



Forest County Natural Heritage Inventory



Pennsylvania Natural Heritage Program

FOREST COUNTY NATURAL HERITAGE INVENTORY

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

PREFACE

Since 1991, Western Pennsylvania Conservancy, in partnership with The Nature Conservancy and the Pennsylvania Department of Natural Resources, has conducted County Natural Heritage Inventories (CNHIs) as a way to both gather new information and to pass along what we have learned to those responsible for making decisions about resources, as well as to community members of that county.

This report represents an important assemblage of that information. The Forest County Natural Heritage is not only a source of information; it is unique in providing a comprehensive look at the exceptional living resources in the county. In many ways, it is also an introduction and an overview. Although areas are mapped and discussed, the details in the report do not do justice to the resources found there. It is up to the people of the county to fully explore and appreciate the resources in their communities.

Consider the inventory as an invitation for the people of Forest County to explore and discuss their natural heritage. For those who wish to learn about and participate in the conservation of the living resources of the county, use this report as a road map to some of the special places in the county. Realize that there will be more places to add to those identified here and that this document can be updated as necessary to accommodate new information. Ultimately, it will be up to the landowners and the people of Forest County to determine how these areas might be used and protected.

Here are some examples of how the inventory and the Natural Heritage Areas identified can be used by various groups and people:

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

County, State, and Federal Agencies: In many counties, Natural Heritage Areas lie within or include state or federal lands. Agencies such as the Pennsylvania Game Commission, the Pennsylvania Bureau of Forestry, and the Army Corp of Engineers can use the inventory to understand the extent of the resource. Agencies can also learn the requirements of the individual plant, animal, or community elements, and the general approach that protection could assume. County Conservation Districts may use the inventories to focus attention on resources (e.g. high diversity streams or wetlands) and as reference in encouraging good management practices.

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

Environmental consultants are increasingly called upon to produce resource plans (e.g. Rivers Conservation Plans, Greenways and Open Space Plans) that must integrate a variety of biological, physical, and social information. County Natural Heritage Inventories often form the framework and background information for these types of plans.

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

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

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



ACKNOWLEDGEMENTS

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We encourage comments and questions. The success of the report will be measured by the use it receives and the utility it serves to those making decisions about resources and land use throughout the county. Thank you for your interest.

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

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EXECUTIVE SUMMARY

Introduction

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

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

Natural Heritage Inventory Mapping

To provide the information necessary to plan for conservation of biodiversity at the species, community, and ecosystem levels, two types of Natural Heritage Areas are used to illustrate the results of the inventory. Additionally, areas identified for conservation by other conservation groups are included in this report to provide information relating to the natural heritage of Forest County that readers of this report may not otherwise be aware of.

Natural Heritage Areas

Conservation Area (CA):

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

Conservation Planning Application: CAs are mapped according to their sensitivity to human activities. "Core" areas delineate essential habitat that cannot absorb significant levels of activity without substantial impact to the elements of concern. "Supporting Natural Landscape" is an area that maintains vital ecological processes or secondary habitat; these areas typically can accommodate some degree of development or low-impact activities.

Landscape Conservation Area (LCA):

Definition: A large contiguous area that is important because of its size, open space, habitats, and/or inclusion of one or more CAs. Although an LCA includes a

variety of land uses, it typically has not been heavily disturbed and thus retains much of its natural character.

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

Other Conservation Areas

Across the state, a number of organizations have undertaken conservation planning efforts at a landscape scale. The areas identified through these efforts frequently overlap with sites identified by County Natural Heritage Inventories, and serve to emphasize the importance of focusing conservation efforts in those areas. The results of three such planning efforts are included here in order to provide information relating to the natural heritage of Forest County that readers of this report may not otherwise be aware of.

Conservation Priority River Reaches and Watersheds:

The Pennsylvania Aquatic Community Classification (ACC) was developed by the Pennsylvania Natural Heritage Program to create a schema of flowing water ecosystems in Pennsylvania and its watersheds. The ACC defines types of stream and river reaches based on aquatic communities, their habitats, and watershed properties.

Conservation Planning Application: Combining data from many parts of the Aquatic Community Classification project has resulted in a means of identifying the unique riverine conditions that designate certain watersheds to be of greater conservation concern than others. Utilizing this information should make conservation and restoration work in Pennsylvania more efficient, more measurable and more effective.

Important Bird Area (IBA):

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

Conservation Planning Application: Planning for these areas should consider how best to maintain their

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

Important Mammal Areas (IMA):

The Important Mammal Areas Project (IMAP) is being carried out by a broad-based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Areas nominated must fulfill at least one of five criteria developed by the Mammal Technical Committee of the Pennsylvania Biological Survey (www.pawildlife.org/imap.htm).

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

Methods

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

- site selection
- ground survey
- data analysis and mapping

Site Selection

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

Ground Surveys

Areas identified as potential inventory sites were scheduled for ground surveys. After obtaining permission from landowners, sites were examined to evaluate the condition and quality of the habitat and to classify the communities present. Field survey forms (Appendix II, pg. 140) were completed for each site. The flora, fauna, level of disturbance, approximate age of community and local threats were among the most important data recorded for each site. Sites were not ground surveyed in cases where permission to visit a site was not granted, when enough information was available from other sources, or when time did not permit.

Data Analysis

Data obtained during the 2004, 2005, and 2006 field seasons were combined with prior existing data and summarized. All sites with species or communities of statewide concern, as well as exceptional examples of more common natural communities, were selected as Conservation Areas (CAs). Spatial data on the elements of concern were then compiled in a geographic information system (GIS) format using ESRI ArcGIS 9 software.

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

Results

The Forest County Natural Heritage Inventory recognizes 36 areas of ecological significance - 31 Conservation Areas and 5 Landscape Conservation Areas.

The results of the Natural Heritage Inventory are summarized below in both graphic and tabular form. Figure 1 shows the spatial distribution of Natural Heritage Areas across the county. Table 1 summarizes the Natural Heritage Areas, in order of their ecological significance. Significance ranks are Exceptional, High, Notable, and County (for a full explanation of these ranks, see Table 3 on pg. 10).

Forest County
Natural Heritage Inventory
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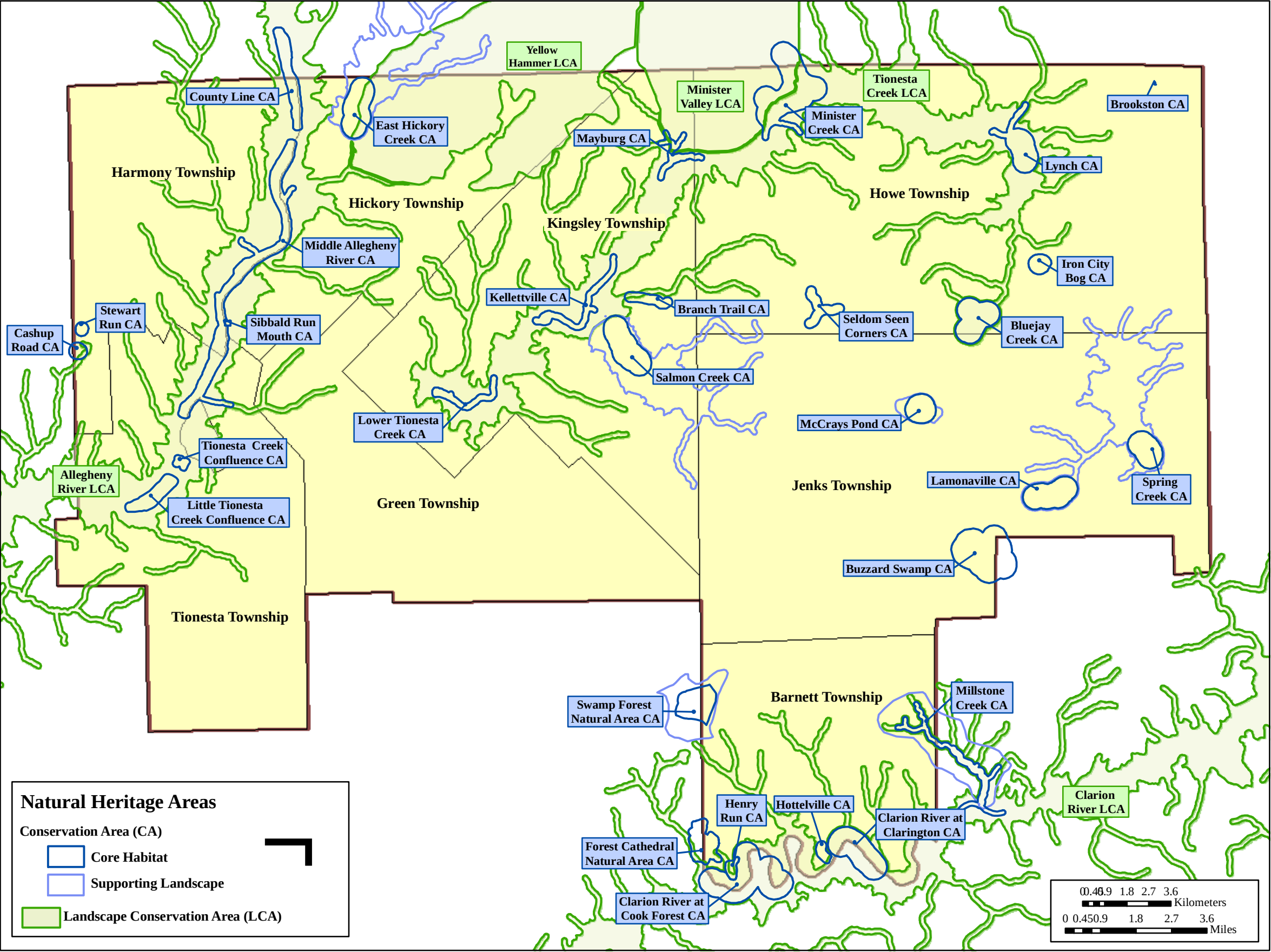


