1991, a population of the **Ski-tailed Emerald (*Somatochlora elongata*), ranked G5 S2** was found at this site, and in 1993, a survey of the site uncovered a population of the **Incurvate Emerald (*Somatochlora incurvata*), a G4 S1**

species of concern. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

This site lies on Tioga State Forest Land and State Game Lands #268. During the 1990s surveys of the site, the forest surrounding the wetland was intact, however future forestry practices could threaten the quality of the habitat. An unpaved road bisects the wetland, which has in turn altered the hydrology of the site. Because this wetland drains, the road construction has caused the water to pond in certain areas. As a result, the open water has altered the floral makeup of the wetland. Additionally, silt from the road material is likely entering the wetland which may fill portions of the wetland and further degrade the habitat.

Conservation Recommendations

A no-cut 100 meter forested buffer should be established around the wetland. The site would also likely be improved if the dirt road were maintained to minimize silt input into the wetland.

WEST RIM VERNAL POOLS (Morris Township and Lycoming County)

a west rim vernal pool containing a healthy population of northeastern bulrush

The forest to the west of the Pine Creek Gorge contains an **entire complex of Ephemeral/ Fluctuating Natural Pools, a GNR S3 community of concern**. This wetland complex is part of the Tioga State Forest and the Pine Creek Gorge Natural Area on Cedar Mountain and West Hill. The high density of vernal pools in this area is unique to the county. Many of the vernal pools of the west rim support populations of the **federally endangered northeastern bulrush (*Scirpus ancistrochaetus*), a G3 S3 species**. Populations of the **Pennsylvania threatened G5 S3 bog sedge (*Carex paupercula*)** and the **PA-rare G5 S3 creeping snowberry (*Gaultheria hispidula*)** can also be found in the wetlands of this site. **Hemlock Palustrine Forests, a GNR S3 tracked community** can be found at the headwaters of some of the rivulets that drain into Pine Creek Gorge. In 2004, a **population of the Sweetflag Spreadwing (*Lestes forcipatus*), a G5 S3S4 species of concern** was identified at this site. This site overlaps the core and conservation boundries of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Much of the site lies on Tioga State Forest land and could be slated for timbering in the future.

Conservation Recommendations

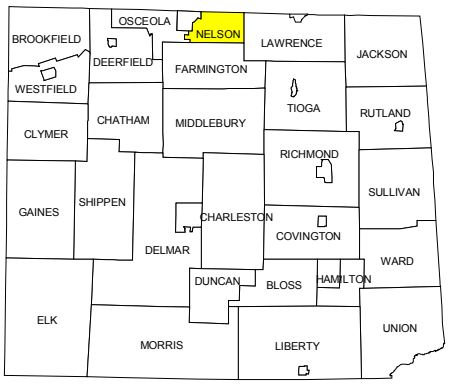
At the very least, no-cut 100 meter forested buffers should be established around all wetlands at this site. Though vernal pools are thought of as isolated wetlands, the species within the pools rely on the linkage between these wetlands. For this reason, any forest management should be conducted with the connectivity of the wetlands in mind. The preservation of an intact forest canopy at this site will help maintain habitat for the rare species that occur within the wetlands.

- notes -

NELSON TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
COWANESQUE LAKE AND RIVER (3)	Osprey (*Pandion haliaetus*)	G5	S2B	PT	2003	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
COWANESQUE RIVER (5)	Animal species of concern	G5	S2B	PT	2000	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

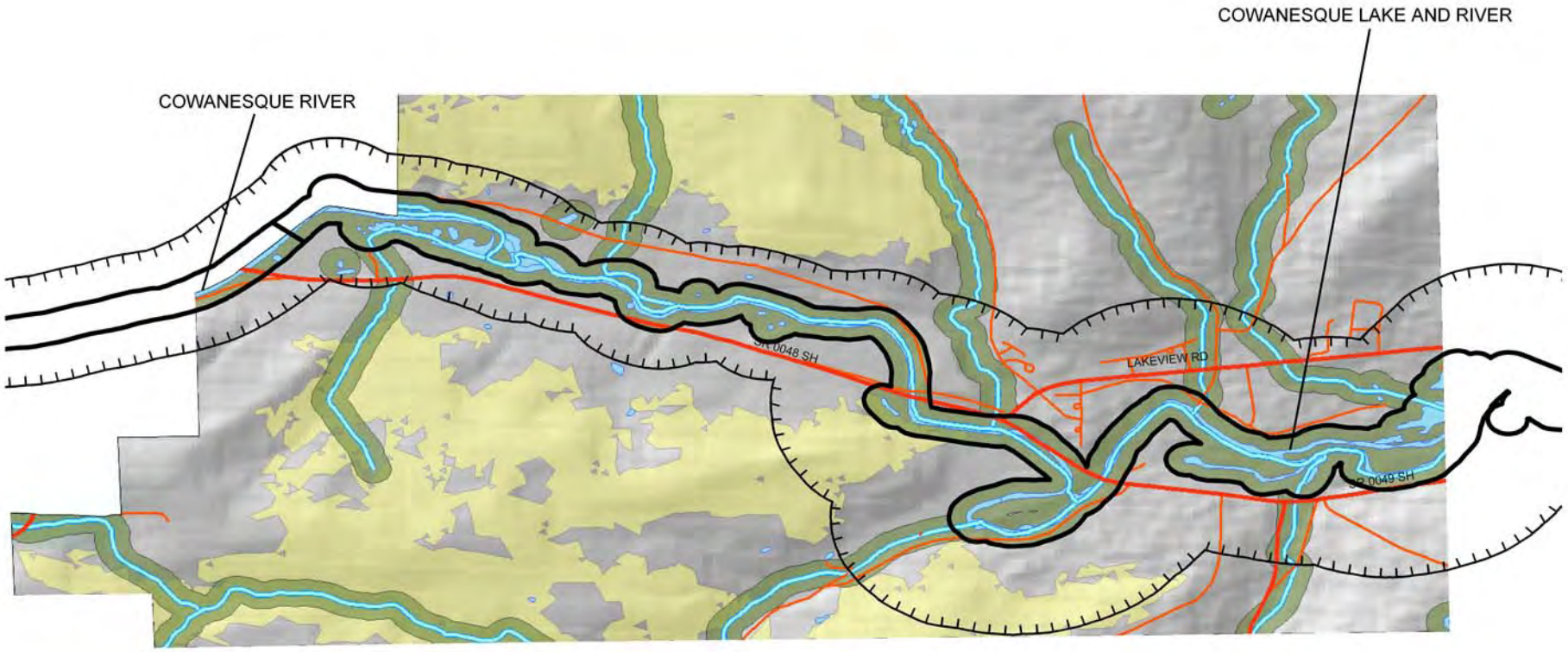
Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River-Camp Brook
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River-Camp Brook
Green Stonefly / Giant Black Stonefly—Cowanesque River-Mapes Creek

Nelson Township is divided by the Cowanesque River and is of mixed land uses, including agriculture and forestry. Most of the township lies within the Glaciated High Plateau of the Appalachian Plateaus geographic province. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts could focus on restoring riparian buffers to the tributary streams. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. A large forest block in the northwest corner of the township should be protected to maintain connectivity with forested areas in New York State.

Nelson Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Scale: 1:50,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles

- 1-3
- 3-5
- >5

COWANESQUE LAKE AND RIVER (Lawrence and Nelson Townships)

The Cowanesque Lake reservoir has been built within the last 30 years, and despite its relatively young age, the lake and surrounding forest has become a hotspot for **Osprey (*Pandion haliaetus*), a G5, S2B threatened species**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the site has been used by a nesting pair of **Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B threatened** species. The lake itself creates over a thousand acres of open water. While created open water habitats are not typically very biologically diverse, there are some small coves jutting off of the lake creating a more varied landscape with some interesting shallow water habitats.

Threats and Disturbances

The rare species that use this site rely on the water quality of the reservoir and any decrease in water quality could negatively impact the persistence of these rare organisms. There are agricultural practices upstream from the reservoir and the runoff from animal waste and fertilizers along with soil erosion associated with agriculture could decrease the water quality of the reservoir. Additionally, the lake is used heavily for recreation and the use of 2-cycle engines increases water pollution.

Conservation Recommendations

The establishment of forested buffers along the banks of the Cowanesque River could help improve the water quality of the river and reservoir by limiting the input of agricultural wastes and reducing the amount of soil erosion. Because of the potential for water quality changes from upstream agricultural inputs and recreational use of the lake, water quality should be monitored.

COWANESQUE RIVER (Deerfield, Osceola and Nelson Townships)

The Cowanesque River supports breeding pairs of **a G5, S2B Pennsylvania threatened species**. This species requires healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This species exhibits strong nest fidelity.

Threats and Disturbances

No threats are presently known.

Conservation Recommendations

The tall trees along the Cowanesque River should be left intact to maintain nesting sites for these rare birds.

- notes -

OSCEOLA TOWNSHIP and Elkland Borough

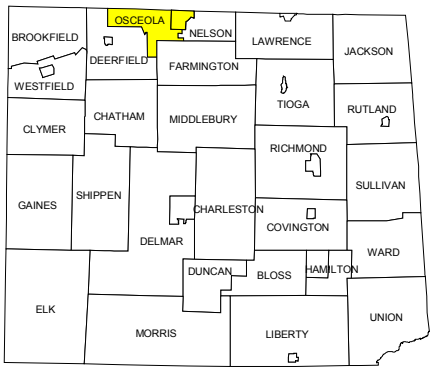
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
COWANESQUE RIVER (5)	Animal species of concern	G5	S2B	PT	2000	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: none

Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River-Camp Brook
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River-Camp Brook
Green Stonefly / Giant Black Stonefly—Cowanesque River-Mapes Creek

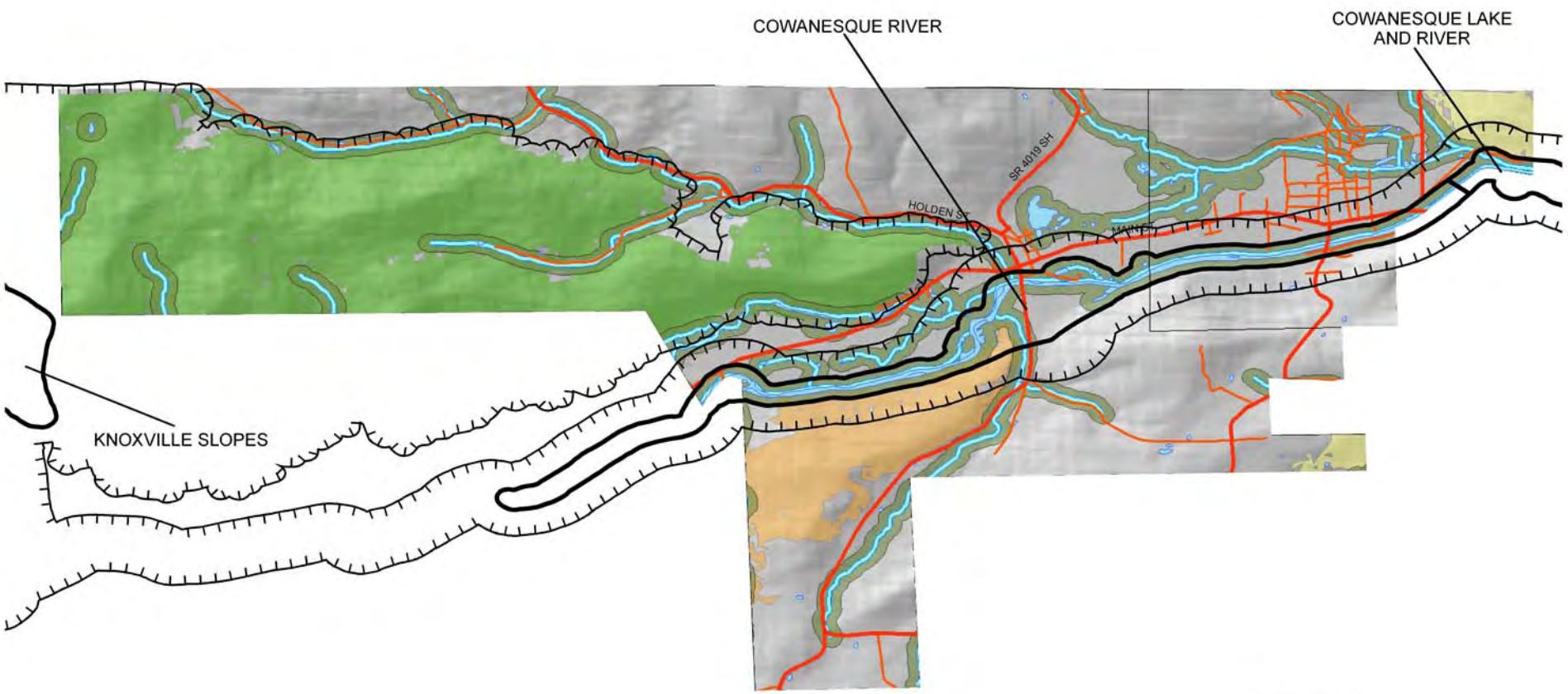


Osceola Township is divided by the Cowanesque River and is of mixed land uses, including agriculture and forestry. The entire township lies within the Glaciated High Plateau of the Appalachian Plateaus geographic province. Several tributaries to the Cowanesque River have their headwaters within the valleys of Osceola Township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Several large forested blocks follow the topography of the drainages towards the river and provide riparian buffers for some of the smaller tributary streams. Protection of these forest blocks will help to protect the water quality of the streams originating within them. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds. A large forest block in the northwest corner of the township should be protected to maintain connectivity with forested areas in neighboring townships and New York State.

OSCEOLA TOWNSHIP MAP

Osceola Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Scale: 1:70,000

0 0.5 1 2 Miles

COWANESQUE RIVER (Deerfield, Osceola and Nelson Townships)

The Cowanesque River supports breeding pairs of **a G5, S2B Pennsylvania threatened species**. This species requires healthy fish populations. For nesting, these birds prefer the snags of tall trees, frequently along the margins of the foraging habitat. This species exhibits strong nest fidelity.

Threats and Disturbances

No threats are presently known.

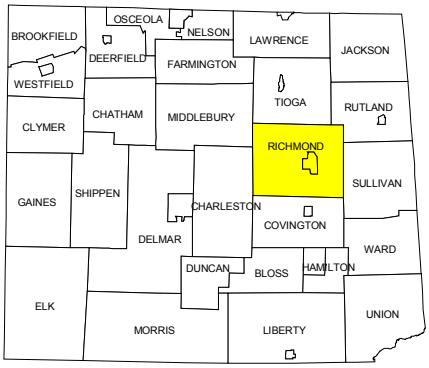
Conservation Recommendations

The tall trees along the Cowanesque River should be left intact to maintain nesting sites for these rare birds.