Figure 1. Conservation Areas and Landscape Conservation Areas in Forest County, Pennsylvania.



Table 1. Natural Heritage Areas categorized by significance.

Site	Municipality	Description	Page No.
<i>Exceptional Significance</i>			
Allegheny River LCA	Green Township, Harmony Township, Hickory Township, Tionesta Township	Wild and Scenic designated section of the Allegheny River that encompasses a number of smaller-scale Conservation Areas for which it functions as supporting landscape.	19
Buzzard Swamp CA	Jenks Township	Area containing a diversity of habitats that support four dragonfly species and seven butterfly species of conservation concern.	61
Clarion River at Clarington CA	Barnett Township	Aquatic habitat that supports six dragonfly species of special concern.	34
Clarion River at Cook Forest CA	Barnett Township	Aquatic habitat that supports seven dragonfly species of special concern.	34
Clarion River LCA	Barnett Township	Wild and Scenic designated section of the Clarion River that encompasses a number of smaller-scale Conservation Areas for which it functions as supporting landscape.	21
County Line CA	Harmony Township	Section of the Allegheny River that provides habitat for five freshwater mussel species, 1 fish species, and one vertebrate species of conservation concern.	46
Little Tionesta Creek Confluence CA	Tionesta Township	Section of the Allegheny River that provides habitat for two animal species of special concern.	69
Middle Allegheny River CA	Harmony Township, Tionesta Township	Section of the Allegheny River that supports seven freshwater mussel species, five fish species, and one plant species of conservation concern.	46
Millstone Creek CA	Barnett Township	Stream habitat supporting two fish species and ten dragonfly species of special concern.	34
Minister Creek CA	Howe Township	Stream and forest habitat that supports five dragonfly species and one fish species of special concern.	56
Salmon Creek CA	Kingsley Township	Stream and forest habitat that supports six species of conservation concern.	66
Tionesta Creek LCA	Kingsley Township, Hickory Township, Howe Township	Section of Tionesta Creek and its tributaries and supporting riparian corridors that encompass a number of smaller-scale aquatic Conservation Areas.	21
<i>High Significance</i>			
Bluejay Creek CA	Howe Township, Jenks Township	Headwaters section of Bluejay Creek that provides habitat for Midland Clubtail Dragonfly, a species of special concern in Pennsylvania.	56
Branch Trail CA	Kingsley Township	Forested habitat that supports a population of Harris' Checkerspot Butterfly, a Pennsylvania-rare species.	65
Cashup Road CA	Kingsley Township	Habitat for American columbo, a plant species of conservation concern.	45

Table 1. Natural Heritage Areas categorized by significance (con't).

Site	Municipality	Description	Page No.
<i>High Significance</i>			
East Hickory Creek CA	Hickory Township	Stream and forest habitat that supports three odonate species of special concern.	49
Hottelville CA	Barnett Township	Riparian forest habitat supporting Large Toothwort, a plant species of concern in Pennsylvania.	41
Kelletville CA	Kingsley Township	Section of Tionesta Creek that provides habitat for Round Pigtoe Mussel, a state-threatened species of concern.	65
Lamonaville CA	Jenks Township	Headwaters of Wolf Run that supports populations of Mustached Clubtail and Rapids Clubtail, river-breeding dragonfly species of special concern.	61
Lower Tionesta Creek CA	Kingsley Township	Section of the Allegheny River that supports populations of Long-Solid Mussel and Round Pigtoe Mussel.	65
Lynch CA	Howe Township	Stream and forest habitat that supports two dragonfly species and one fish species of conservation concern.	56
Mayburg CA	Howe Township, Kingsley Township	Section of Tionesta Creek that provides habitat for two mussel species and one fish species of conservation concern.	65
McCrays Pond CA	Jenks Township	Man-made impoundment and adjacent bog that support populations of Comet Darner Dragonfly and Bog Sedge.	61
Minister Valley LCA	Howe Township, Kingsley Township	Landscape encompassing an area of contiguous forest greater than 12,000 acres.	22
Seldom Seen Corners CA	Howe Township	Roadside habitat the supports two butterfly species of concern: Indian Skipper and Long Dash.	58
Spring Creek CA	Jenks Township	Section of Spring Creek and adjacent beaver impoundment and forest that serve as habitat for four dragonfly species of conservation concern.	62
Stewart Run CA	Harmony Township	Habitat supporting a population of American Columbo, a plant species of conservation concern.	45
Swamp Forest Natural Area CA	Barnett Township	Bureau of State Parks Natural Area containing an old-growth hemlock palustrine forest community at the headwaters of Browns Run.	36
Yellow Hammer LCA	Hickory Township, Kingsley Township	Landscape encompassing an area of contiguous forest greater than 12,000 acres.	22
<i>Notable Significance</i>			
Brookston CA	Howe Township	Roadside ditch and adjacent wet area supporting a population of Queen-of-the-Prairie, a Pennsylvania-rare plant species.	55

Table 1. Natural Heritage Areas categorized by significance (con't).

Site	Municipality	Description	Page No.
<i>Notable Significance</i>			
Tionesta Creek Confluence CA	Tionesta Township	Section of the Allegheny River that supports Red-Head Pondweed, a Pennsylvania-rare plant species.	69
<i>County Significance</i>			
Forest Cathedral Natural Area CA	Barnett Township	Bureau of State Parks Natural Area containing old-growth Hemlock – White Pine forest.	36
Henry Run CA	Barnett Township	Old-growth remnant of Hemlock – White Pine forest.	36
Iron City Bog CA	Howe Township	<i>Sphagnum</i> -dominated seepage wetland occurring in a mid-elevation saddle.	56
Sibbald Run Mouth CA	Hickory Township	Old-field habitat supporting several healthy butternuts, a tree species dramatically declining due to an introduced fungus.	50

Discussion and Recommendations

Status of natural features today

The landscape and waterways of Forest County have undergone considerable change over the course of human settlement, most notably from timber extraction. During the timber boom in the early twentieth century, much of the forest in the county underwent general clear-cutting for lumber, tanning material, and chemical wood. Throughout the county, the condition of ecological resources today closely reflects the history of human land use.

Forest Communities. Natural communities have redeveloped across large swaths of the landscape previously used for timber extraction. Large areas of contiguous forest provide abundant habitat for forest-dwelling species. These forested areas also help to maintain water quality in streams.

The condition of forest communities varies across the county. While many areas have regenerated into a broad spectrum of natural forest communities, some areas remain fragmented by roads, artificial clearings from oil and gas development, and utility right-of-ways. Additionally, over-browsing by deer poses a threat to biological diversity and forest regeneration in many regions of the county.

Despite the variable condition of the forests, their contiguity is a great asset to the county's ecological integrity and is regionally important in sustaining mid-Atlantic populations for many animal species. While a number of generalist species can succeed and reproduce in

small patches of forest, many species can only utilize large, unbroken tracts of forest. Because several of the forested areas in Forest County today are large and contiguous, they support species which are declining in other areas of the state and the continent due to lack of habitat.

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

Wetland/Aquatic Communities. Unique communities including forested seepage wetlands, shrub swamps, emergent wetlands, and seasonal pools occur in conjunction with specific topographic or geologic conditions. Although these communities occupy a comparatively small portion of the natural landscape, they are of particular value to the county's biodiversity because of the species they support. Groups of specialist species—such as amphibians that breed only in seasonal ponds, or plant species that live only in wetlands—that would otherwise not be present in the county inhabit these communities. One-half of Pennsylvania's wetlands have been lost or substantially degraded. Wetland and aquatic species that depend on these habitats are likewise declining.

Planning for biodiversity and ecological health tomorrow

Provision for the future health of ecological resources in Forest County will require a combination of efforts to steward specific sites that host unique species and communities, broader-scale planning to maintain the unique contiguity of its forested regions, and restoration efforts to alleviate water pollution and restore ecological function to damaged landscapes and waterways.

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

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

Wetland/Aquatic Communities. Forest County's waterways, ranging from headwater mountain streams to the Allegheny River, include some of Pennsylvania's more scenic features. Objectives for large-scale planning should include preservation of water quality in the county's waterways by limiting development in riparian corridors.

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

Evaluating proposed activity within Natural Heritage Areas

A very important part of encouraging conservation of the Natural Heritage Areas identified within the Forest County Natural Heritage Inventory is the careful review of proposed land use changes or development activities that overlap with Natural Heritage Areas.

Always contact the Forest County Conservation and Planning Department before beginning any development project. The County Planning Commission should be

aware of all activities that may occur within Natural Heritage Areas in the county so that they may work with other relevant organizations or agencies to better understand the implications of proposed activities. They can also provide guidance to the landowners, developers, or project managers as to possible conflicts and courses of action.

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

If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources. In general, the responsibility for reviewing impacts on natural resources is partitioned among agencies in the following manner:

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

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

If the decision is made to move forward with a project in a sensitive area, WPC can work with municipal officials and project personnel during the design process to develop strategies for minimizing the project's ecological impact

while meeting the project's objectives. The resource agencies in the state may do likewise. However, early consultation and planning as detailed above can provide a more efficient and better integrated permit review, and a better understanding among the parties involved as to the scope of any needed project modifications.



INTRODUCTION

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

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

Genetic diversity refers to the variation in genetic makeup between individuals and populations of organisms and provides a species with the ability to adapt successfully to environmental changes. In order to conserve genetic diversity, it is important to maintain natural patterns of gene flow through the migration of individual plants and animals across the landscape and the dispersal of pollen and seeds among populations (Thorne et al. 1996). Individual species play a role in sustaining ecosystem processes such as nutrient cycling, decomposition, and plant productivity: declines in native species diversity alter these processes (Naeem et al. 1999).

A natural community is “an interactive assemblage of plant and animal species that share a common environment and occur together repeatedly on the landscape, such as a red maple swamp” (NHESP 2001). Each type of natural community represents habitat for a different assemblage of species, hence identification and stewardship of the full range of native community types is needed to meet the challenge of conserving habitat for all species.

From an ecological perspective, a landscape is “a large area of land that includes a mosaic of natural community types and a variety of habitats for many species” (NHESP 2001). At this scale, it is important to consider whether communities and habitats are isolated or connected by corridors of natural landscape traversable by wildlife, and whether the size of a natural landscape is sufficient to support viable populations and ecosystems. Because all the living and non-living elements of an ecosystem are interconnected and interdependent, it is essential to conserve native biodiversity at all these scales (genes, species, natural communities, and landscapes) if ecosystems are to continue functioning.

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

Fifty-six percent of Pennsylvania's wetlands have been lost or substantially degraded by filling, draining, or conversion to ponds (Dahl 1990). According to the Pennsylvania Department of Environmental Protection, 60% of those Pennsylvania lakes that have thus far been assessed for biological health are listed as impaired. Of 83,000 miles of stream in Pennsylvania, almost 70,000 miles have been assessed for water quality and nearly 11,000 miles have been designated as impaired due to abandoned mine discharges, acid precipitation, and agricultural and urban runoff (PA DEP 2004). The species that depend on these habitats are correspondingly under threat: 58% of threatened or endangered plant species are wetland or aquatic species; 13% of Pennsylvania's 200 native fish species have been lost, while an additional 23% are imperiled; and among freshwater mussels – one of the most globally imperiled groups of organisms – 18 of Pennsylvania's 67 native species are extinct and another 22 are imperiled (Goodrich et al. 2003).

Prior to European settlement, over 90% of Pennsylvania's land area was forested. Today, 60% of the state is still forested, but much of this forest is fragmented by non-forest uses such as roads, utility rights-of-way, agriculture, and housing: only 42% is interior forest habitat, and some of the species that depend upon interior forest habitat are in decline (Goodrich et al. 2003). In addition to habitat fragmentation, forest pests, acid precipitation (which causes nutrient leaching and stunted growth), over-browsing by deer, and invasive species also threaten forest ecosystem health.

The Pennsylvania Natural Heritage Program (PNHP) assesses the conservation status of animal and vascular plant species native to Pennsylvania. While Pennsylvania also hosts a diversity of other life forms such as mosses, fungi, bacteria, and protists, too little is known of these species to assess their conservation status. The goal of this report is to identify areas important in sustaining biodiversity at the species, natural community, and landscape levels, and provide that information to more fully inform land use decisions. Using information from PNHP, County Natural Heritage Inventories (CNHIs) identify areas in the county that support Pennsylvania's rare, threatened or endangered species as well as natural communities that are considered to be rare in the state or exceptional examples of the more common community types. The areas that support these features are identified as Conservation Areas (CAs). At a broader scale, CNHIs recognize landscape-level features termed Landscape Conservation Areas (LCAs). LCAs identify areas of relatively intact natural landscape such as large areas of forest unbroken by roads or other fragmenting features, areas which function as a corridor connecting patches of natural landscape, and regions in which a high number of other biodiversity features are concentrated.

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



OVERVIEW OF FOREST COUNTY NATURAL FEATURES

The climate, topography, geology, and soils are key to the biogeography of species, and are particularly important in the development of ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains) that occur in a region. Anthropogenic disturbance has been influential in forming and altering many of the ecosystems in the unglaciated Allegheny Plateau region, resulting in the extinction 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 natural history of Forest County.

Climate

The climate in Forest County is humid and temperate. Based on temperature and precipitation data recorded at Tionesta, the mean annual temperature for the region is 46° F (7.8° C). In winter, the mean temperature is 32.2° F (0° C), with an average daily minimum temperature of 22° F (-5.6° C). In summer, the mean temperature is 60° F (15.6° C) and the average daily maximum temperature is 72° F (22.2° C; NCDC [n.d.]). The growing season, calculated as the probable number of days that the daily minimum temperature will be higher than 32° F, ranges from approximately 126 to 165 days, depending on aspect and elevation. Precipitation is evenly distributed throughout the year, but is significantly heavier on the windward, west facing slopes than in the valleys. The average annual precipitation is 43in. (109 cm), while the average annual snowfall is 74 in. (188 cm; NCDC [n.d.], Cerutti 1985).

Physiography and Geology

A physiographic province is a geographic region in which all parts are similar in geologic structure and climate and which has a unified geomorphic or surficial history. 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 regimes, certain plant communities would be expected to occur within some provinces and not others.