RICHMOND TOWNSHIP **and Mansfield Borough**

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
WHITNEYVILLE MEADOW (5)	Torrey's rush (*Juncus torreyi*)	G5	S2	PT	1985-8-22	C

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

Managed Lands: State Game Lands #37

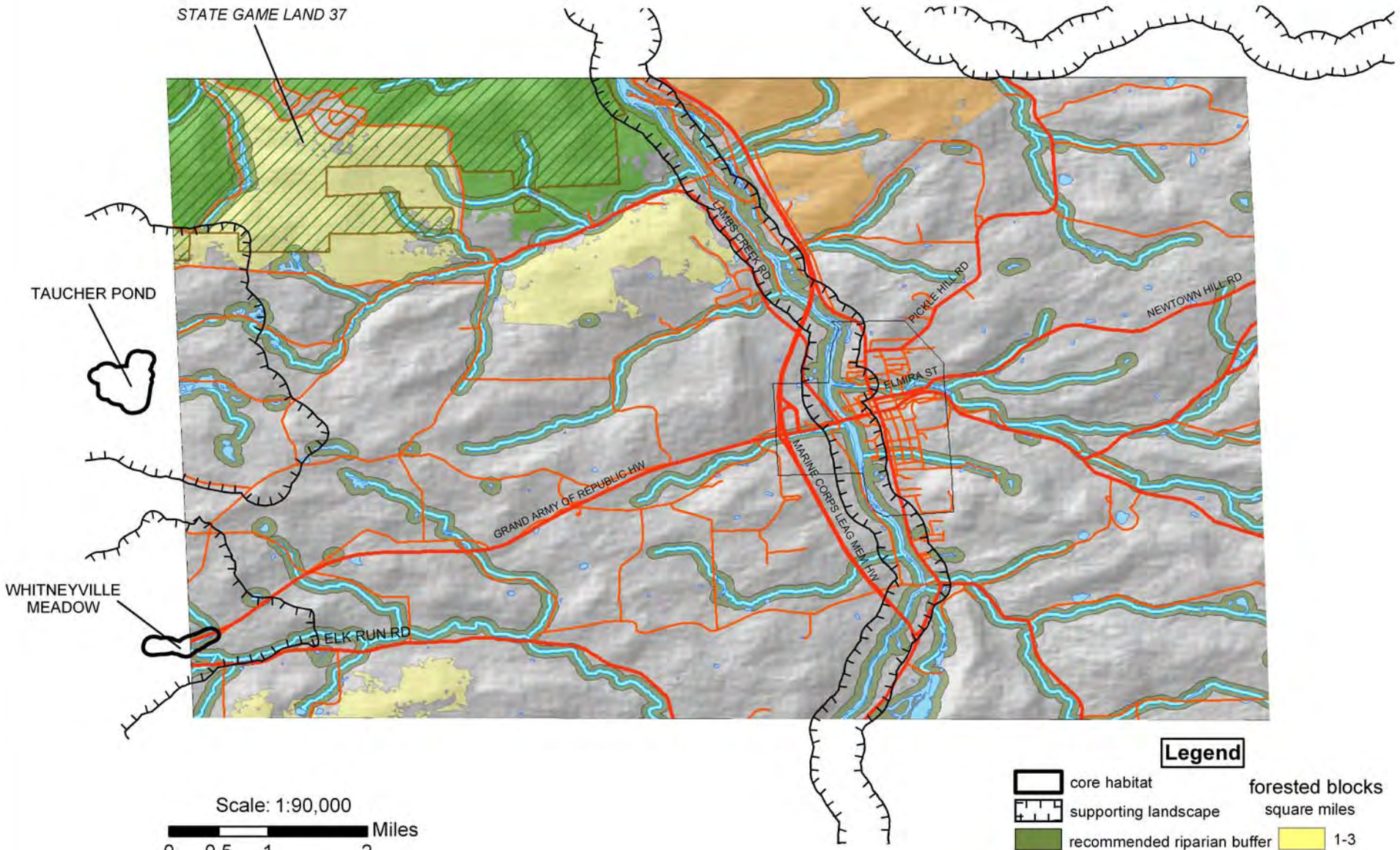
Aquatic Classification Project Results:
Warm Water Community 1—Mill Creek, Tioga River-Crooked Creek, Corey Creek
Cool Water Community 1—Tioga River-Corey Creek
Cold Water Community—Elk Run
Rolledwinged Stonefly / Small Minnow Mayfly—Mill Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Corey Creek, Canoe Camp Creek
Nemourid Broadback Stonefly / Ameletid Mayfly—Tioga River-Crooked Creek, Corey Creek

Richmond Township includes portions of two physiographic sections: the Deep Valley Section of the Ridge and Valley in the north, the Glaciated Low Plateau Section of the Appalachian Plateaus in the south. The divisions between these provinces define the land use in the township—primarily forested in the Deep Valley and agricultural and mixed developed land uses in the more fertile Low Plateau. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. The low plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams, characteristic of the formerly glaciated regions of the state. The township is bisected by the Tioga River and Route 15 running from south to north. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining and restoring riparian forest buffers. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

RICHMOND TOWNSHIP MAP

Richmond Township
Tioga County, PA

Pennsylvania Natural Heritage Program



WHITNEYVILLE MEADOW (Charleston and Richmond Townships)

This site is a wet meadow along a small stream. At the time of the survey, the site was used as a cow pasture. A population of the **G5 S2 threatened species, Torrey's rush (*Juncus torreyi*)** was found within the pasture.

Threats and Disturbances

The Torrey's rush population is in danger of being trampled because the habitat is actively being used by livestock. There is also much manure runoff that will affect the makeup of the wetland.

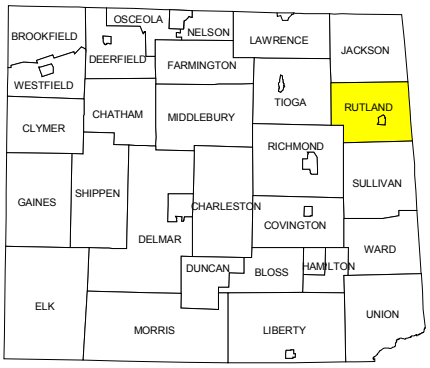
Conservation Recommendations

Fencing should be erected to keep the livestock in this pasture from trampling this population of Torrey's rush. There should also be a vegetated buffer established around the wetland to minimize the negative effects of the manure runoff. Beaver activity has been documented in the surrounding area and any beaver activity in the vicinity of the wetland should be monitored. If the Torrey's rush population is threatened by flooding due to beavers, a trapping regimen should be employed to sustain the hydrologic conditions of Whitneyville Meadow.

RUTLAND TOWNSHIP **and Roseville Borough**

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
none						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

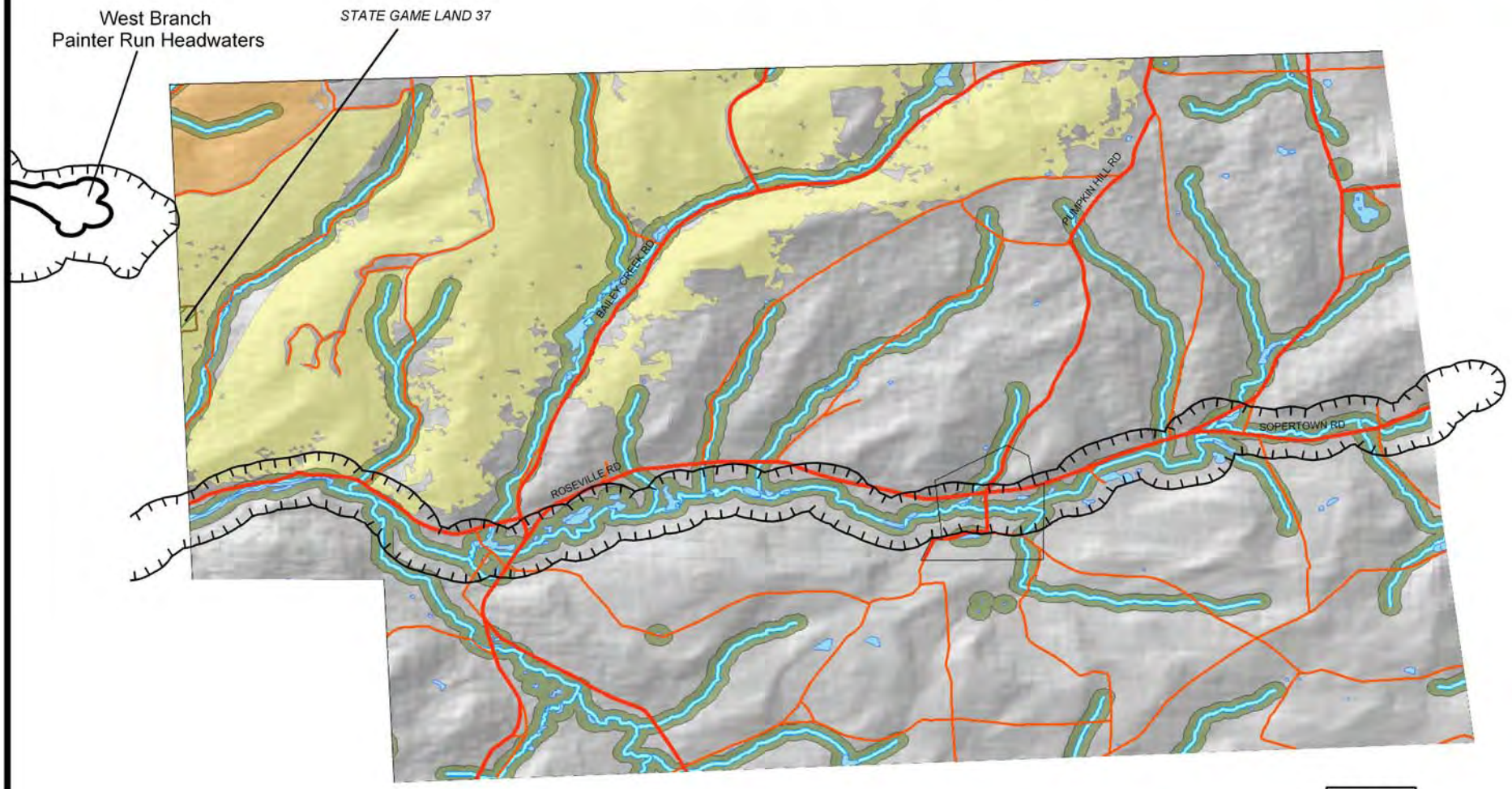
Managed Lands: State Game Lands #37

Aquatic Classification Project Results:
Warm Water Community 1—Mill Creek
Cold Water Community—Elk Run
Rolledwinged Stonefly / Small Minnow Mayfly—Mill Creek

Rutland Township is within the Glaciated Low Plateau Section of the Appalachian Plateaus to the south and the Deep Valley Section of the Ridge and Valley geographic province along the northwestern portion of the township. The Deep Valley portion is almost entirely forested and represents the terminus of a forested finger stretching across the whole county. Protection of the integrity of the forested blocks in this section enhances its value as a wildlife corridor and maintains connectivity to the rest of the county. Mill Creek drains most of the township, flowing east to west through the center. The township land uses are mixed, including agriculture, forestry, and road corridors. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on restoring buffering and protection for the aquatic resources of the township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Rutland Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Scale: 1:75,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

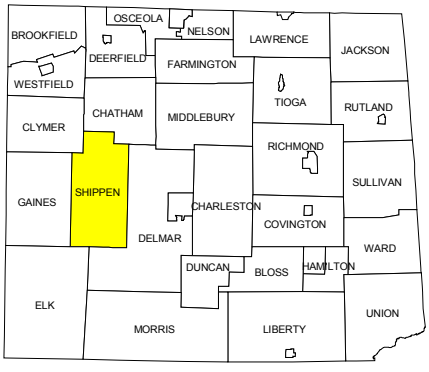
forested blocks
square miles
- 1-3
- 3-5
- >5

SHIPPEN TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
ASAPH SLOPES (5)	Animal species of concern	G5	S3S4B,S4N	N	1987-4-29	C
BEAR WALLOW WETLANDS (5)	soft leaved sedge (*Carex disperma*)	G5	S3	PR	2005-7-26	E
BLACK ASH SWAMP (5)	Graminoid Marsh	GNR	S3	N	1985-8-21	D
	Baltimore Checkerspot (*Euphydryas phaeton*)	G4	S2S4	N	2005-7-7	E
GOODALL FIRETOWER VERNAL POOLS (3)	northeastern bulrush (*Scirpus ancistrochaetus*)	G3	S3	PE	2005-7-7	E
LAKE LARD SLOPES (5)	cranesbill (*Geranium bicknellii*)	G5	S1	PE	2002-6-27	C
LAKE LARD POOLS (3)	few-seeded sedge (*Carex oligosperma*)	G5	S2	PT	2004-7-15	AB,B
	Ephemeral/Fluctuating Natural Pool	GNR	S3	N	2004-7-15	E
	Acidic Glacial Peatland Complex	GNR	SNR	N	2004-7-15	E
MARSH CREEK FLOODPLAIN (2)	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Animal species of concern	G5	S2S3B	N	2005-6-30	E
	Northern Bluet (*Enallagma annexum*)	G5	S3	N	2005-6-30	E
MIDDLE RIDGE SWAMP (4)	marsh bedstraw (*Galium trifidum*)	G5	S2	N	2005-8-18	BC
MIDDLE RIDGE VERNALS (5)	few-seeded sedge (*Carex oligosperma*)	G5	S2	PT	1993-6-24	E
PINE CREEK GORGE (1)	Elktoe (*Alasmidonta marginata*)	G4	S4	N	1997	AB
	Brook Floater (*Alasmidonta varicosa*)	G3	S2	N	1997	AB
	Green Floater (*Lasmigona subviridis*)	G3	S2	N	1997	AB
	Triangle Floater (*Alasmidonta undulata*)	G4	S3S4	N	1997	AB
	Earwig Scorpionfly (*Merope tuber*)	G3G5	SU	N	2000-8-3	C
	Sprengel's sedge (*Carex sprengelii*)	G5	S3	N	2005-5-17	C

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
PINE CREEK GORGE (1)	wild-pea (*Lathyrus ochroleucus*)	G4G5	S1	PT	2005-5-16	BC
	roundleaf serviceberry (*Amelanchier sanguinea*)	G5	S1	TU	2005-5-16	C
	Red-head Pondweed (*Potamogeton richardsonii*)	G5	S3	PT	2000-9-29	D
	Canada buffalo-berry (*Shepherdia canadensis*)	G5	S1	PE	2001-8-28	CD
	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2000-8-4	B
	slender wheatgrass (*Elymus trachycaulus*)	G5	S3	N	2001-5-15	C
	common juniper (*Juniperus communis*)	G5	S2	N	2001-10-3	C
	ebony sedge (*Carex eburnea*)	G5	S1	PE	2001-10-3	CD
	Allegheny Woodrat (*Neotoma magister*)	G3G4	S3	PT	1999-5-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2003	E
	Animal species of concern	G5	S2S3B,S3N	N	1988	E
	Erosional Remnant	GNR	SNR	N	1979	E
WOODRUFF HOLLOW WETLANDS (5)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2005-7-7	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

Managed Lands: Pine Creek Gorge Natural Area, Leonard Harrison State Park, Colton Point State Park, Tioga State Forest, Asaph Wild Area, Black Ash Swamp Natural Area

High Quality Cold Water Fishery: Asaph Run, Straight Run, Fourmile Run, Little Fourmile Run, Bee Tree Hollow, Owassee Slide Run, Pinafore Run, Darling Run, Schanbacher Hollow, Harrington Hollow, Woodruff Hollow, Steele Run Hollow, Strap Mill Hollow, Pine Creek Main Stem: Marsh Creek to Mouth

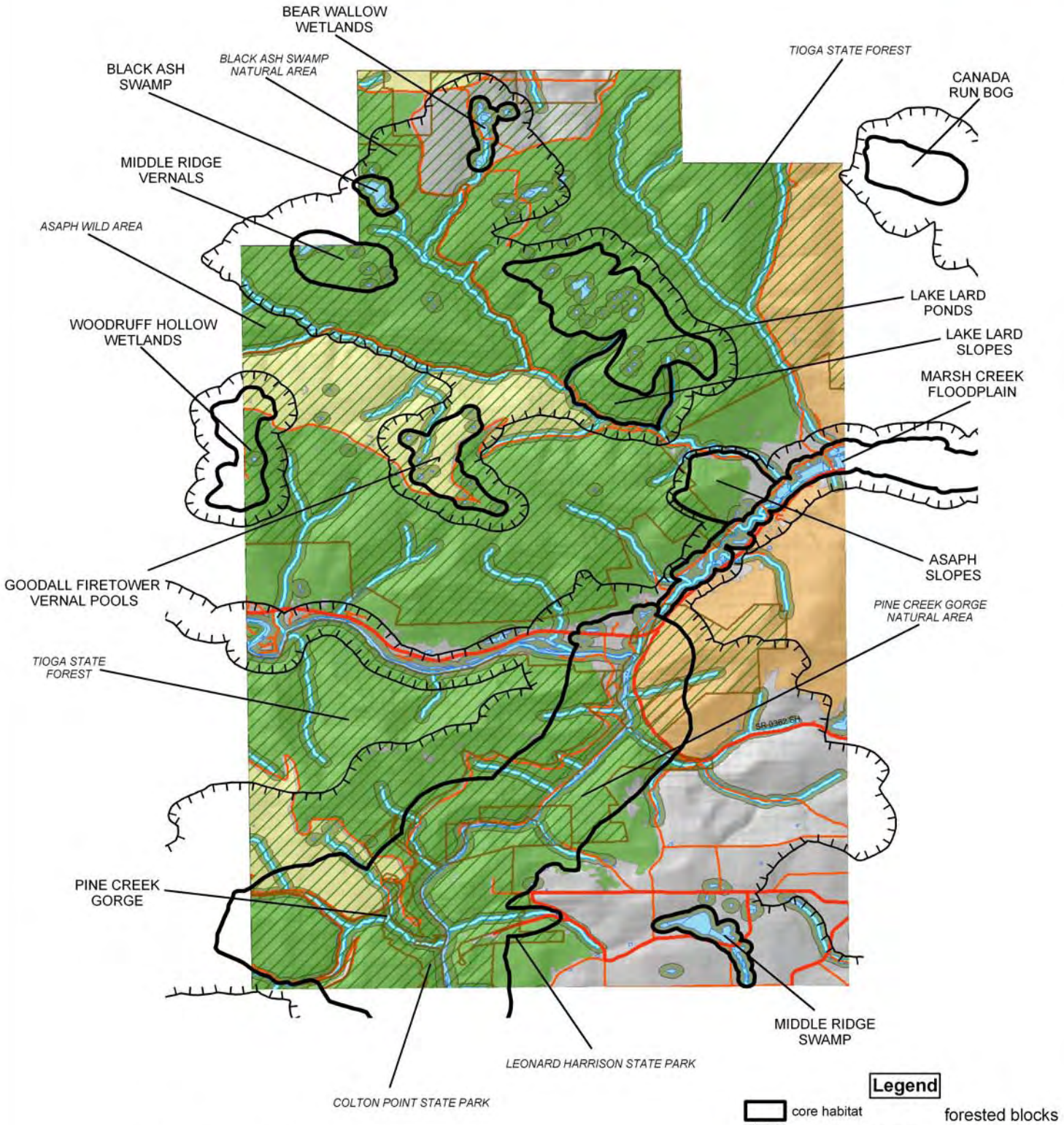
Exceptional Value Stream: Pine Creek Main Stem: South Branch Pine Creek to Marsh Creek

Aquatic Classification Project Results:
Warm Water Community 1—Pine Creek-Marsh Creek, Stony Fork, East Branch Stony Fork
Cool Water Community 1—Marsh Creek
Cold Water Community—Asaph Run
Riffle Beetle / Water Penny Community—Marsh Creek
Eastern Elliptio Community—Pine Creek-Cedar Run, Marsh Creek

SHIPPEN TOWNSHIP MAP

Shippen Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Scale: 1:100,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Shippen Township is mostly within the Deep Valley Section of the Ridge and Valley geographic province as it stretches into Tioga County. The township is almost entirely forested and forms part of a forested finger stretching across the whole county. These significantly-sized forest blocks are largely managed by the Tioga State Forest. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The township is notable for the many high-quality forested creeks and headwater streams flowing into Marsh and Pine Creeks. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, maintaining forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Protection of the continuity of the forested corridor through the county is critical to maintaining this area as a wildlife corridor and to protecting the water quality of the Pine Creek watershed. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Woodruff Hollow Wetlands

ASAPH SLOPES (Shippen Township)

The Asaph Slopes site overlooks the Marsh Creek Floodplain. A nest site of **a G5 S3S4B,S4N species of concern**, was located at this site in 1987. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

The Asaph Slopes site occurs on private land that abuts Tioga State Forest land, and could be threatened by future timbering operations.

Conservation Measures

A no-cut forested buffer should be established around this site to maintain the habitat used by this rare species for nesting.

BEAR WALLOW WETLANDS (Shippen Township)

Two large beaver influenced wetlands and one small sphagnous wetland occur in this site. A population of the **G5, S3 PA-rare plant soft-leaved sedge (*Carex disperma*)** was documented in a small shrub-dominated sphagnum wetland. This wetland is isolated from flowing water, getting its water input primarily from precipitation and runoff. The wetland is carpeted in sphagnum moss forming numerous mounds that are habitat for plants needing slightly drier root bases like cinnamon fern (*Osmunda cinnamomea*) and the soft-leaved sedge. Short shrubs and trees form a loose tangle through most of the wetland. The other two wetlands are much larger and have been subject to cyclic beaver influence. The beaver dams have recently collapsed, leaving wide expanses of water saturated soil and early successional graminoids like rice cut grass (*Leersia oryzoides*), soft rush (*Juncus effusus*) and woolgrass (*Scirpus cyperinus*). These beaver modified wetlands provide valuable habitat for a number of plant and animal species including numerous dragonflies. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances:

Two utility rights-of-way skirt the larger wetlands and a forestry service road passes between the two larger wetlands. The wetlands are on Tioga State Forest property, but are adjacent to private land, some of which has been recently fragmented by subdivision. Fragmentation of the forest by additional roads, utility ROWs and development may decrease the quality of the forest matrix and the wetlands they contain by contributing to the edge effect and the spread of invasive species of plants and animals.

Conservation Recommendations:

Preserve a 100-meter undisturbed forester buffer around all wetlands. Avoid further fragmentation of the forest with additional roads, utility ROWs and development

BLACK ASH SWAMP (Clymer and Shippen Townships)

Black Ash Swamp is a 25-30 acre, high elevation marsh dominated by cutgrass (*Leersia oryzoides*) and woolgrass (*Scirpus cyperinus*) with a mixture of cattail (*Typha latifolia*) and sedges (*Carex* spp.). This site is a graminoid marsh, the result of previous beaver activity as evidenced by numerous dead trees and the remnants of a beaver dam. **Graminoid marshes are a tracked community in Pennsylvania and are ranked GNR S3**. Surveys in 2005 located a **population of Baltimore Checkerspot (*Euphydryas phaeton*), a G4 S2S4 species of concern**. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Beavers have previously modified this site.

Conservation Recommendations

This site occurs on Tioga State Forest property and is part of the Black Ash Swamp Natural Area. No management is necessary as the site is already protected, but spraying for gypsy moth control should steer clear of the area around Black Ash Swamp to avoid harming the Baltimore Checkerspot population at this site.

GOODALL FIRE TOWER POOLS (Shippen Township)

The high elevation forested plateau in this area includes several small wetlands, some of which are

characteristic of vernal pools, while others are larger and more complex. Vernal pools frequently dry completely in the summer, but are filled with water in the winter and early spring. They provide the necessary breeding habitat for several species of amphibians, some of which breed solely in this type of habitat. Also occurring in several of these pools is the **G3 S3 PA-endangered northeastern bulrush (*Scirpus ancistrochaetus*)**. This plant is considered to occur almost exclusively in temporary pools. The majority of the occurrence of this globally rare species occur in Pennsylvania. The Tioga County populations of this species are an important component of the global distribution of this species. One of the pools is very small and has been subject to frequent disturbance. The population of northeastern bulrush at this pool is small. Another pool in this group is larger, with zones of shrub swamp and herbaceous openings dominated by cinnamon fern. The ground layer is dominated by deep hummocks of sphagnum and politrychum mosses. A large population of northeastern bulrush occurs in this pool system. The pool system is ringed by a narrow hemlock palustrine forest that has seen some past logging disturbance. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

northeastern bulrush (*Scirpus ancistrochaetus*)

Threats and Disturbances:
One of the pools of this group is close to a narrow dirt road. A forestry logging road also skirts the edge of the pool. The logging road also serves as a horse and hiking trail. Horse tracks lead through the edge of one of the pools. Weed seeds present in horse dung could potentially infect the pools with invasive species of plants. Logging has occurred directly adjacent to several of the pools. Logging of the pool's forested buffers facilitates excessive siltation of the pools. Removal of the forested canopy also changes the light, temperature and other microhabitat features of the wetlands.

Conservation Recommendations:
The pools should have a 100-meter undisturbed forested buffer to protect them from external disturbances. Logging roads and horse trails should be rerouted well away from the pools. The populations of northeastern bulrush at these pools should be monitored periodically. Other pools on this plateau should be the focus of future biological surveys.

LAKE LARD POOLS (Shippen Township)

Lake Lard Pools contains a high elevation group of **Ephemeral/Fluctuating Natural Pools, a GNR S3 tracked community** and **an Acidic Glacial Peatland Complex, a GNR SNR tracked community**. Within this group of wetlands is a large boggy wetland with graminoid herbaceous vegetation. This site has a carpet of Sphagnum moss, interspersed with cinnamon fern (*Osmunda cinnamomea*), woolgrass (*Scirpus cyperinus*), rattlesnake mannagrass (*Glyceria canadensis*), and three-way sedge (*Dulichium arundinaceum*). The dominant species at this site is the **state threatened**

G5 S2 few-seeded sedge, *Carex oligosperma* which creates a monoculture in a portion of the wetland. The land surrounding the wetlands is forested and lies on Tioga State Forest land. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

No threats were noted during the recent surveys; however, because the site occurs on Tioga State Forest land, the site could potentially be threatened by future timbering operations.

Conservation Recommendations

At the very least, a no-cut 100 meter forested buffer should be established around the pools. To protect the rare species that inhabit this community, linkage between the pools should be preserved.

LAKE LARD SLOPES (Shippen Township)

This site lies to the southwest of the Lake Lard Pools site. Along the hillside, a **population of the G5 S1 state endangered cranesbill (*Geranium bicknellii*)** was discovered in 2002. This species thrives under a variety of conditions, including recently disturbed areas. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Recent logging activities have occurred at this site.

Conservation Recommendations

No specific management is needed for this species.

Photo Source: PNHP

Lake Lard

MARSH CREEK FLOODPLAIN (Shippen and Delmar Townships)

This site is an expansive but rather narrow stretch of cattail (*Typha latifolia*) dominated marsh that stretches along Marsh Creek in an agricultural and rural housing setting. An old railroad bed trail is adjacent to the marsh (Norman 1994). A survey of the floodplain in 2005 revealed **a population of a G5 S2S3B bird species of concern**. This species requires shallow wetlands that support tall marsh plants in which they build their nests. Nest building usually occurs in cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.). Additionally, during the most recent site survey **a G5 S3 animal species of concern, the Northern Bluet (*Enallagma annexum*)** was captured and a **G4 S3S4 species of concern, the Triangle Floater (*Alasmidonta undulata*)** was located at the site in 1997. Both of these species use wetlands as their primary habitats. This site overlaps the core boundary of the Marsh Creek Wetlands Important Bird Area #27 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Hydrologic changes due to beavers or humans could negatively affect the current wetland community by reducing the shallower portions of floodplain. The tall marsh plants upon which the inhabiting rare species relies on for nest construction could be reduced or eliminated from an increase in water level. The residential areas and agriculture associated with the floodplain, could result in nutrient influx that may decrease the water quality and alter the floral makeup of the site. Invasive species, such as Purple loosestrife (*Lythrum salicaria*), are currently degrading the habitat at the site. By choking out the native plant species, the diversity of the entire site is reduced and the continual spread of the exotics could eventually lead to the exclusion of the rare species currently found at the site. Further draining of the wetlands for additional residential and commercial development would jeopardize the quality of the unique habitats at this site.

Conservation Recommendations

Hydrologic conditions should be maintained to promote the shallower waters that support marsh

Northern Bluet (*Enallagma annexum*)

plants. Beaver activity could severely impact the habitat by increasing water depth so that the marsh plants are excluded. Beavers should be monitored and removed if they would begin to alter the structure of the wetland. Much of the floodplain is used as agricultural fields and a vegetated buffer of native species would help reduce the amount of nutrient and sediment influx from nonpoint sources into the wetland. The invasive species that are present on the site are threatening the native plant communities and action should be taken to reduce the spread or eliminate these aggressive invasives. The habitat for the rare species at this site could be improved if efforts were made to restore portions of the floodplain to their natural conditions. If land is to be converted from present agricultural use, a wide forested buffer should be developed along the length of the marsh to decrease contamination from non-point sources of pollution. Restoration efforts could eventually increase the habitat for the rare species that inhabit the floodplain.