Forest County lies entirely within the High Plateau Section of the Unglaciated Appalachian Plateau (or Allegheny Plateau) Physiographic Province. Broad, rounded to flat uplands with deep, angular valleys characterize the High Plateau Section. The stream drainage pattern of the Unglaciated Allegheny Plateau is dendritic, resembling the branching of trees.

The bedrock geology in Forest County was formed during the Pennsylvanian, Mississippian, and Devonian Periods of the Paleozoic Era (about 280 million to 405 million years before the present). During that span of time, repeated sea advances and retreats deposited sands, silts, clays, and coals, which in turn formed the sequence of sedimentary rocks that are found in the county today. Minor uplift occurring about 200 million years ago, caused in part by the Allegheny Orogeny (mountain building event), added to the present bedrock structure. Since that time, streams have eroded and dissected the plateau, exposing the younger rock at the higher elevations and the successively older rock of the valley walls and bottoms. The surficial geology of the county is dominated by sandstone, shale, siltstone, and conglomerates, with coal and limestone found in lower, or older strata (Cerutti 1985).

Soils

The soils of Forest County are primarily derived from siltstone, shale, and sandstone, and tend to be acidic in nature. On a gross scale, the soils of the county are gray-brown podzolic soils that typically underlie mixed northern conifer-hardwood forest (Braun 1950, Jennings 1953). On a finer scale, the county's fifty-three soil types have been grouped into six associations – assemblages of soils based on similarities in climatic or

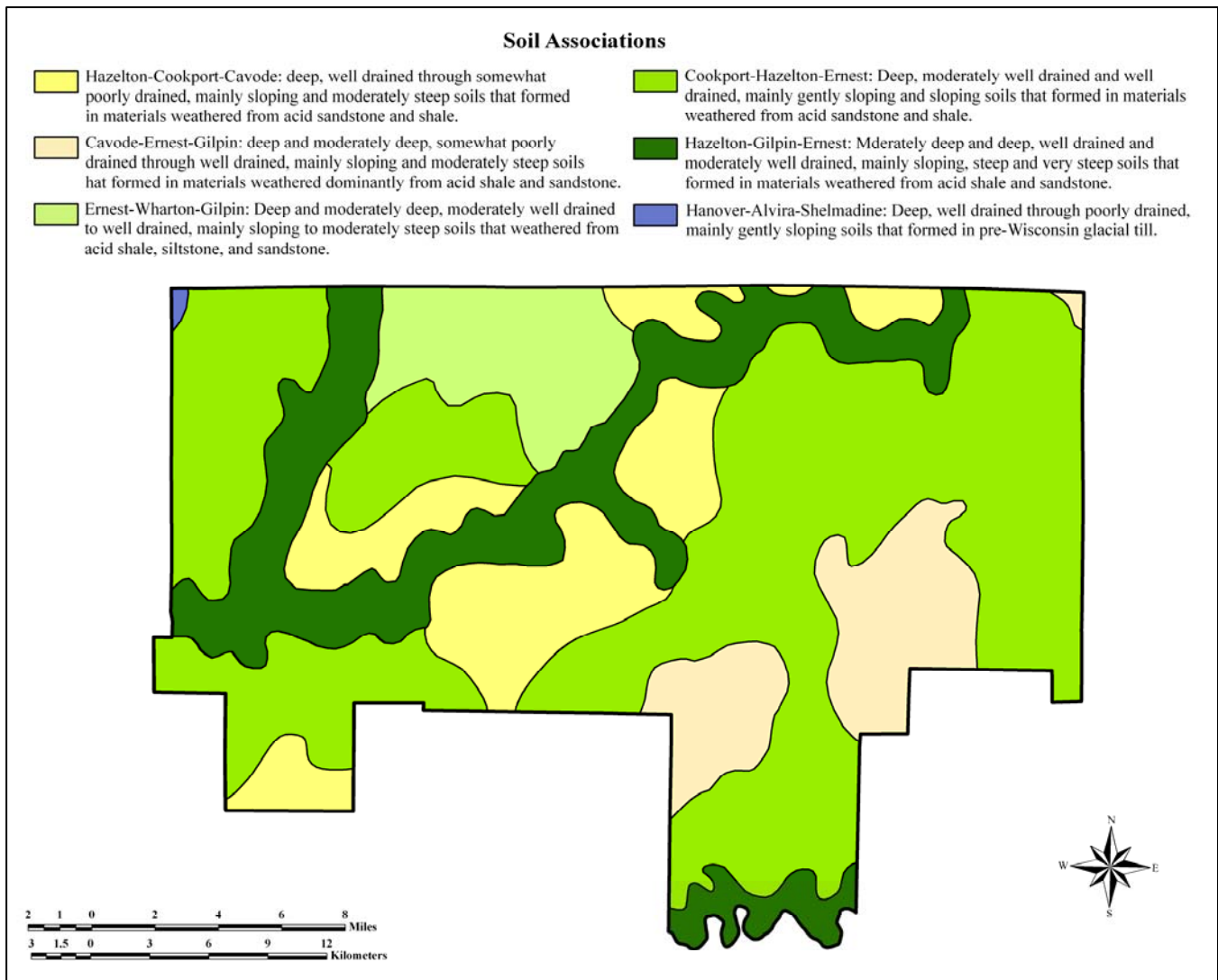


Figure 2. Soil associations of Forest County, Pennsylvania (adapted from Cerutti 1985).

physiographic factors and soil parent materials. The distribution and descriptions of the soil associations are shown above in Figure 2.

Water Resources

Forest County lies entirely within the Ohio River drainage basin, and is drained by the Allegheny River and its tributaries. The main stem of the Allegheny River drains an area of 118 mi² within the county and its two major tributaries, the Clarion River and Tionesta Creek, drain 105 mi² and 209 mi² respectively (see Figure 3).

In 1992, three sections of the Allegheny River – totaling 86.6 miles – that flow through Warren, Forest and Venango counties were granted Wild and Scenic River status by Congress in recognition of its status as one of the nation's outstanding free-flowing rivers. Additionally, in 1984, Congress designated seven National Forest islands between Buckaloons and Tionesta as part of the National Wilderness Preservation System, to preserve vestiges of unique riverine forests. The islands are mostly vegetated with fine riverine forests of sycamore, silver maple, shagbark hickory and green ash. The Allegheny River Islands Wilderness, totaling 368 acres, is one of the smallest components of the Wilderness System in the United States. The US Forest Service, Allegheny National Forest, is the federal agency responsible for managing both the Wild and Scenic River and Wilderness Islands.