MIDDLE RIDGE SWAMP (Delmar and Shippen Townships)

This site is a relatively undisturbed wetland dominated by cattails (*Typha* sp.) and other herbaceous plants. Occasional thickets of shrubs or small trees are present, particularly along the edges and at the eastern end. At least one active beaver dam was noted in the 2005 surveys. Some bog species were encountered at the site including leatherleaf (*Chamaedaphne calyculata*). The thick vegetation at the site provides good wildlife habitat. A recent survey of the site yielded **a population of a G5 S2 species of concern, marsh bedstraw (*Galium trifidum*)**. This site is partially within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances:

Agricultural practices are upslope of the site and runoff from these areas is likely decreasing the water quality of the wetland. Beaver activity was noted in the recent survey. Additionally, there are large portions of the wetland, mainly on the southern quarter, that are nearly exclusive monocultures of the invasive exotic, purple loosestrife (*Lythrum salicaria*).

Conservation Recommendations:

A 100 meter no-cut forested buffer should be established around the wetland to minimize runoff from nearby agricultural practices. Beaver activity should be monitored so that control measures can be quickly employed if the beavers begin to dramatically alter the site. Progress of the purple loosestrife should be monitored and control measures should be implemented if the plant spreads further northward.

MIDDLE RIDGE VERNALS (Clymer and Shippen Townships)

These fluctuating wetlands sit high atop the ridge and are dependent on rainfall for their sole source of water input. There is a dense shrub layer of highbush blueberry (*Vaccinium corymbosum*), mountain holly (*Nemopanthus mucronatus*), and leatherleaf (*Chamaedaphne calyculata*). A forest of tall trees, including eastern white pine (*Pinus strobus*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), and yellow birch (*Betula alleghaniensis*) surrounds the wetlands. During a 1993 survey of the site, a population of the **G5 S2 threatened plant species, the few-seeded sedge (*Carex oligosperma*),** was located at this site. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances

This site is within the Black Ash Swamp Natural Area. No apparent threats were noted during a recent site visit.

Conservation Recommendations

The Middle Ridge Vernals are within the Black Ash Swamp Natural Area. The current protection of the forest is sufficient for the protection of the wetlands at this site.

PINE CREEK GORGE (Delmar, Elk, Gaines, Morris and Shippen Townships)

This area encompasses an approximate sixteen mile stretch of Pine Creek Gorge, including the "Grand Canyon of Pennsylvania", and is well known for its scenic values and outdoor recreation activities. In addition, the gorge is very noteworthy from the standpoint of geology, as it illustrates to a remarkable extent the natural processes of glaciation and erosion.

The gorge also has major biodiversity significance. The slopes of the main gorge and its tributary streams have mesic hardwood forests on the more-protected lower and middle slopes, and eastern hemlock (*Tsuga canadensis*) dominated forests or mixed hardwood/conifer forests on the steeper, northerly-facing slopes. The extremely steep upper slopes and rims of the gorge, particularly where tributary streams have further dissected the terrain, often feature a more scrubby woodland, consisting of mixed hardwoods and conifers, along with various shrubs and herbaceous plants. The growing conditions on the upper slopes and rims are challenging, due to thin soil, outcroppings of sandstone and shale bedrock, exposure to winds, and occasional wildfire. These scrubby areas support a number of plant species of special concern that are of generally northern distribution, including the **G5 S1 PA-species of concern roundleaf serviceberry (*Amelanchier sanguinea*), G5 S1 PA-endangered ebony sedge (*Carex eburnea*), G5 S3 PA-species of concern slender wheatgrass (*Elymus trachycaulus*), G5 S2 PA-species of concern common juniper (*Juniperus communis*), G4G5 S1 PA-threatened wild pea (*Lathyrus ochroleucus*)**, and the **G5 S1 PA-endangered Canada buffalo-berry (*Shepherdia canadensis*)**, as well as a variety of other plant species. These steep slopes also support populations of two animal species of special concern, including **the G3G4 S3 PA-threatened Allegheny Woodrat (*Neotoma magister*),** and another **animal species of special concern ranked G5 S2S3B,S3N**.

The waters of Pine Run, adjacent floodplain, and lower slopes support the **G5 S2B PA-threatened Bald Eagle (*Haliaeetus leucocephalus*)**, the **G5**

Canada buffalo berry (*Shepherdia canadensis*)

S3 plant species of concern, Sprengel's sedge (*Carex sprengelii*) and six invertebrate animal species of special concern including the **Elktoe (*Alasmidonta marginata*), ranked G4 S4,** the **Brook Floater (*Alasmidonta varicosa*), ranked**

G3 S2, the **Green Floater (*Lasmigona subviridis*), ranked G3 S2,** the **Triangle Floater (*Alasmidonta undulata*), ranked G4 S3S4**, the **Earwig Scorpionfly (*Merope tuber*), ranked G3G5 SU**, and the **Ocellated Darner (*Boyeria grafiana*), ranked G5 S3**. The **Red-headed Pondweed (*Potamogeton richardsonii*), a G5 S3 threatened species** is also known from the waters of Pine Creek in the gorge. Barbour Rock, which overlooks Pine Creek Gorge, is recognized as an outstanding geologic feature in the state and this **erosional remnant is ranked GNR SNR**. This site roughly overlaps the core boundry of the Pine Creek Gorge Natural Area Important Bird Area #28 defined by the Pennsylvania Audubon Society.

Threats and Disturbances

Exotic and weedy native species are well established in the base of the gorge, particularly along the former railroad bed (now Pine Creek Trail) and Pine Creek. Japanese knotweed (*Polygonum cuspidatum*) and reed canary grass (*Phalaris arundinacea*), which are particularly invasive, represent a threat to the species diversity along the margins of Pine Creek.

Maintaining high water quality is necessary for the continued viability of the aquatic animal and plant life in Pine Creek.

Conservation Recommendations

This tract of land is almost completely owned by the Bureau of Forestry of the Pennsylvania Department of Conservation and Natural Resources, and is included in the Pine Creek Gorge Natural Area. The utilization of this area for outdoor recreation would appear to be compatible with maintaining the significant biodiversity features.

The major recommendations would be taking steps to control invasive plant species along Pine Creek and safeguarding the water quality in the surrounding watershed.

In order to protect the delicate communities and species that inhabit the Pine Creek Gorge, private land inholdings around the rim of the gorge should be managed to preserve the integrity of this unique natural feature.

WOODRUFF HOLLOW WETLANDS (Gaines and Shippen Townships)

The Plateau in this area is primarily covered in a dry oak – heath forest dominated by black (*Quercus velutina*), red (*Q. rubra*), white (*Q. alba*) and chestnut (*Q. prinus*) oaks underlain by shrubs in the heath family including various low growing blueberries and huckleberries (*Vaccinium* spp.) and occasional thick tangles of mountain laurel (*Kalmia latifolia*). Several small isolated wetlands also occur in this habitat and provide important habitat for wetland dependent plants and animals. A population of **the G5, S3 PA-rare creeping snowberry (*Gaultheria hispidula*)** was documented in a shrub and sedge dominated acidic wetland on this plateau. Creeping snowberry is related to the common wintergreen and shares its characteristic wintergreen aroma. It grows infrequently in Pennsylvania, occurring primarily in bogs and acidic wetlands in the northern portion of the state. This plant typically grows on elevated hummocks of deep sphagnum moss within saturated soils of a wetland or within the swamp forest edges of a wetland opening. This wetland is also noteworthy for a good diversity of lichens clinging to the trees and shrubs. This site is entirely within the conservation boundry of the Pine Creek Gorge Natural Area Important Bird Area defined by the Pennsylvania Audubon Society.

Threats and Disturbances:

There were no observed disturbances to this site. Logging of the forested buffer surrounding the wetland is a potential threat.

Conservation Recommendations:

Preservation of a 100-meter undisturbed forested buffer around all wetlands on this plateau will help provide isolation from potential external disturbances. Other isolated wetlands on this plateau should be the focus of future biological surveys.

SULLIVAN TOWNSHIP

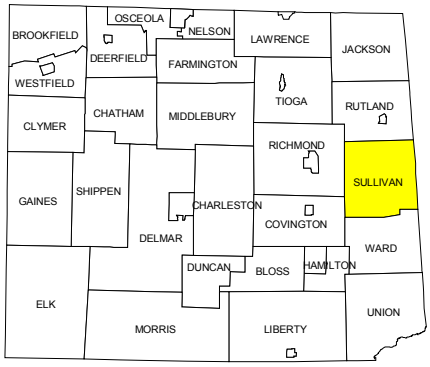
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
RT-6 COUNTY LINE WETLANDS (4)	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2003-8-6	E
	Hemlock Palustrine Forest	GNR	S3	N	2003-8-6	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: Armenia Mountian Wetlands

Managed Lands: none

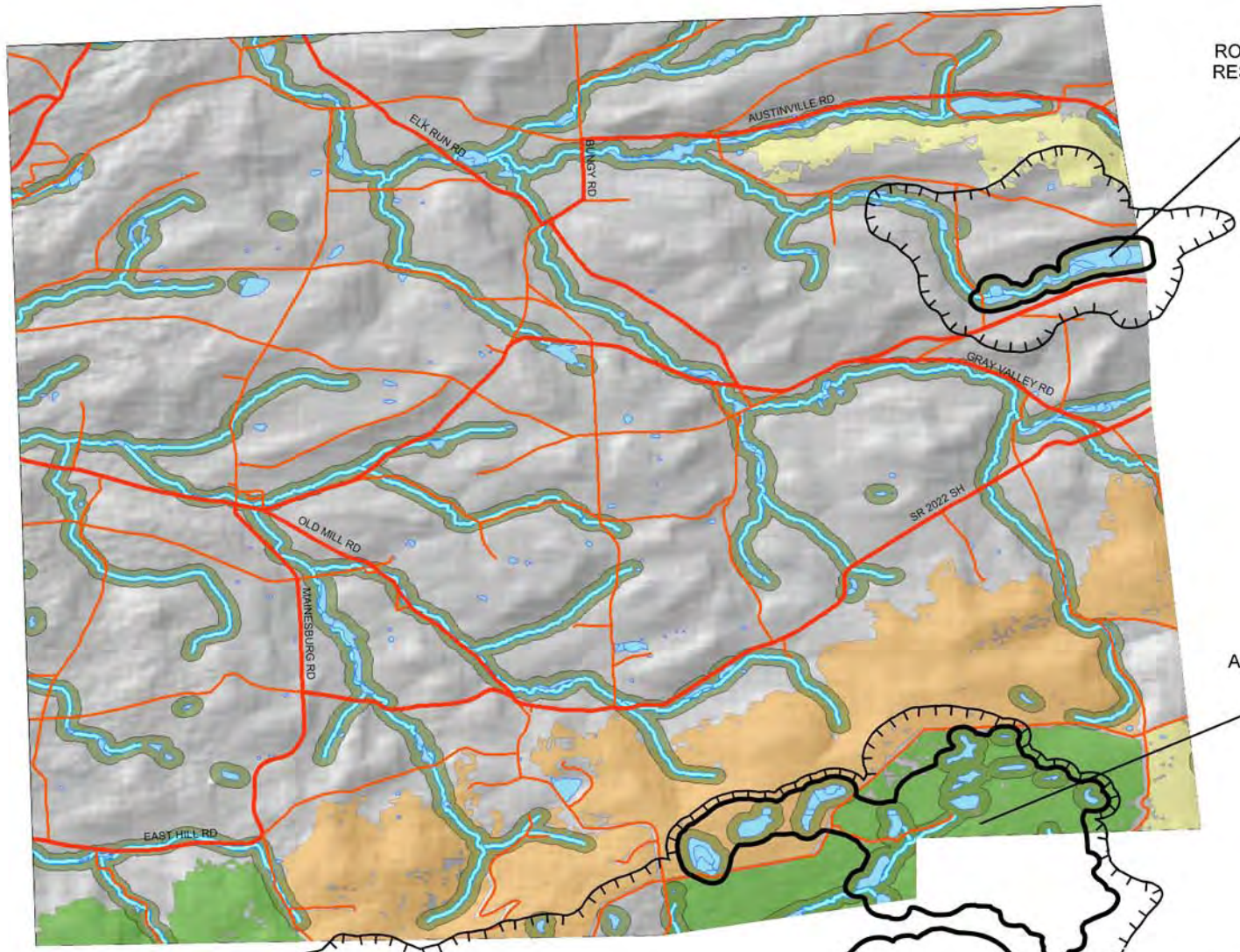
Aquatic Classification Project Results:
Warm Water Community 1—Corey Creek
Cold Water Community—Elk Run
Brushlegged Mayfly / Fingernet Caddisfly—Canoe Camp Creek
Nemourid Broadback Stonefly / Ameletid Mayfly—Corey Creek



Sullivan Township includes portions of two physiographic sections: the Glaciated Low Plateau Section of the Appalachian Plateaus, and the Glaciated High Plateau in the southeastern corner. The divisions between these provinces define the land use in the township—primarily forested in the High Plateau and agricultural in the more fertile Low Plateau. The High Plateau portion is almost entirely forested and forms a forested finger stretching across the whole county. The Low Plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams. Elk and Corey Creeks are major drainages through the township. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that are part of the contiguous forested High Plateau. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin.

Sullivan Township
Tioga County, PA

Pennsylvania Natural Heritage Program



ROUTE 6 COUNTY LINE
REST STOP WETLANDS

Armenia Mountain Wetlands

FELLOWS CREEK
WETLANDS EAST

Scale: 1:80,000

0 0.5 1 2 Miles

Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

RT-6 COUNTY LINE WETLANDS (Sullivan Township and Bradford County)

This site contains forested wetlands that support a good–quality population of the **soft-leaved sedge (*Carex disperma*) a G5 S3 PA-rare plant species of concern.** This site has richly diverse vegetation that includes a **GNR S3 Hemlock Palustrine Forest Natural Community**. This wet forested type is characterized by the dominance of hemlock in saturated soils. The hemlocks are raised on their moss-covered roots out of the thick muddy substrate in typical mound and pool topography. A rare fern species, Clinton's shield fern (*Dryopteris clintoniana*), was last documented from this site in 1935. This fern was not relocated at this site in 2003.

RT-6 County Line Road Wetlands

Threats and Disturbances:

The potential of logging within this wetland poses a threat to the integrity of the habitat at this location. Changes in the hydrology (damming or draining) could destroy the forested wetland occurring at this site. Runoff from the roadway and adjacent rest stop could contribute to degradation of the water quality.

Conservation Recommendations:

Logging should be avoided within and adjacent to the forested wetland. Some areas adjacent to the wetland may require additional forested buffers to minimize the impact of non-point sources of pollution. Forested buffers provide critical protection to streams by reducing nutrient, sediment and toxic runoff from roads, residences and agricultural fields. Monitoring for invasive species of plants is also recommended. Removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

Locally Significant Sites:

Armenia Mountain Wetlands (Sullivan and Ward Townships)

This expansive wetland complex has portions of open canopied wet meadows while other wetlands in the system are completely forested. Future biological surveys should be conducted at this site.