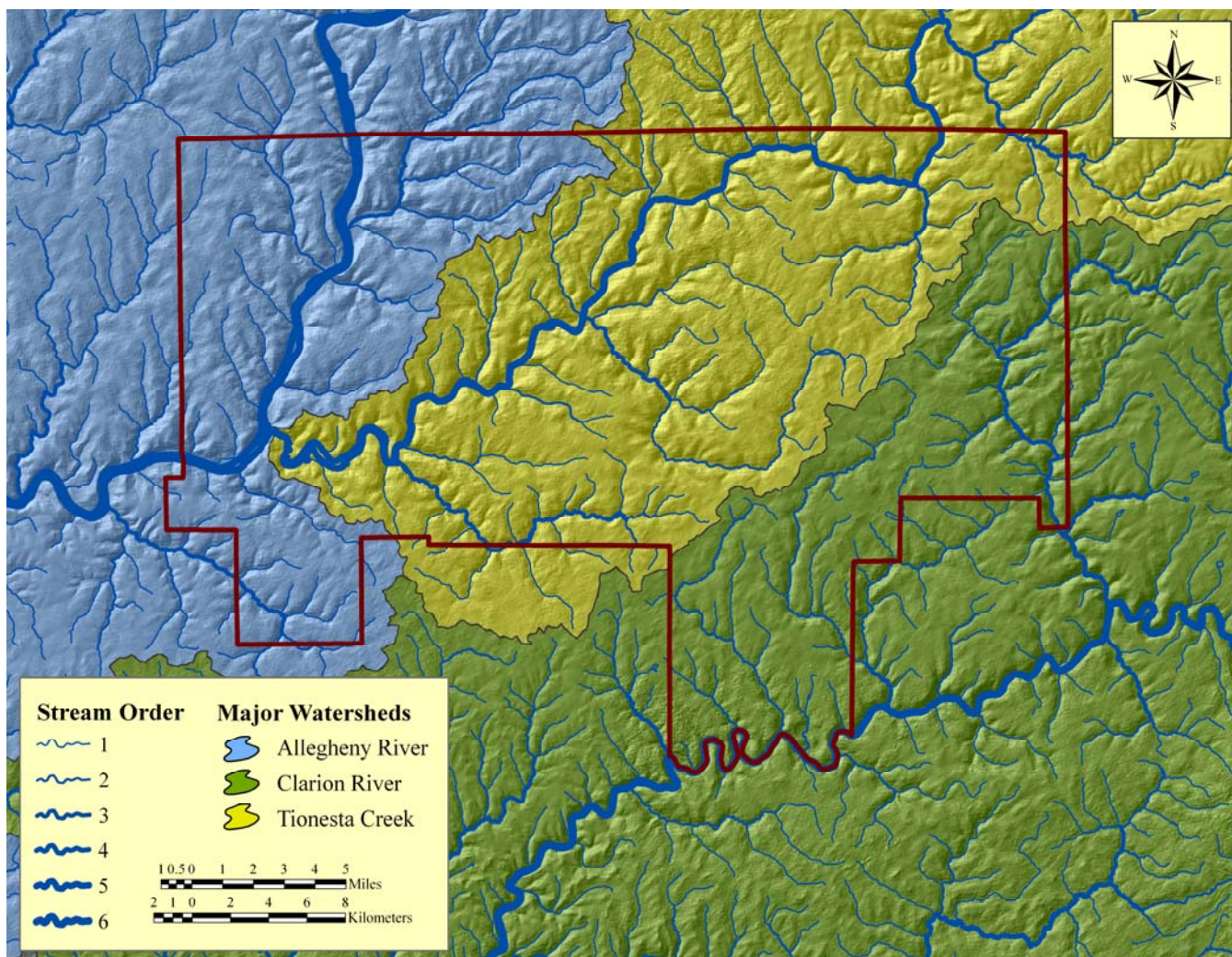


Figure 3. Major watersheds of Forest County, Pennsylvania.

At the turn of the 20th century, the Clarion River was considered one of the worst streams in the state, highly degraded due to pollution from tanneries, paper mills, chemical extraction plants, and acid mine drainage resulting from coal mining (Ortmann 1909). By 1996, the Clarion River had recovered to such an extraordinary degree that the U.S. Congress designated a 51.7-mile section below Ridgeway as a component of the National Wild and Scenic Rivers System. One of the benefits of this status is that the Wild and Scenic Rivers Act includes a number of provisions to prevent adverse impacts on designated rivers: 1) construction of dams requiring federal permits or with federal funding is prohibited; 2) federal lands within the legally-established river areas are required to be managed under special guidelines to protect and enhance river values; and 3) a management plan is required for the river to establish management objectives and guidelines for managing the river and designated area (US Forest Service 1998). Management responsibility for the Wild and Scenic section of the Clarion River was assigned to the Allegheny National Forest.

Wetlands on the Unglaciaded Allegheny Plateau typically occur at the heads of streams, in stream riparian zones, as seeps and springs where groundwater emerges at the surface of the ground, at beaver-impounded streams, and in depressions underlain by an impermeable subsoil layer. The types of wetlands in Forest County range from forested seeps where groundwater saturates the surface only when heavy precipitation raises the water table, to open marshes that are continuously flooded, to low areas along streams that are flooded during high water events, to beaver-influenced meadows where water levels fluctuate over decades as beavers colonize, abandon, and re-colonize, and forested depression wetlands.

Vegetation

Forest County lies within the hemlock-white pine-northern hardwood forest region of Braun (1950) and the hemlock-northern hardwood forest and Appalachian oak forest types of Kuchler (1964). Prior to European settlement, the forests of the Unglaciaded Allegheny Plateau were dominated by hemlock (*Tsuga canadensis*) and American beech (*Fagus grandifolia*) on moister plateaus and stream valleys, and oak-chestnut (*Quercus rubra*, *Q. montana*, *Castanea dentata*) on drier ridges and outcrops (Marquis 1975, Whitney 1990, Abrams and Ruffner 1995).

Prior to 1890, small stands of white pine and hemlock were selectively cut, leaving much of the virgin forest intact. Following the advent of logging railroads and specialized locomotives in the late 1800s, the Allegheny Plateau was almost entirely clearcut. Virtually everything extracted from the forest had economic value: hemlock bark was used in tanning leather; logs were processed for lumber, railroad ties, shingles, barrel staves, lath, furniture, and tool handles; distillation produced acetic acid, wood alcohol and other chemicals; homes were heated and power was generated using slabs, edgings, and sawdust (Marquis 1975). The miles of narrow gauge railbed running up the tributary valleys remain as evidence of the massive clearings that began over 100 years ago. Fires often followed the cuttings - many ignited by locomotive sparks, some begun intentionally - and for some years, parts of the plateau appeared as a ravaged landscape. The extensive logging that occurred between 1890 and 1930 produced the Allegheny hardwood forest type that now covers much of the region. Dominant tree species of this forest type include black cherry (*Prunus serotina*), red maple (*Acer rubrum*), sugar maple (*A. saccharum*), and yellow birch (*Betula lenta*) (Marquis 1975, Whitney 1990, Abrams and Ruffner 1995).

Disturbance

Disturbances, whether natural or man-made, are pivotal in shaping many natural communities. The nature, scale, and frequency of disturbance are influential in the evolution and occurrence of natural communities and associated rare species. Examples of natural and anthropogenic disturbance events are presented below in Table 2.

Natural Disturbances

Natural disturbances such as fire and flooding can benefit certain natural communities and species. For example, periodic fires are needed to maintain pitch pine (*Pinus rigida*) and scrub oak (*Quercus illicifolia*) barrens. Burns in such areas stimulate new growth in these species and exclude other successional species. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same time, streamside wetland communities hold excess water, thus reducing the scale of flooding downstream. On the Unglaciaded Allegheny Plateau, tornadoes and other windstorms commonly cause catastrophic disturbances on sites tens to thousands of acres in size. Lightning may be an important cause of individual tree mortality, and ice storms have periodically caused large-scale crown dieback (McNab and Avers 1994).

Table 2. Examples of natural and anthropogenic disturbances (adapted from Scott et al. 1999)*

<i>Natural Events</i>	<i>Anthropogenic Events</i>
<i>fire</i>	residential development
<i>disease epidemic</i>	road, trail, railroad line
<i>flood</i>	telephone line, utility line
<i>drought</i>	dam, canal
<i>hurricane/tornado</i>	commercial development
<i>landslide</i>	modern agriculture
<i>ice storm</i>	mining
	<i>logging</i>
	<i>grazing</i>

*Entries in italics connote reversible disturbances, while those in roman usually represent long-term effects

In contrast, deer have a number of negative impacts on Pennsylvania flora and fauna (Rhoads and Klein 1993). Over-browsing can result in a lack of forest regeneration, a reduction in the diversity and density of forest understory, decreased songbird diversity, and a direct loss of rare plants (Yahner 1995). For example, forests that

were once dominated by oak are now converting to red maple in large part because of deer pressure (Abrams 1998).

Anthropogenic Disturbances

In many cases, human-caused disturbance has been clearly destructive to natural habitats and the species associated with them. In Forest County, intensive human uses of the land, including logging and oil and gas development, have played a major role in altering the landscape over the past one hundred years.

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



METHODS

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

Site Selection

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

Aerial photographs were reviewed to identify sites for ground survey. Initial study of aerial photos revealed large-scale natural features (e.g., contiguous forest, wetlands), disturbances (e.g., utility right-of-ways, strip mines, timbered areas) and a variety of easily interpretable features. Potential sites were eliminated from consideration if they proved to be highly disturbed, fragmented, lacked the targeted natural feature, or were purely attributable to human-made features (e.g., impoundments, clearings, farm fields).