Threats and Disturbances

The site lies on private property and Tioga State Forest land and may be slated for future timbering operations. Numerous forestry roads are throughout the site.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this wetland in order to maintain the character of the site.

- notes -

TIOGA TOWNSHIP and Tioga Borough

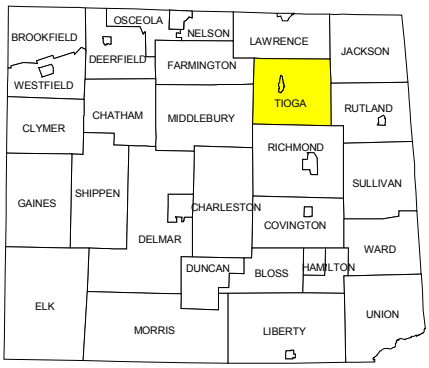
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
HAMMOND LAKE MACROSITE (3)	Osprey (*Pandion haliaetus*)	G5	S2B	PT	2001-6-5	E
	Bald Eagle (*Haliaeetus leucocephalus*)	G5	S2B	PT	2000	E
	Pied-billed Grebe (*Podilymbus podiceps*)	G5	S3B,S4N	N	1994	E
MITCHELL CREEK SLOPES (5)	Northern Myotis (*Myotis septentrionalis*)	G4	S3B,S3N	N	2003-8-5	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: West Branch Painter Run Headwaters

Managed Lands: State Game Lands #37

Aquatic Classification Project Results:
Warm Water Community 1—Mill Creek, Tioga River-Crooked Creek, Crooked Creek
Warm Water Community 2—Tioga River-Cowanesque River
Rolledwinged Stonefly / Small Minnow Mayfly—Mill Creek, Crooked Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Cowanesque River
Nemourid Broadback Stonefly / Ameletid Mayfly—Tioga River-Crooked Creek
Eastern Floater Community—Crooked Creek



Tioga Township is within the Glaciated Low Plateau Section of the Appalachian Plateaus to the north and the Deep Valley Section of the Ridge and Valley geographic province along the southern portion of the township. The Deep Valley portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by State Game Lands #37. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. Water resources in the township are dominated by the confluences of the Crooked Creek and Mill Creek with the Tioga River, and Hammond and Tioga Lakes and dams. The township land uses are mixed, including agriculture, forestry, and road corridors. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

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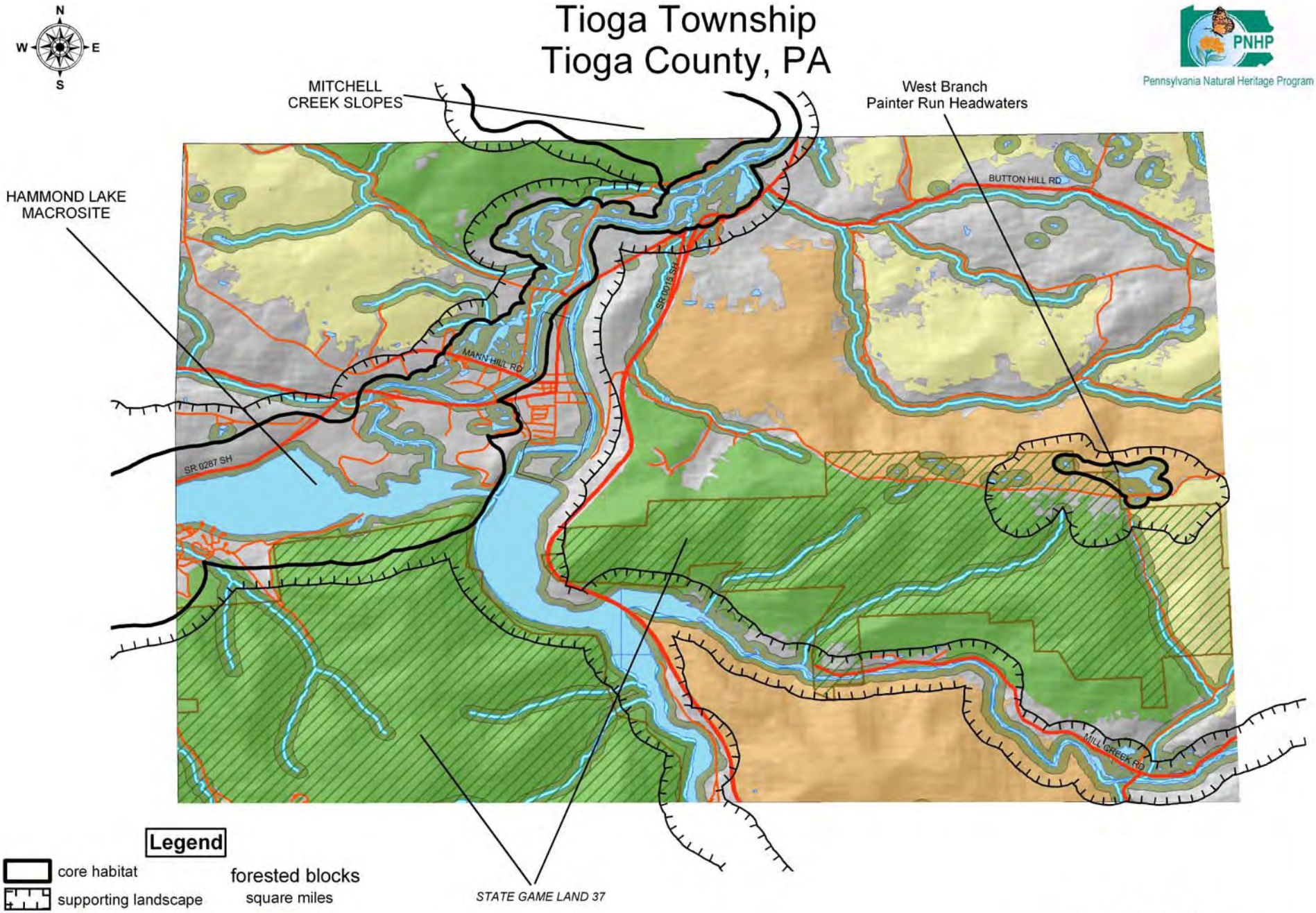
Tioga County, PA



Pennsylvania Natural Heritage Program

HAMMOND LAKE MACROSITE (Tioga and Middlebury Townships)

The Hammond Lake reservoir was created within the last 30 years. Although created open water habitats are generally considered to have rather low biological diversity, some species tend to thrive in these habitats. Hammond Lake is one of two reservoirs in Tioga County that support the **G5 S2B threatened species, the Osprey (*Pandion haliaetus*)**. Numerous nesting pairs have been recorded from this site for the past 10 years. Additionally, the **threatened Bald Eagle (*Haliaeetus leucocephalus*), a G5 S2B species** have nested around Hammond Lake. In 1994, **the G5 S3B,S4N Pied-billed grebe (*Podilymbus podiceps*), a species of concern,** was found nesting at this site.

Threats and Disturbances

The rare species that use this site rely on the water quality of the reservoir and any decrease in water quality could negatively impact the persistence of these rare organisms. There are agricultural practices upstream from the reservoir and the runoff from animal waste and fertilizers along with soil erosion associated with agriculture could decrease the water quality of the reservoir. Additionally, the lake is used heavily for recreation and the use of 2-cycle engines increases water pollution.

Conservation Recommendations

The establishment of forested buffers along the banks of the Crooked Creek could help improve the water quality of the creek and reservoir by limiting the input of agricultural wastes and reducing the amount of soil erosion. Because of the potential for water quality changes from upstream agricultural inputs and recreational use of the lake, water quality at this site should be monitored.

MITCHELL CREEK SLOPES (Lawrence and Tioga Townships)

The Mitchell Creek Slopes site is a wooded ravine which overlooks the Tioga River and the Town of Mitchell Creek. During several 2003 surveys of this site, **a population of the G4 S3B,S3N species of concern, the Northern Myotis (*Myotis septentrionalis*)** was found feeding along the open areas at this site. While the relationship of this location to a maternity site or roost is unknown, the multiple individuals captured here on several different nights show that this population uses this site for foraging.

Locally Significant Sites:

West Branch Painter Run Headwaters (Tioga Township)

The wetland at this site is forested in sections with the vast majority of the wetland composed of a variety of other wetland shrubs and graminoids. This wetland may hold biological significance for Tioga County and future surveys should be conducted at this site.

Threats and Disturbances

This site is surrounded by forested land on private property and State Game Lands #37. The forest surrounding this site may be marked for future timbering practices.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the integrity of this site.

UNION TOWNSHIP

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
TIOGA RIVER AT BEAR RUN (5)	Ocellated Darner (*Boyeria grafiana*)	G5	S3	N	2005-8-2	E
	Ski-tailed Emerald (*Somatochlora elongata*)	G5	S2	N	2005-8-2	E
WEST MILL CREEK HEADWATERS (4)	Hemlock Palustrine Forest	GNR	S3	N	2005-6-28	E
	soft-leaved sedge (*Carex disperma*)	G5	S3	PR	2005-6-28	E

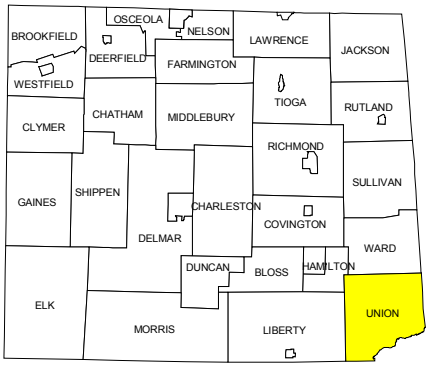
* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: East Point Forested Wetlands

Managed Lands: Tioga State Forest

High Quality Cold Water Fishery: Sugar Works Run, Mill Creek, West Mill Creek, Roaring Branch

Aquatic Classification Project Results:
Warm Water Community 1—Towanda Creek
Cold Water Community—Tioga River-Taylor Creek, Lycoming Creek-Rock Run, Roaring Branch
Brushlegged Mayfly / Fingernet Caddisfly—Roaring Branch, Lycoming Creek-Rock Run
Green Stonefly / Giant Black Stonefly—Tioga River-Taylor Creek

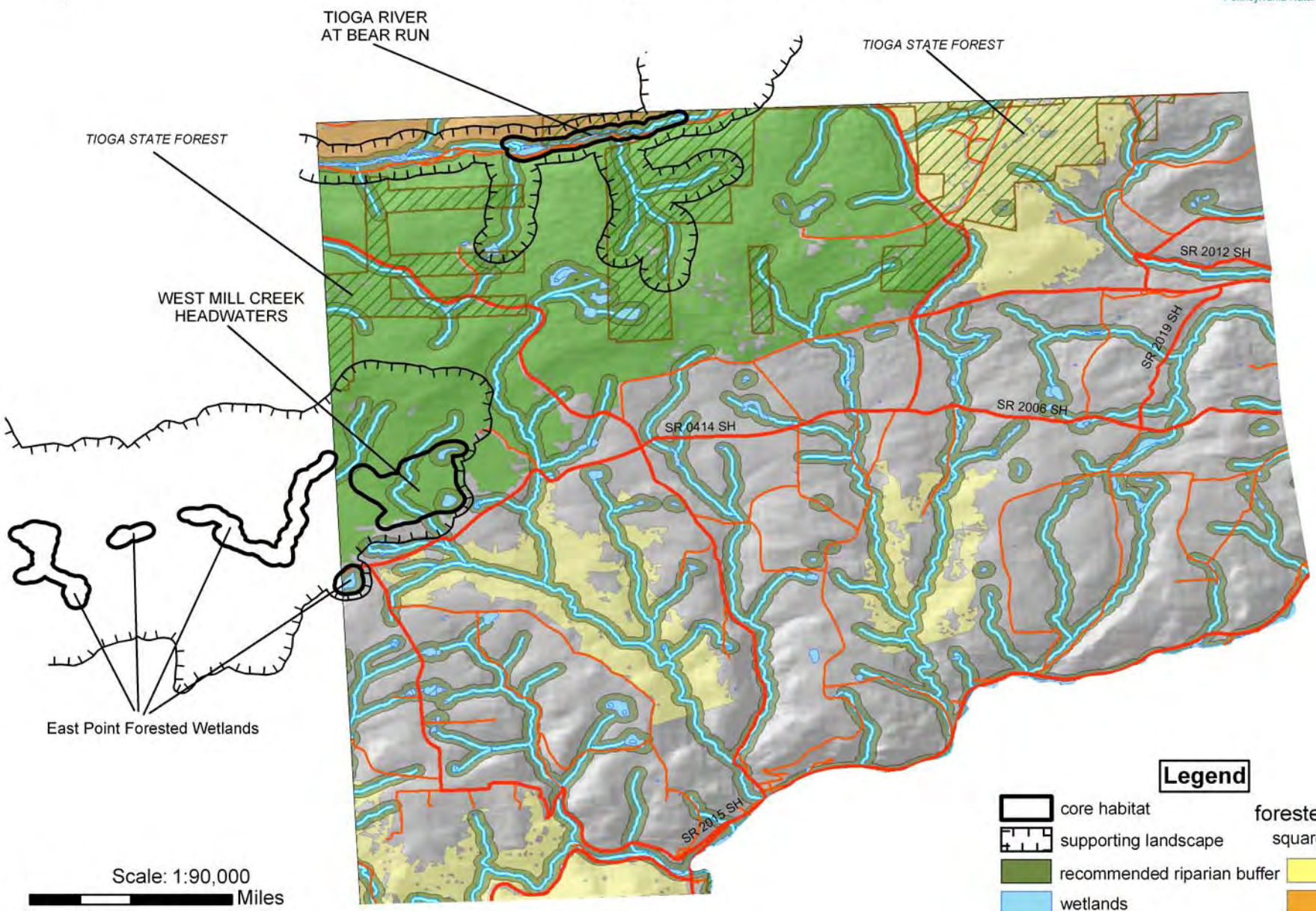


Union Township includes portions of two physiographic sections: the Glaciated Low Plateau Section of the Appalachian Plateaus in the southern portions, and the Glaciated High Plateau in the north. The divisions between these provinces define the land use in the township; primarily forested in the High Plateau and agricultural in the more fertile Low Plateau. The High Plateau portion is almost entirely forested and forms a forested finger stretching across the whole county. These significantly-sized forest blocks are partially managed by the Tioga State Forest. Conservation efforts to buffer the edges of the state lands from development and disturbance are important to the long-term quality of the wildlife and land resources within this corridor. The large tracts of forested land in the township support populations of the timber rattlesnake, a species of special concern in the state. Permit review processes within the township should consult with the Pennsylvania Fish & Boat Commission to minimize potential conflicts. The Low Plateau, though fragmented by agriculture, is host to an abundance of wetlands and headwater streams flowing to Lycoming Creek, several of which are rated High Quality. Streams in the High Plateau flow north to the Tioga River. Much of the biodiversity of the township can be maintained by avoiding draining or damming wetlands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township, and restoring riparian forest buffers. Most of the creeks in the township have existing riparian buffers that should be maintained. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in the watersheds flowing through the more heavily used portions of the township. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations.