Ground Surveys

Areas identified as inventory sites were scheduled for ground surveys. Biologists conducted field surveys throughout Forest County between 2004 and 2006. After obtaining permission from landowners, sites were examined to evaluate the condition and quality of the habitat and to classify the communities present. Field survey forms (Appendix II) were completed for each site. If a plant species of special concern was recorded and the population was of sufficient size and vigor, a voucher specimen was collected and archived either with the appropriate taxonomic section of the Carnegie Museum of Natural History or within the collection of the Western Pennsylvania Conservancy. The flora, fauna, level of disturbance, approximate age and condition of forest community, and local threats were among the most important data recorded for each site. In cases where landowner permission for site visits was not obtained, or enough information was available from other sources, sites were not ground surveyed.

Data Analysis and Mapping

Data on species of special concern and natural communities obtained during the 2003 and 2004 field seasons were combined with prior existing data and summarized.

Two types of Natural Heritage areas are identified in County Natural Heritage Inventories:

Conservation Areas (CAs) are areas containing plants or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity. CAs include both the immediate habitat and surrounding lands important in the support of these special elements and are mapped according to their sensitivity to human activities. A "Core" area delineates essential habitat that cannot absorb significant levels of activity without substantial impact to the elements of concern. A "Supporting Natural Landscape"

includes the area necessary to maintain vital ecological processes or secondary habitat; these areas typically can accommodate some degree of development or low-impact activities.

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

Plant and animal nomenclature follows that adopted by the Pennsylvania Biological Survey. Community descriptions primarily follow Fike (1999); for systems not addressed in Fike (i.e. subterranean and non-vegetated habitats), Smith (1991) was followed. All sites with rare species and/or natural communities, as well as exceptional examples of more common natural communities were selected for inclusion in Conservation Areas (CAs). Spatial data on the element of concern were then compiled in a Geographic Information System (GIS) format using ESRI ArcGIS 9.1 software. Boundaries defining core habitat and supporting natural landscape for each CA were derived from the occupied habitat data based upon Pennsylvania Natural Heritage Program conservation planning specifications for the elements of concern within the CA. Specifications outline protocols for identifying lands important in the support of elements of concern and are based on scientific literature and professional judgment for individual species or taxonomic groups of species. They may incorporate physical factors (e.g., slope, aspect, hydrology), ecological factors (e.g., species composition, disturbance regime), and specifications provided by jurisdictional government agencies. Boundaries tend to vary in size and extent depending on the physical characteristics of a given site and the ecological requirements of its unique natural elements. For instance, two wetlands of exactly the same size occurring in the same region may require areas of very different size and extent for support if one receives mostly ground water and the other mostly surface water, or if one supports migratory waterfowl and the other does not. CAs were then assigned a significance rank to help

Table 3. County Natural Heritage Areas Significance Ranks

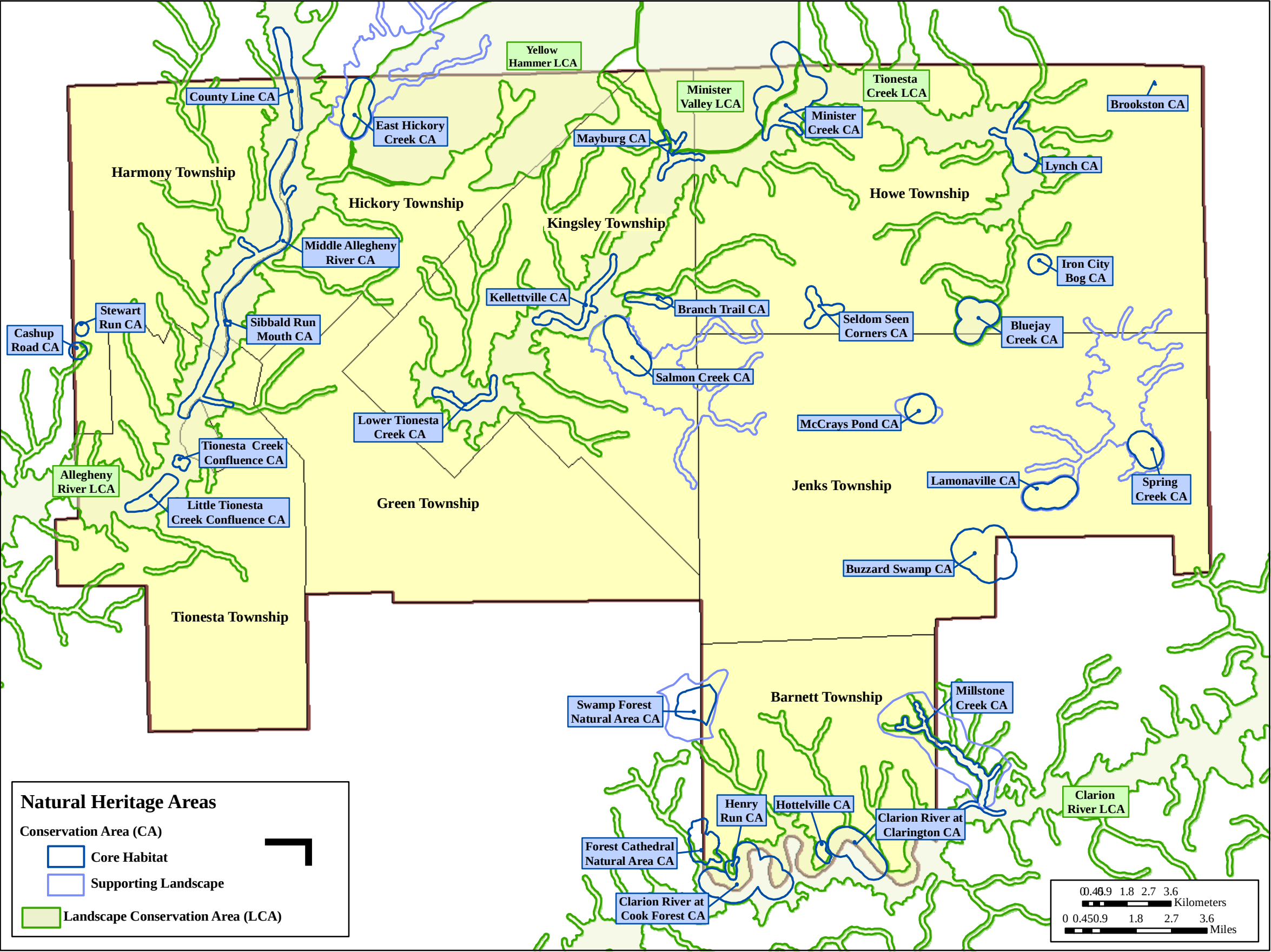
<i>Ranks</i>	<i>Description</i>
Exceptional	Sites that are of exceptional importance for the biological diversity and ecological integrity of the county or region. Sites in this category contain one or more occurrences of state or national species of special concern or a rare natural community type that are of a good size and extent and are in a relatively undisturbed condition. Sites of exceptional significance merit quick, strong, and complete protection.
High	Sites that are of high importance for the biological diversity and ecological integrity of the county or region. These sites contain species of special concern or natural communities that are highly ranked, and because of their size or extent, and/or relatively undisturbed setting, rate as areas with high potential for protecting ecological resources in the county. Sites of high significance merit strong protection in the future.
Notable	Sites that are important for the biological diversity and ecological integrity of the county or region. Sites in this category contain occurrences of species of special concern or natural communities that are either of lower rank (G and S rank – refer to appendix V) or smaller size and extent than exceptional or high ranked areas, or are compromised in quality by activity or disturbance. Sites of notable significance merit protection within the context of their quality and degree of disturbance.
Local	Sites that have great potential for protecting biodiversity in the county but are not, as yet, known to contain species of special concern or state significant natural communities. Often recognized because of their size, undisturbed character, or proximity to areas of known significance, these sites invite further survey and investigation. In some cases, these sites could be revealed as high or exceptional sites.

prioritize future conservation efforts. This ranking is based on the extent, condition, and rarity of the unique feature, as well as the quality of the surrounding landscape (see Table 3).