UNION TOWNSHIP MAP

Union Township
Tioga County, PA

Pennsylvania Natural Heritage Program



TIOGA RIVER AT BEAR RUN (Union Township)

This site, nestled within Tioga State Forest and private forestland, is a scoured stony river bed which appears to flood violently periodically. Steep forested banks contrast drastically with the open canopied riverbed. The cobble scour and open canopy support vegetative communities that support a unique suite of animals. A 2005 survey of the site located two species of special concern including **a population of the G5 S2 Ski-tailed Emerald (*Somatochlora elongata*)** and **a population of the G5 S3 Ocellated Darner (*Boyeria grafiana*).**

Threats and Disturbances

A visit to the site in 2005 showed no apparent threats to the habitat. The forest upstream of the river remains intact. The integrity of the surrounding forest is an asset to the water quality of the river and the habitat at this site.

Conservation Recommendations

The integrity of the forest surrounding this site is critical to the maintenance of the river's water quality and the habitat at this site. Any forestry practices upstream of the river should be conducted with the well being of the river in mind. If the surrounding forest is to be cut, generous forested buffers around the river will be required to maintain the habitat at this site.

WEST MILL CREEK HEADWATERS (Union Township)

The West Mill Creek Headwaters site is a fair sized **Hemlock Palustrine Forest, a GNR S3 tracked community**, with a Sphagnum layer and dense cinnamon fern (*Osmunda cinnamomea*). This area also has some dryer hemlock forested areas. There is extensive forest to the north and rural housing and agriculture to the south. During recent surveys of the site, a **population of the PA-rare soft-leaved sedge (*Carex disperma*), a G5 S3 species** was found. This site lies on private property.

Threats and Disturbances

Beavers pose a threat to this site because their impoundments would flood the area and destroy the hemlock palustrine forest. Flooding would also eliminate the habitat for the soft-leaved sedge. Additional threats include logging, encroachment from agriculture and the runoff from the agricultural lands.

Conservation Recommendations

This natural community cannot handle complete inundation from flooding by beaver or through man-made structures. If beavers were to begin modifying this site through flooding, a trapping regimen should be employed. Additionally, logging should be kept to a minimum in this area. A no-cut 100 meter forested buffer should be established around this site.

Tioga River at Bear Run

Locally Significant Sites:

East Point Forested Wetlands (Liberty and Union Townships)

The wetlands that make up this site include eastern hemlock palustrine forests with some portions having sedgy openings. Future biological surveys should be conducted at this site.

Threats and Disturbances

Much of the area surrounding these wetlands is used for agriculture. It is likely that the runoff from these practices is decreasing the water quality of the wetlands by increasing the nutrient levels. The agricultural practices may also be adding to erosion which will further degrade the site.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around the site to maintain the character of these wetlands.

WARD TOWNSHIP

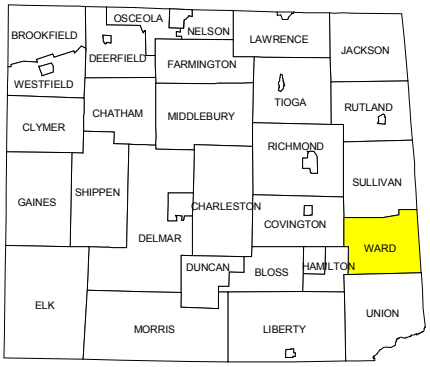
Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
FALL BROOK WETLANDS (4)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2005-8-11	B
FELLOWS CREEK WETLANDS WEST (2)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2003-6-26	AB,B,BC
	marsh willow-herb (*Epilobium palustre*)	G5	S1	TU	2003-10-7	BC
	showy mountain-ash (*Sorbus decora*)	G4G5	S1	PE	2003-6-26	BC
	Hemlock Palustrine Forest	GNR	S3	N	2004-7-1	E
	Silver-bordered Fritillary (*Boloria selene myrina*)	G5T5	S1S3	N	2004-6-2	E
FELLOWS CREEK WETLANDS EAST (3)	creeping snowberry (*Gaultheria hispidula*)	G5	S3	PR	2004-6-4	CD,E
	Animal species of concern	G5	S3B,S4N	N	2004-7-1	E
	Northern Bluet (*Enallagma annexum*)	G5	S3	N	2004-6-3	E

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.

Locally Significant: East Creek Headwaters, Armenia Mountain Wetlands

Managed Lands: Tioga State Forest

Aquatic Classification Project Results:
Cool Water Community 1—Tioga River-Corey Creek
Cold Water Community—Tioga River-Taylor Creek
Brushlegged Mayfly / Fingernet Caddisfly—Tioga River-Corey Creek
Green Stonefly / Giant Black Stonefly—Tioga River-Taylor Creek

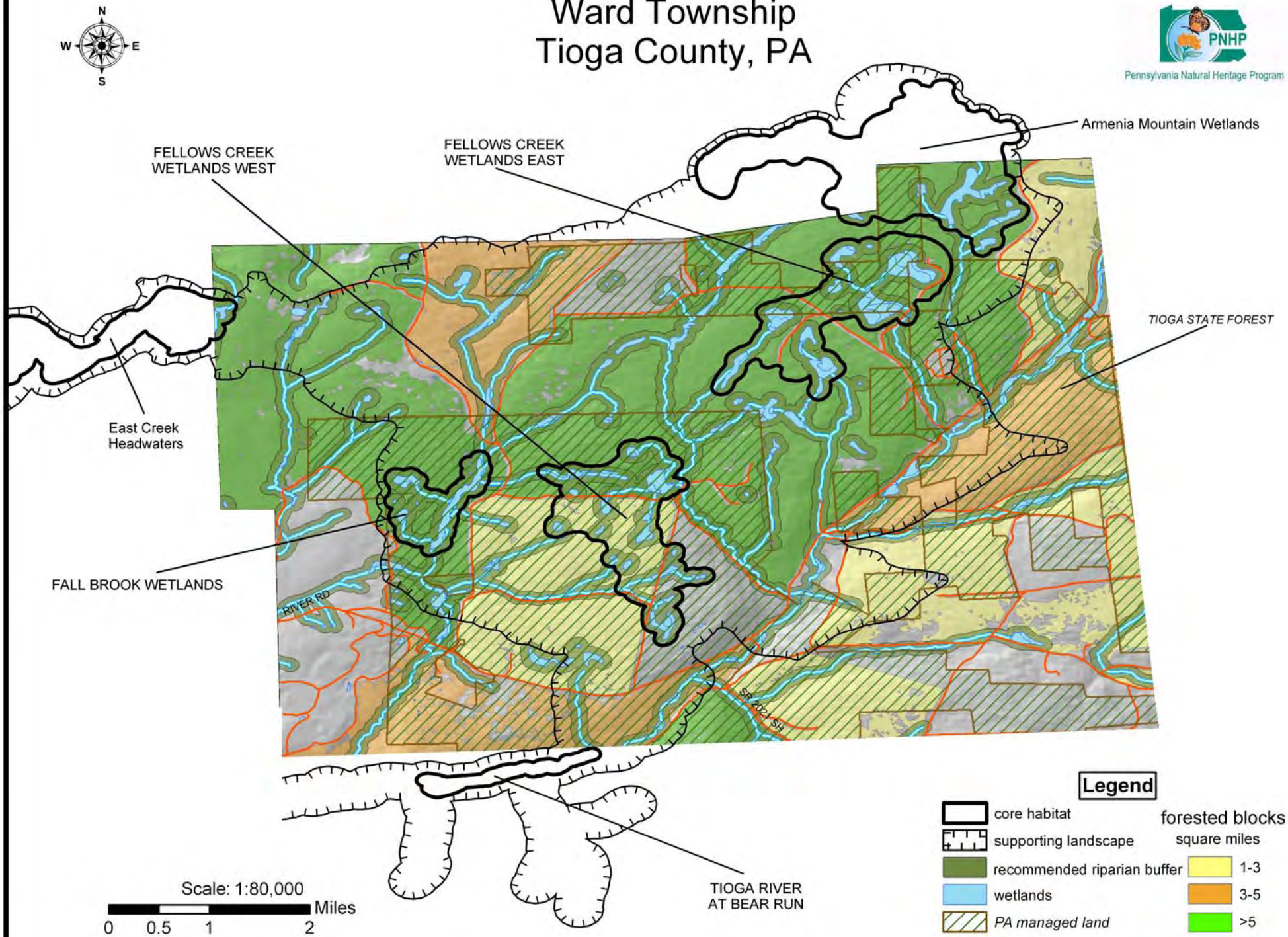


Ward Township is entirely within the Glaciated High Plateau Section of the Appalachian Plateaus. The township is predominantly forested and forms part of a forested finger stretching across the whole county. The plateau is host to an abundance of wetlands and headwater streams, characteristic of the formerly glaciated regions of the state. The township is primarily drained by the Tioga River, and portions have been heavily impacted by strip mining. Much of the remaining biodiversity of the township can be maintained by avoiding draining or damming wetlands, restoring formerly mined lands, providing forested buffers along watercourses, and avoiding fragmentation of the largest forest blocks with additional roads. Conservation efforts should concentrate on maintaining the large forest blocks that also provide buffering and protection for the aquatic resources of the township. In particular some of the largest wooded areas in the northcentral portion of the township are host to a significant number of wetlands and should be protected from fragmentation. Much of these lands are within the Tioga State Forest. Care should be taken during logging operations to avoid introducing invasive species of plants into the largely unfragmented forest blocks. Machinery should be thoroughly rinsed to avoid transferring invasive plant seeds and other exotic pests and pathogens from other locations. The spread of invasive species of plants could severely degrade the forest quality of the township. Prevention of or removal of invasive species as they first appear is easier and more cost effective than removal of established populations. Water quality should be monitored and restored in formerly mined portions of the township.

WARD TOWNSHIP MAP

Ward Township
Tioga County, PA

Pennsylvania Natural Heritage Program



FALL BROOK WETLANDS (Ward Township)

The Fall Brook Wetlands site is a reforesting wetland with a base of Sphagnum moss and other mosses (*Polytrichum* spp.). The site is dominated by saplings and small trees of red maple (Acer rubrum), eastern hemlock (*Tsuga canadensis*), yellow birch (Betula alleghaniensis) and clumps of shrubs, including mountain holly (*Nemopanthus mucronatus*) and withe-rod (*Viburnum cassinoides*). The site has several openings throughout that are dominated with tawny cotton grass (*Eriophorum virginicum*). During 2005 surveys, **a population of creeping snowberry (*Gaultheria hispidula*), a G5 S3 PA-rare species** was found at this site.

Threats and Disturbances

Many of the larger sized hemlocks seem to be dying, perhaps from the hemlock wooly adelgid.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the habitat for the rare species that occur here.

FELLOWS CREEK WETLANDS EAST (Ward Township)

The Fellows Creek Wetlands East site is a boggy, Sphagnum dominated wetland. The Sphagnum moss forms a carpet with cottongrass (*Eriophorum* spp.) and cinnamon fern (*Osmunda cinnamomea*) as associates. Recent surveys of this site located **population of creeping snowberry (*Gaultheria hispidula*),** and a **population of the Norhtern Bluet (*Enallagma annexum*), a G5 S3 speices of concern**. This site is also used by **a G5 S3B,S4N animal species of concern**, for breeding.

Threats and Disturbances

This site occurs on Tioga State Forest land and could be slated for future timbering practices.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the habitat for the rare species that occur here.

FELLOWS CREEK WETLANDS WEST (Ward Township)

This site is a boggy wetland with shrubs and small trees in the western portion. The eastern portion is more open and is dominated by Sphagnum moss and graminoids. A portion of this site is a Hemlock Palustrine Forest, a GNR S3 tracked community. Recent surveys of this site located a **population of creeping snowberry (*Gaultheria hispidula*) a G5 S3 PA-rare species** and **a G5T5 S1S3 species of concern, the Silver-bordered Fritillary (*Boloria selene myrina*)**. Additionally, surveys uncovered a population of **marsh willow-herb (*Epilobium palustre*), a G5 S1 species of concern** and **a population of the state endangered showy mountain-ash (*Sorbus decora*), a G4G5,S1 species**.

A portion of the Fellows Creek Wetlands

Threats and Disturbances

This site occurs on Tioga State Forest land and could be slated for future timbering practices.

A Hemlock Palustrine Forest

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the habitat for the rare species that occur here.

Locally Significant Sites:

East Creek Headwaters (Covington and Ward Townships)

This cluster of high altitude wetlands sits atop of Pine Hill and feeds East Creek. This site contains a mixture of wetlands, some are forested while others include some open water with sections of shrubs and open marshy areas. This site may hold biological significance for Tioga County. Future surveys should be conducted at this site.

Threats and Disturbances

This site is surrounded by forested land and the forest surrounding this site may be marked for future timbering practices.

Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this site to maintain the integrity of this site.

Armenia Mountain Wetlands (Sullivan and Ward Townships)

This expansive wetland complex has portions of open canopied wet meadows while other wetlands in the system are completely forested. Future biological surveys should be conducted at this site.

Threats and Disturbances

The site lies on private property and Tioga State Forest land and may be slated for future timbering operations. Numerous forestry roads are throughout the site.

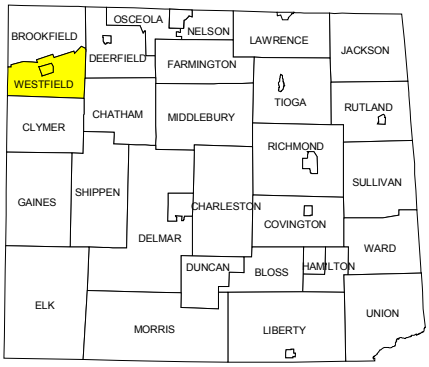
Conservation Recommendations

A 100 meter no-cut forested buffer should be established around this wetland in order to maintain the character of the site.

WESTFIELD TOWNSHIP **and Westfield Borough**

Site Name (County Rank)	Special Species / Community Type	PNHP Ranks* Global	PNHP Ranks* State	State Status	Last Seen (y-m-d)	Quality**
none						

* Please refer to Appendix IV for an explanation of PNHP Ranks and State Status.
**Please refer to Appendix V for an explanation of Quality Ranks.