Landscape Conservation Areas (LCAs) were delineated to include important landscape features and functions. These features include large blocks of contiguous forest, extensive wetland complexes, areas linking ecologically significant features such as those recognized for CAs, and otherwise comparatively (relative to an individual county) undisturbed, ecologically intact portions of the landscape. LCAs delineated around contiguous forest were identified by means of GIS analysis, refined through aerial photograph inspection, and selected based on size. Forested areas were identified through a classification of 1992 National Land Cover Data (NLCD), compiled from Landsat TM (thematic mapping) satellite imagery with a resolution of 30 meters, downloaded from the Pennsylvania Spatial Data Access (PASDA) website (<http://pasda.psu.edu>). Land coverage types used in the analysis were transitional, deciduous forest, coniferous forest, mixed forest, woody wetlands, and emergent herbaceous wetlands. Roads, active railroads, and utility rights-of-way were considered fragmenting features. Existing GIS data for roads, which included interstates, US and state highways, state, county and township roads, Pennsylvania Bureau of Forestry roads, Allegheny National Forest roads, some private forest roads, and active railroads, were combined with utility right-of-way locations digitized from aerial photos. Analysis to identify contiguous blocks of forest was conducted using the map calculator function of the Spatial Analyst Extension in ArcView 3.2. Forest blocks less than 1 acre were removed and those remaining were grouped into five size classes: 1-250 acres, 251-1,000 acres; 1,001-5,000 acres; 5,001-10,000 acres; 10,001-15,783 acres. Perimeter-to-area ratios, a measure of habitat quality, were calculated for the four forest blocks greater than 10,000 acres; the forest block with the smallest ratio was selected as an LCA. A detailed description of the GIS analysis is available upon request from the Pennsylvania Natural Heritage Program.



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Natural Heritage Inventory
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Figure 4. Conservation Areas and Landscape Conservation Areas in Forest County, Pennsylvania.

RESULTS

The results of the Forest County Natural Heritage Inventory are presented in three sections. The Summary Results section summarizes the rare elements documented throughout the entire county. The Landscape-Scale Results section presents the results of a GIS-based landscape analysis identifying large areas of contiguous forest. The Results by Municipality section discusses species and natural communities of special concern on a site-by-site basis, and is organized alphabetically by township.

The focus of this report is rare natural elements, namely rare plant and animal species, rare or exemplary natural communities, and notable geologic features. Common species are discussed in site descriptions to help draw a picture of the habitat that supports rare elements. For those interested in a more comprehensive look at the common species that have been documented within Forest County, a list of sources has been compiled in Appendix VIII. Currently, no all-inclusive list of species occurring within Pennsylvania, broken down by county, exists.

Summary of Results

The Forest County Natural Heritage Inventory has identified 35 areas of ecological significance - 30 Conservation Areas and 5 Landscape Conservation Areas (see Figure 4). This report incorporates only data on rare elements documented since 1986, given that records of natural element occurrences collected within the last 20 years are the most likely to result in potential conflicts during the environmental review stage of a land development project. Altogether, 55 elements of conservation concern (45 animal species, 7 plant species, 2 natural community types, and 1 geologic feature type) have been documented in the county since 1986. A complete list is presented below in Table 4.

Table 4. Elements of conservation concern documented in Forest County since 1986 (*denotes species considered too sensitive to human perturbation to name elsewhere in this report).

Taxon	Common Name	Scientific Name
Bird	Bald Eagle	<i>Haliaeetus leucocephalus</i>
	Northern Goshawk	<i>Accipiter gentilis</i>
Fish	Bluebreast Darter*	<i>Etheostoma camurum</i>
	Channel Darter*	<i>Percina copelandi</i>
	Gilt Darter*	<i>Percina evides</i>
	Longhead Darter*	<i>Percina macrocephala</i>
	Mountain Brook Lamprey	<i>Ichthyomyzon greeleyi</i>
	Mountain Madtom*	<i>Noturus eleutherus</i>
	Northern Madtom*	<i>Noturus stigmosus</i>
Freshwater Mussel	Clubshell*	<i>Pleurobema clava</i>
	Long-solid	<i>Fusconaia subrotunda</i>
	Northern riffleshell*	<i>Epioblasma torulosa rangiana</i>
	Rayed bean*	<i>Villosa fabalis</i>
	Round Pigtoe	Round Pigtoe
	Sheepnose*	<i>Plethobasus cyphus</i>
Geologic Feature	Wavy-rayed Lampmussel	<i>Lampsilis fasciola</i>
	Erosional Remnant	---
Insect	Amber-winged Spreadwing Damselfly	<i>Lestes eurinus</i>

Table 4. Elements of conservation concern documented in Forest County since 1986 (*denotes species considered too sensitive to human perturbation to name elsewhere in this report).

Taxon	Common Name	Scientific Name
Insect	American Emerald Dragonfly	<i>Cordulia shurtleffii</i>
	Arctic Skipper Butterfly	<i>Carterocephalus palaemon</i>
	Azure Bluet Damselfly	<i>Enallagma aspersum</i>
	Comet Darner Dragonfly	<i>Anax longipes</i>
	Coral Hairstreak Butterfly	<i>Satyrrium titus</i>
	Eyed Brown Butterfly	<i>Satyrodes eurydice</i>
	Gray Comma Butterfly	<i>Polygonia progne</i>
	Green-faced Clubtail Dragonfly	<i>Gomphus viridifrons</i>
	Harpoon Clubtail Dragonfly	<i>Gomphus descriptus</i>
	Harris' Checkerspot Butterfly	<i>Chlosyne harrisii</i>
	Indian Skipper Butterfly	<i>Hesperia sassacus</i>
	Long Dash Butterfly	<i>Polites mystic</i>
	Maine Snaketail Dragonfly	<i>Ophiogomphus mainensis</i>
	Midland Clubtail Dragonfly	<i>Gomphus fraternus</i>
	Mocha Emerald Dragonfly	<i>Somatochlora linearis</i>
	Mustached Clubtail Dragonfly	<i>Gomphus adelphus</i>
	Northern Pearly-eye Butterfly	<i>Enodia anthedon</i>
	Northern Pygmy Clubtail Dragonfly	<i>Lanthus parulus</i>
	Ocellated Darner Dragonfly	<i>Boyeria grafiana</i>
	Rapids Clubtail Dragonfly	<i>Gomphus quadricolor</i>
	Silver-bordered Fritillary Butterfly	<i>Boloria selene</i>
	Ski-Tailed Emerald Dragonfly	<i>Somatochlora elongata</i>
	Superb Jewelwing Damselfly	<i>Calopteryx amata</i>
	Sweetflag Spreadwing Damselfly	<i>Lestes forcipatus</i>
	Taiga Bluet Damselfly	<i>Coenagrion resolutum</i>
	Uhler's Sundragon Dragonfly	<i>Helocordulia uhleri</i>
	Zebra Clubtail Dragonfly	<i>Stylurus scudderi</i>
Natural Community	Hemlock – Mixed Hardwood Palustrine Forest	---
	Hemlock Palustrine Forest	---
Plant	American Columbo	<i>Swertia caroliniensis</i>
	Bog Sedge	<i>Carex paupercula</i>
	Butternut	<i>Juglans cinerea</i>
	Large Toothwort	<i>Cardamine maxima</i>
	Queen-of-the-Prairie	<i>Filipendula rubra</i>
	Redhead Pondweed	<i>Potamogeton richardsonii</i>
	Stalked Bulrush	<i>Scirpus pedicellatus</i>
Reptile	Timber rattlesnake*	<i>Crotalus horridus</i>

Landscape Fragmentation

Prior to European settlement, forest covered more than 90 percent of Pennsylvania (Goodrich et al. 2003). Today, 62 percent of the state is forested, comprising an area of over 17 million acres (Figure 5; Goodrich et al. 2003, Myers et al. 2000). However, much of this forest exists as relatively small islands isolated by surrounding linear features such as roads, utility right-of-ways, and railroads, as well as non-forest lands. A number of studies have looked at the effects of roads and other linear features on the landscape. Ecological impacts of these fragmenting features include: (1) direct mortality of wildlife from vehicles; (2) disruption of wildlife dispersal; (3) habitat fragmentation and loss; (4) imposition of edge effects; (5) spread of exotic species; (6) alteration of the chemical environment.