Locally Significant: none

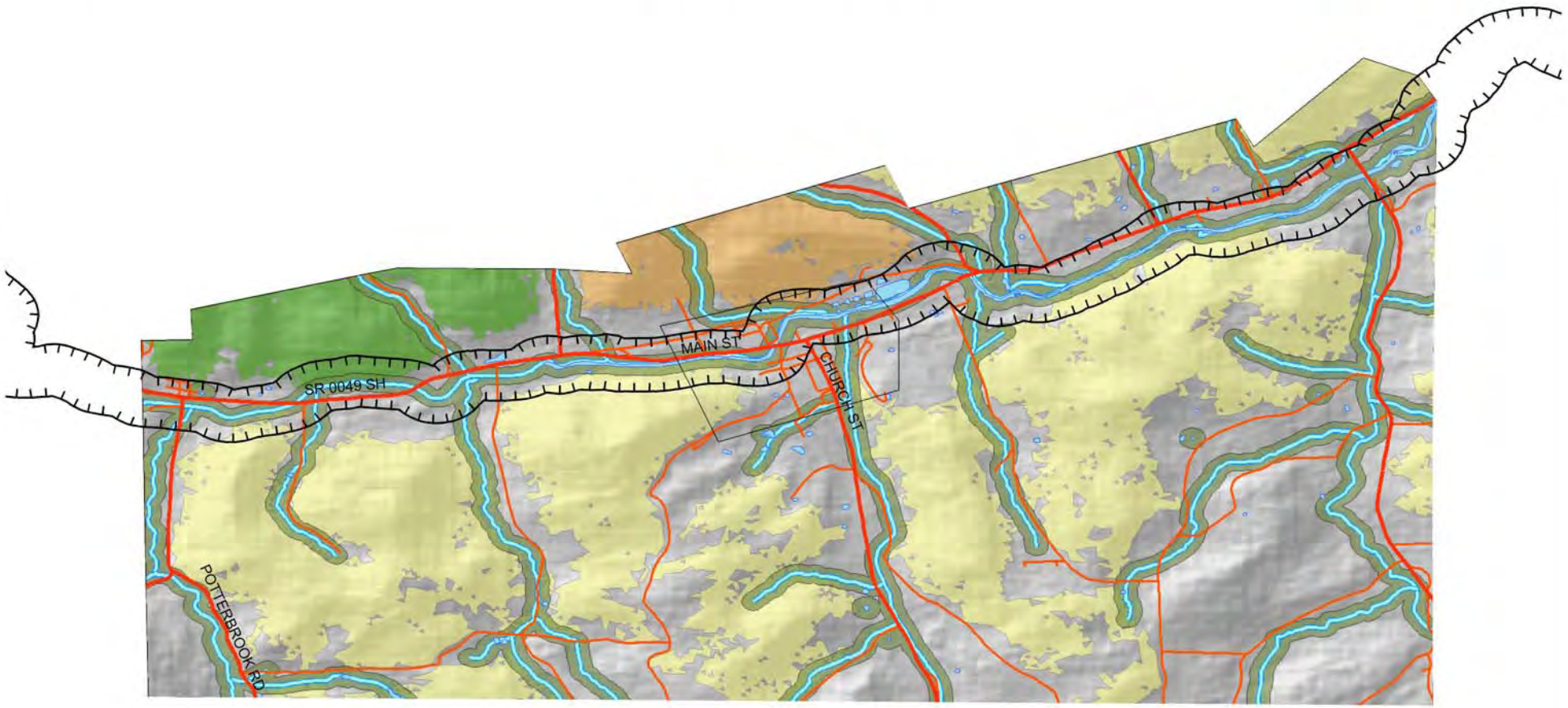
Managed Lands: none

Aquatic Classification Project Results:
Warm Water Community 1—Cowanesque River, Troups Creek, Mill Creek
Cool Water Community 1—Jemison Creek
Rolledwinged Stonefly / Small Minnow Mayfly—Cowanesque River, Mill Creek

Westfield Township is drained by the Cowanesque River, which flows along its northern border. The township is fragmented by cleared lands, agriculture, non-coal mining, and roads, but several large forested blocks remain. The abundance of water resources in this township put maintenance of water quality high in importance to the natural resources of the township and downstream neighbors. Though fragmented, most of the remaining woodlands in the township follow the upland areas between drainages and many include wetlands. Therefore, the focus of conservation in this township should be maintaining and providing buffers to streams and wetlands. Restoration efforts should focus on riparian plantings along creeks and providing buffers to natural wetlands. Forested buffers help filter surface water runoff, preventing many non-point sources of pollution from entering waterways and protecting water quality in the township and the Susquehanna River basin. In addition, reforestation of creek and stream banks can help link larger forested blocks together, contributing to their utility as a natural wildlife corridor. Warm water fish communities, though common, are easily degraded in quality as they usually occur downstream of human influenced areas. Storm water management, restoration of riparian buffer zones, exclusion of livestock from streams are some mitigation techniques for non-point source pollution in these watersheds.

Westfield Township
Tioga County, PA

Pennsylvania Natural Heritage Program



Legend

- core habitat
- supporting landscape
- recommended riparian buffer
- wetlands
- *PA managed land*

forested blocks
square miles
- 1-3
- 3-5
- >5

Scale: 1:70,000

0 0.5 1 2 Miles

- notes -

Appendices

Glossary

Acid Mine Drainage (AMD) – drainage flowing from or caused by surface mining, deep mining, or coal refuse piles that are typically highly acidic with elevated levels of dissolved metals (DEP).

Acidophilic – a plant that requires or prefers acidic soil conditions.

Alluvium – material such as sand, silt, or clay that is deposited on land by streams.

Anthracite - Dense, shiny coal that has a high carbon content and little volatile matter and burns with a clean flame. Also called hard coal.

Anthropogenic – human caused.

ATV – all-terrain-vehicle.

Bedrock - The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Bt (*Bacillus thuringiensis*) – an insecticide, which is produced by the fermentation of a bacterium (Bt), used to control many caterpillar-type pests (e.g., gypsy moth).

Bog – a nutrient poor, acidic peatland that receives water primarily from direct rainfall with little or no input from groundwater or runoff; vegetation consists primarily of peat moss and ericaceous shrubs.

Calcareous- composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.

Canopy – the layer formed by the tallest vegetation.

Circumneutral – pH between 5.5 and 7.

Co-dominant – where several species together comprise the dominant layer (see "dominant" below).

Community – an assemblage of plant or animal populations sharing a common environment and interacting with each other and the physical environment.

DBH – the diameter of a tree at breast height.

DCNR – Pennsylvania Department of Conservation and Natural Resources.

DEP – Pennsylvania Department of Environmental Protection.

Diabase – a dark gray igneous rock. The chemical composition of diabase may support unusual plant communities.

Dimilin – a commercially produced, restricted-use insecticide containing diflubenzuron as the active ingredient. Diflubenzuron, which has been used as a method to control gypsy moth, interferes with chitin production during the early stages of certain insects (DCNR, Division of Pest Management).

Dominant – the species (usually plant) exerting the greatest influence on a given community either by numerical dominance or influence on microclimate, soils and other species.

Ecosystem - an ecological community together with its environment, functioning as a unit.

Element – all-inclusive term for species of special concern and exemplary natural communities.

Ericaceous – members of the heath family including blueberries, huckleberries, rhododendrons, and azaleas; these plants are adapted to living in acidic soils.

Exceptional Value Waters (EV) – DEP designation for a stream or watershed which constitutes an outstanding national, state, regional or local resource, such as waters of national, state or county parks or forests; or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuges or State Game Lands, and other waters of substantial recreational or ecological significance. For more detailed information about EV stream designations, the reader is referred to the Special Protection Waters Implementation Handbook (Shertzer 1992).

Exotic – non-native; used to describe plant or animal species that were introduced by humans; examples include Japanese honeysuckle, purple loosestrife and grass carp; exotics present a problem because they may out-compete native species.

Extant – currently in existence.

Fen - open-canopy peatland that has developed under the influence of basic-rich waters

Floodplain – low-lying land generally along streams or rivers that receives periodic flooding.

Forb – non-grass herbaceous plant such as goldenrod.

Fragipan - a very dense soil layer that prevents water from draining quickly through the soil.

Graminoid – grass or grass-like plant such as a sedge or a rush.

Ground cover – low shrubs, herbs and mosses that are found at or close to the ground surface.

Hemic – an organic soil in which the plant remains show a good degree of decomposition (between 1/3 and 2/3 of the fibers are still visible after rubbing the material between the fingers).

Herptile – a reptile or amphibian

Herpetofauna – the group of reptiles and amphibians found in a particular region

Hibernacula – a location where animals hibernate.

Hibernation – the period of winter inactivity during which time normal physiological processes are reduced and a significant decrease in body temperature occurs. In Pennsylvania, true hibernation is shown by woodchucks, jumping mice, and bats.

High-Quality Coldwater Fisheries (HQ-CWF) – DEP designation (PA Code, Chapter 93) for a stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.

Hydrology – water system of an area including both surface water and ground water.

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

Kame – a short ridge or mound of sand and gravel deposited during the melting of glacial ice.

Kettle – a depression left in a mass of glacial drift, apparently formed by the melting of an isolated block of glacial ice.

Lepidoptera – moths and butterflies.

Listed species – species that is monitored and considered to be of concern by PNHP.

Littoral – the area where water meets land, the shoreline.

Matrix – the form of land use or habitat that surrounds a focal patch of habitat.

Mesic – moist, not saturated.

Minerotrophic – groundwater fed; influenced by water that has been in contact with bedrock or soil, and is richer in mineral content than rainwater.

Native – describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities.

Natural area – as used in this study, a site with either an exemplary natural community or species of special concern; not to be confused with the State Forest Natural Areas which are specific management units designated by DCNR Bureau of Forestry.

Neo-tropical - referring to the tropical locations in the new world; Mexico, Caribbean Islands, and Central and parts of Northern South America.

Non-point – refers to diffuse sources of pollution such as storm water runoff contaminated with oil or pesticides.

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

Oligotrophic – poor to extremely poor in nutrients; typically describes dilute waters with low base metal ion concentrations.

Palustrine - describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominately hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.

Peat – partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable.

POSCIP – Plant of Special Concern in Pennsylvania.

Potential Natural Area – used by The Nature Conservancy to denote an area that may have desirable environmental characteristics to support rare species or exemplary natural communities, but which needs a field survey to confirm; a preliminary category given to sites prior to field survey (see METHODS section).

Prescribed burning – burning under controlled conditions; needed to maintain communities such as limestone glades and pitch pine barrens.

Riparian – streamside.

Rookery - the breeding ground of certain birds or animals, such as herons, penguins and seals.

R-O-W – strip of land occupied or intended to be occupied by a street, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer line, or other special use.

Sapric – organic soils (muck) in which most of the plant material is decomposed and the original constituents cannot be recognized.

Sedge - grasslike herbaceous plant of the family Cyperaceae, especially members of the genus Carex.

Seeps – where water flows from the ground in a diffuse pattern and saturates the soil; lush herbaceous vegetation often grows in these wet areas.

Shrub - a perennial, woody plant that differs from a tree in its short stature (less than five meters in height) and typically multi-growth form.

Soil association – a group of soils that are geographically associated in a characteristic repeating pattern and defined and delineated as a single unit.

Soil series – groups of soils that have vertical profiles that are almost the same, that is, with horizons (layers) that are similar in composition, thickness, and arrangement.

Subcanopy - in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).

Swamp - a wooded wetland, intermittently or permanently flooded

Succession – natural process of vegetation change through time; over time, the plant species of a site will change in composition and structure as light and soil conditions change (e.g., a field that is left alone may, over time, be taken over by shrubs, then small trees and eventually a woodland).

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

TNC – The Nature Conservancy

Understory – layer of shrubs and small trees between the herbaceous layer and the canopy.

Upland - sites with well-drained dry to mesic soils.

Wetlands - areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.

Vernal – occurring in the spring.

Xeric – extremely dry or droughty.

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APPENDIX I: Natural Area Survey Form

Surveyor: Address & Phone:

Date of Observation_____Site Name:

Quadrangle Name_____ Exact Location of
Site (please be specific & include a map or sketch)

Owner:
Owners Attitude Toward Conservation:

Site Elevation:_____ Size of Site (acres):

Source of Lead:

Current Land Use:

Type of Area: __Old Growth Forest; __Marsh; __Shrub Swamp;
__Forested Swamp; __Bog; __Natural Pond.

Written Description: Try to convey a mental image of the site features (including vegetation, significant animals & plants, aquatic features, land forms, geologic substrata, scenic qualities, etc.):

Evidence of Disturbance:

Site Condition Compared to Your Last Visit:

Please attach any additional information, species list, etc.
Please send completed report forms to Pennsylvania Science Office
of The Nature Conservancy, 208 Airport Drive, Middletown, PA 17057
(717) 948-3962. Additional forms may be obtained from this
office. Thank you for your contribution.

APPENDIX II: Community Classification

CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA (Fike 1999)

Community Name	State Rank
Terrestrial Forests	
CONIFEROUS TERRESTRIAL FORESTS:	
Hemlock (white pine) forest	S4
CONIFER – BROADLEAF TERRESTRIAL FORESTS	
Serpentine pitch pine - oak forest	S1
Serpentine Virginia pine - oak forest	S1
Pitch pine - mixed oak forest	S4
Virginia pine - mixed hardwood forest	S5
Dry white pine (hemlock) - oak forest	S4
Hemlock (white pine) -northern hardwood forest	S5
Hemlock (white pine) - red oak - mixed hardwood forest	S4
Hemlock - tuliptree - birch forest	S4
Rich hemlock - mesic hardwoods forest	S2S3
BROADLEAF TERRESTRIAL FORESTS	
Dry oak-heath forest	S4S5
Dry oak-mixed hardwood forest	S3
Red oak - mixed hardwood forest	S5
Northern hardwood forest	S4
Black cherry - northern hardwood forest	S4
Tuliptree- beech -maple forest	S4
Sugar maple - basswood	S4
Mixed mesophytic forest	S1S2
Sweet gum - oak coastal plain forest	S1
Red maple (terrestrial) forest	S5
Black-gum Ridgetop Forest	S3
Aspen/gray (paper) birch forest	S3 NOT TRACKED
Palustrine Forests	
CONIFEROUS PALUSTRINE FORESTS	
Black spruce - tamarack peatland forest	S3
Red spruce palustrine forest	S3
Hemlock palustrine forest	S3
CONIFER – BROADLEAF PALUSTRINE FORESTS	
Hemlock - mixed hardwood palustrine forest	S3S4
Red spruce - mixed hardwood palustrine forest	S3
BROADLEAF PALUSTRINE FORESTS	
Bottomland oak - hardwood palustrine forest	S2
Red maple - black-gum palustrine forest	S3S4
Red maple - black ash palustrine forest	S2S3
Red maple - magnolia Coastal Plain palustrine forest	S1
Great Lakes Region lakeplain palustrine forest	S1
Sycamore - (river birch) - box-elder floodplain forest	S3
Silver maple floodplain forest	S3

Red maple - elm - willow floodplain swamp	S2
Terrestrial Woodlands	
CONIFEROUS WOODLANDS	
Pitch pine - heath woodland	S2
Pitch pine - scrub oak woodland	S2S3
Red spruce rocky summit	S1
Pitch pine - rhodora - scrub oak woodland	S1
CONIFER – BROADLEAF TERRESTRIAL WOODLANDS	
Pitch pine - mixed hardwood woodland	S2S3
Virginia pine - mixed hardwood shale woodland	S2
Red-cedar - mixed hardwood rich shale woodland	S1S2
BROADLEAF – TERRESTRIAL WOODLANDS	
Dry oak - heath woodland	S3
Birch (black-gum) rocky slope woodland	S2
Yellow oak - redbud woodland	S2
Great Lakes Region scarp woodland	S1S2
Great Lakes Region bayberry - cottonwood community	S1
Palustrine Woodlands	
CONIFEROUS PALUSTRINE WOODLANDS	
Pitch pine - leatherleaf palustrine woodland	S1
Black spruce - tamarack palustrine woodland	S2
Red spruce palustrine woodland	S2S3
BROADLEAF PALUSTRINE WOODLANDS	
Red maple - highbush blueberry palustrine woodland	S4
Red maple - sedge palustrine woodland	S4
Red maple - mixed shrub palustrine woodland	S4
Terrestrial Shrublands	
CONIFEROUS TERRESTRIAL SHRUBLANDS	
Red-cedar - prickly pear shale shrubland	S2
Red-cedar - pine serpentine shrubland	S1
CONIFER – BROADLEAF TERRESTRIAL SHRUBLANDS	
Red-cedar - redbud shrubland	S2
BROADLEAF TERRESTRIAL SHRUBLANDS	
Low heath shrubland	S1
Low heath - mountain ash shrubland	S2
Scrub oak shrubland	S3
Rhodora - mixed heath - scrub oak shrubland	S1
Palustrine Shrublands	
BROADLEAF PALUSTRINE SHRUBLANDS	
Buttonbush wetland	S4
Alder - ninebark wetland	S3
Alder - sphagnum wetland	S4
Highbush blueberry - meadow-sweet wetland	S5
Highbush blueberry - sphagnum wetland	S5
Leatherleaf - sedge wetland	S3
Leatherleaf - bog rosemary peatland	S2
Leatherleaf -cranberry peatland	S2S3
Water-willow (Decodon verticillatus) shrub wetland	S3
River birch - sycamore floodplain scrub	S4

Black willow scrub/shrub wetland	S4
Poison sumac - red-cedar - bayberry fen	S1
Buckthorn - sedge (Carex interior) - golden ragwort fen	S1
Great Lakes Region scarp seep	S1
Great Lakes Region bayberry - mixed shrub palustrine shrubland	S1

Terrestrial Herbaceous Openings

Little bluestem - Pennsylvania sedge opening	S2
Side-oats gramma calcareous grassland	S1
Calcareous opening/cliff	S2
Serpentine grassland	S1
Serpentine gravel forb community	S1
Great Lakes Region dry sandplain	S1
Great Lakes Region sparsely vegetated beach	S1

Herbaceous Wetlands

PERSISTENT EMERGENT WETLANDS

Bluejoint - reed canary grass marsh	S5
Cattail marsh	S5
Tussock sedge marsh	S3
Mixed forb marsh	S3
Herbaceous vernal pool	S3S4
Wet meadow	S5 NOT TRACKED
Bulrush marsh	S3
Great Lakes Region palustrine sandplain	S1
Prairie sedge - spotted joe-pye-weed marsh	S1S2
Open sedge (Carex stricta, C. prairea, C. lacustris) fen	S1
Golden saxifrage - sedge rich seep	S2
Skunk cabbage - golden saxifrage forest seep	S4S5
Serpentine seepage wetland	S1
Golden saxifrage - Pennsylvania bitter-cress spring run	S3S4
Sphagnum - beaked rush peatland	S3
Many fruited sedge - bladderwort peatland	S2
Water-willow (Justicia americana)- smartweed riverbed community	S4
Riverside ice scour community	S1S2
Big bluestem - Indian grass river grassland	S3

NON-PERSISTENT EMERGENT WETLANDS

Pickerel-weed - arrow-arum - arrowhead wetland	S4
Spatterdock - water lily wetland	S4

Community Complexes

ACIDIC GLACIAL PEATLAND COMPLEX
GREAT LAKES REGION SCARP COMPLEX
ERIE LAKESHORE BEACH - DUNE - SANDPLAIN COMPLEX
MESIC TILL BARRENS COMPLEX
SERPENTINE BARRENS COMPLEX
RIDGETOP ACIDIC BARRENS COMPLEX
RIVER BED - BANK - FLOODPLAIN COMPLEX

APPENDIX III: Field Survey Form

PENNSYLVANIA NATURAL DIVERSITY INVENTORY EAST:
SPECIES OF SPECIAL CONCERN FIELD REPORT

SNAME: **EOCODE:**

SURVEYDATE:

SITENAME:

SOURCECODE

SURVEYSITE: **SURVEYOR:**

SPECIMEN REPOSITORY:

Locational Information: QUADCODE DOTNUM TEN,TEN COUNTYCODE TOWNSHIP

LAT:

LONG:

DIRECTIONS:

Global **PA EORANK:**

EORANK COMMENTS:

DATA:

HABITAT DESCRIPTION:

MISCELLANEOUS:

DATA SENSITIVITY: **OWNERCODE**

REASON FOR DATA SENSITIVITY: **OWNER**

HABITAT SKETCH:

APPENDIX IV: Federal and State Status, and PNHP Program Ranks

FEDERAL STATUS

U.S. FISH AND WILDLIFE SERVICE CATEGORIES OF ENDANGERED AND THREATENED PLANTS AND ANIMALS

The following definitions are extracted from the September 27, 1985 U.S. Fish and Wildlife Service notice in the Federal Register:

LE - Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.

LT - Listed Threatened - Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.

PE - Proposed Endangered - Taxa proposed to be formally listed as endangered.

PT - Proposed Threatened - Taxa proposed to be formally listed as threatened.

C1 - Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

C2 - Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules.

C3 - Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three categories, depending on the reason(s) for removal from consideration.

3A--Taxa for which the Service has persuasive evidence of extinction.

3B--Names that, on the basis of current taxonomic understanding, usually as represented in published revisions and monographs, do not represent taxa meeting the Act's definition of "species".

3C--Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

N - Taxa not currently listed by the U.S. Fish and Wildlife Service

APPENDIX IV (continued)

STATE STATUS-NATIVE PLANT SPECIES

Legislative Authority: Title 25, Chapter 82, Conservation of Native Wild Plants, amended June 18, 1993, Pennsylvania Department of Environmental Resources.

PE - Pennsylvania Endangered - Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.

PT - Pennsylvania Threatened - Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent further decline in this Commonwealth, or if the species is greatly exploited by man.

PR - Pennsylvania Rare - Plant species which are uncommon within this Commonwealth. All species of native wild plants classified as Disjunct, Endemic, Limit of Range and Restricted are included within the Pennsylvania Rare classification.

PX - Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plant species may or may not be in existence outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.

PV - Pennsylvania Vulnerable - Plant species which are in danger of population decline within Pennsylvania because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.

TU - Tentatively Undetermined - Plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.

N - None - Plant species which are believed to be endangered, rare, or threatened, but which are being considered by the required regulatory review processes for future listing

APPENDIX IV (continued)

STATE STATUS-ANIMALS

The following state statuses are used by the Pennsylvania Game Commission for (1990, Title 34, Chapter 133 pertaining to wild birds and mammals) and by the Pennsylvania Fish and Boat Commission (1991, Title 30, Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms):

PE - Pennsylvania Endangered

Game Commission - Species in imminent danger of extinction or extirpation throughout their range in Pennsylvania if the deleterious factors affecting them continue to operate. These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat has been so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherality places them in potential danger of precipitous declines or sudden extirpation throughout their range in Pennsylvania; or 3) species that have been classified as "Pennsylvania Extirpated", but which are subsequently found to exist in Pennsylvania as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87 Stat. 884), as amended.

Fish and Boat Commission - Endangered Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species list published in the Federal Register; or, (2) declared by the Executive Director (PaFC) to be threatened with extinction and appear on the Pennsylvania Endangered Species List published in the Pennsylvania Bulletin.

PT - Pennsylvania Threatened

Game Commission - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the causal factors affecting the organism are abated. These are: 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered, are still in critical condition; or 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87-Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

Fish and Boat Commission - Threatened Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on a Threatened Species List published in the Federal Register; or, (2) have been declared by the Executive Director (PaFC) to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published in the Pennsylvania Bulletin.

APPENDIX IV (continued)

PNHP GLOBAL ELEMENT RANKS

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's Warbler).

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.

PNHP STATE ELEMENT RANKS

S1 =Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).

S4 = Apparently secure in state, with many occurrences.

S5 = Demonstrably secure in state and essentially ineradicable under present conditions.

SA = Accidental in state, including species which only sporadically breed in the state.

APPENDIX IV (continued)

SE = An exotic established in state; may be native elsewhere in North America (e.g., house finch).

SH = Of historical occurrence in the state with the expectation that it may be rediscovered.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state.

SR = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SRF = Reported falsely (in error) from the state but this error persisting in the literature.

SU = Possibly in peril in state but status uncertain; need more information.

SX = Apparently extirpated from the state.

Note: A "T" appearing in either the G Rank or S Rank indicates that the intraspecific taxa is being ranked differently than the species. A "Q" in the rank indicates that there is taxonomic uncertainty about a taxa being ranked (i.e., taxa is being accepted as a full species or natural community in this list but may be treated as a variety or form by others). A "?" after a "G" "S" indicates that the rank is uncertain at this time.

APPENDIX V: **Pennsylvania Element Occurrence Quality Ranks**

Quality Rank*	Explanation
A	Excellent occurrence: all A-rank occurrences of an element merit quick, strong protection. An A-rank community is nearly undisturbed by humans or has nearly recovered from early human disturbance; further distinguished by being an extensive, well-buffered occurrence. An A-rank population of a sensitive species is large in area and number of individuals, stable, if not growing, shows good reproduction, and exists in natural habitat.
B	Good occurrence: protection of the occurrence is important to the survival of the element in Pennsylvania, especially if very few or no A-rank occurrences exist. A B-rank community is still recovering from early disturbance or recent light disturbance, or is nearly undisturbed but is less than A-rank because of significantly smaller size, poorer buffer, etc. A B-rank population of a sensitive species is at least stable, in a minimally disturbed habitat, and of moderate size and number.
C	Fair occurrence: protection of the occurrence helps conserve the diversity of a region's or County's biota and is important to statewide conservation if no higher-ranked occurrences exist. A C-rank community is in an early stage of recovery from disturbance, or its structure and composition have been altered such that the original vegetation of the site will never rejuvenate, yet with management and time partial restoration of the community is possible. A C-rank population of a sensitive species is in a clearly disturbed habitat, small in size and/or number, and possibly declining.
D	small occurrence: protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrences exist. A D-rank community is severely disturbed, its structure and composition been greatly altered, and recovery to original conditions, despite management and time, essentially will not take place. A D-rank population of a sensitive species is very small with a high likelihood of dying out or being destroyed, and exists in a highly disturbed and vulnerable habitat.
E	Verified as extant, but has not been given a rank; additional information needed to evaluate quality.

- Intermediate ranks may also be assigned.

APPENDIX VI: Plants, Animals and Natural Communities of Special Concern in Tioga County

Plants

Scientific Name	State Common Name
Alisma triviale	broad-leaved water-plantain
Amelanchier sanguinea	roundleaf serviceberry
Bartonia paniculata	screw-stem
Carex bebbii	Bebb's sedge
Carex diandra	lesser panicled sedge
Carex disperma	soft-leaved sedge
Carex eburnea	ebony sedge
Carex oligosperma	few-seeded sedge
Carex paupercula	bog sedge
Carex retrorsa	backward sedge
Carex sprengelii	Sprengel's sedge
Elymus trachycaulus	slender wheatgrass
Epilobium palustre	marsh willow-herb
Epilobium strictum	downy willow-herb
Galium trifidum	marsh bedstraw
Gaultheria hispidula	creeping snowberry
Geranium bicknellii	cranesbill
Hypericum majus	larger Canadian St. John's-wort
Juncus torreyi	Torrey's rush
Juniperus communis	common juniper
Lathyrus ochroleucus	wild-pea
Oclemena nemoralis	bog aster
Schoenoplectus torreyi	Torrey's bulrush
Scirpus ancistrochaetus	northeastern bulrush
Scirpus pedicellatus	stalked bulrush
Shepherdia canadensis	Canada buffalo-berry
Sorbus decora	showy mountain-ash
Stellaria borealis	mountain starwort

APPENDIX VI: (continued)

Animals

Scientific Name	Common Name
Accipiter gentiles	Northern Goshawk
Aeshna verticalis	Green Stripe Darner
Alasmidonta marginata	Elktoe
Alamidonta undulata	Triangle Floater
Alasmidonta varicosa	Brook Floater
Apharetra (purpurea) dentata	Blueberry Sallow
Ardea herodias	Great Blue Heron
Boloria selene myrina	Silver-bordered Fritillary
Boyeria grafiana	Ocellated Darner
Chlosyne harrisii	Harris' Checkerspot
Circus cyaneus	Northern Harrier
Cistothorus palustris	Marsh Wren
Enallagma annexum	Northern Bluelet
Eumeces anthracinus	Coal Skink
Euphydryas phaeton	Baltimore Checkerspot
Euphyes dion	Sedge Skipper
Gallinago delicata	Wilson's Snipe
Haliaeetus leucocephalus	Bald Eagle
Lasmigona subviridis	Green Floater
Lestes eurinus	Amber-winged Spreadwing
Lestes forcipatus	Sweetflag Spreadwing
Lycaena epixanthe	Bog Copper
Merope tuber	Earwig Scorpionfly
Myotis septentrionalis	Northern Myotis
Neotoma magister	Allegheny Woodrat
Pandion haliaetus	Osprey
Poanes viator viator	Broad-winged Skipper
Podilymbus podiceps	Pied-billed Grebe
Polites mystic	Long Dash
Polygonia progne	Gray Comma
Porzana carolina	Sora
Somatochlora elongate	Ski-tailed Emerald
Somatochlora incurvata	Incurvate Emerald
Somatochlora walshii	Brush-tipped Emerald
Sympetrum semicinctum	Band-winged Meadowmark

APPENDIX VI: (continued)

Natural Communities

Natural Community Name
Acidic Glacial Peatland Complex
Boreal Conifer Swamp
Ephemeral/Fluctuating Natural Pool
Graminoid Marsh
Hemlock Palustrine Forest
Leatherleaf – Sedge Wetland
Mixed Graminoid-Robust Emergent Marsh
Nonglacial Bog

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