Roads can be a significant source of mortality for a variety of animals. Few if any terrestrial species are immune. Amphibians may be especially vulnerable to road-kill because their life histories often involve migration between wetland and upland habitats, and individuals are inconspicuous. One study conducted in southeastern Pennsylvania documented over 100 road-killed salamanders and frogs on a single-mile stretch of road during one rainy night in the spring breeding season (Goodrich et al. 2003). Large and mid-sized mammals are particularly susceptible to vehicle collisions on secondary roads, while birds and small mammals are most vulnerable on wider, high-speed highways (Forman & Alexander 1998). In Upper St. Clair Township, Pennsylvania, over the last four years, white-tailed deer mortality due to road-kills was approximately four times higher than mortality due to hunting (Upper St. Clair Township Department of Deer Management 2005). A total of 637 bobcats (*Lynx rufus*) were reported as road-kills in Pennsylvania from 1985 to 2000 (Goodrich et al. 2003). A 10-year study of road mortality in New Jersey recorded 250 dead raptors representing 12 species along a 90-mile section of road (Loos and Kerlinger 1994, cited in Goodrich et al. 2003).

Animals may alter their behavior in the presence of a road. One study found that small forest mammals (e.g., eastern chipmunk, eastern gray squirrel, and deer mouse) were reluctant to venture onto road surfaces where the distance between forest margins exceeded 20 m. The same study concluded that a four-lane divided highway might be as effective a barrier to the dispersal of small forest mammals as a body of fresh water twice as wide (Oxley et al. 1974). A study conducted in North Carolina found that black bears shift their home ranges away from areas with high road densities (Brody and Pelton 1989). Songbirds seem to be especially sensitive to traffic noise; it interferes with their vocal communication and thus affects their territorial behavior and mating success (Seiler 2001).

Roads, wide trails, and grassy corridors can also function as barriers restricting the movement of invertebrates and amphibians. Populations of microhabitat-specific species, such as land snails and salamanders that generally require moist habitats, may be isolated by inhospitable, xeric corridors (Williams 1995a, Blaustein et al. 1994). Some forest butterflies, like the West Virginia white (*Pieris virginiensis*), will not cross open habitats and its current rarity may be a function of habitat fragmentation and isolation (Williams 1995a). Consequences of the isolation of populations include reduced genetic diversity and low recruitment rates that can, in turn, result in local extinctions (Seiler 2001).

Fragmentation of formerly contiguous forested landscapes into smaller, isolated tracts has an effect on plant and animal distribution and community composition. When an extensive forest tract is fragmented, the resulting forest islands may lack the full range of microhabitats that existed in the original tract. If a habitat fragment lacks required microhabitat(s), or is smaller than the minimum area required by a given species, individuals of that species will not likely be found within that habitat fragment (Lynch and Whigham 1984). For example, the Louisiana waterthrush (*Seiurus motacilla*) is rarely found in small woodlots because they require upland forest streams within their territory, and most small woodlots lack this necessary component (Robbins 1980, Robinson 1995). Area-sensitive species such as northern goshawk (*Accipiter gentilis*),

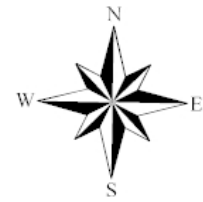
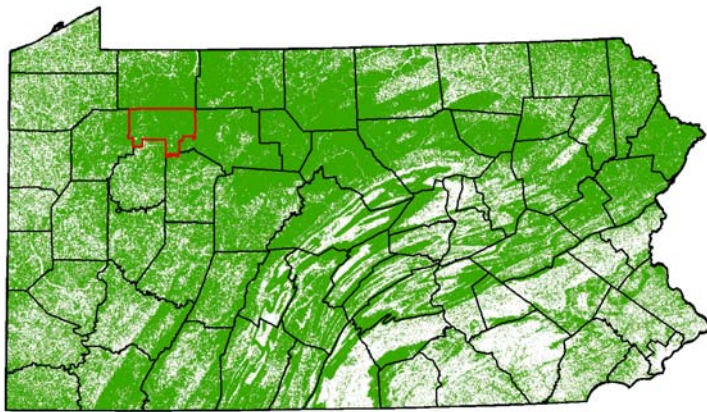
barred owl (*Strix varia*), bobcat, and timber rattlesnake (*Crotalus horridus*) require interior forest areas in excess of 6,000 acres to accommodate breeding and foraging territories (Squires & Reynolds 1997, Mazur & James 2000, Ciszek 2002, Natureserve 2005).

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

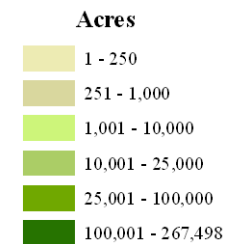
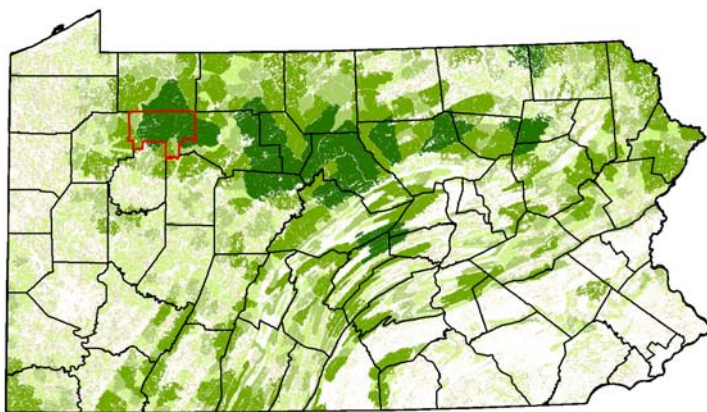
Roads can act as corridors for plant dispersal, and exotic species increase their range by spreading along roadsides (Watkins et al. 2003). Vehicles and road-fill operations transport exotic plant seeds into uninfested areas, and road construction and maintenance operations provide safe sites for seed germination and seedling establishment (Schmidt 1989, Trombulak and Frissell 2000). Unpaved road edges often have exposed areas of mineral soil and suitable light and moisture conditions that allow exotic seeds to become established (Parendes and Jones 2000, Trombulak and Frissell 2000).

Road traffic and maintenance of right-of-ways contribute at least six different classes of chemicals to the environment: heavy metals, salt, organic pollutants, ozone, nutrients, and herbicides (Forman & Alexander 1998, Trombulak and Frissell 2000). Heavy metals, which include lead, aluminum, iron, cadmium, copper, and manganese, contaminate soils, plants, and invertebrates up to 200 m from roads, as well as vertebrate fauna foraging within the affected zone (Trombulak and Frissell 2000). One study found elevated lead concentrations in tissue of several small mammal species in a narrow zone by roads (Getz et al. 1977, cited in Forman and Alexander 1998). De-icing salts contribute ions to the soil, altering pH and soil chemical composition, which effects plant growth (Forman and Alexander 1998, Trombulak and Frissell 2000). Airborne sodium chloride from snowplowing may cause leaf injury to trees (e.g., white pine) up to 120 m from a road, especially downwind and downslope (Forman and Alexander 1998). Organic pollutants such as dioxins and polychlorinated biphenyls (PCBs) are present in higher concentrations along roads and hydrocarbons may accumulate in aquatic ecosystems near roads (Trombulak and Frissell 2000). Vehicles produce ozone, which increases the concentration of this gas in the lower atmosphere where it acts as a greenhouse gas (Trombulak and Frissell 2000). Storm runoff from roads, particularly where roads abut or cross water bodies, results in the transport of nutrients and sediments into aquatic ecosystems (Trombulak and Frissell 2000). Herbicides are often applied to roadsides and utility right-of-ways to control woody plant growth. Forest edge and interior plant species can be damaged or destroyed by drifting or misapplied herbicide (Williams 1995a, Forman and Deblinger 2000).

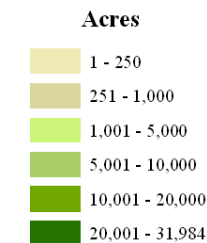
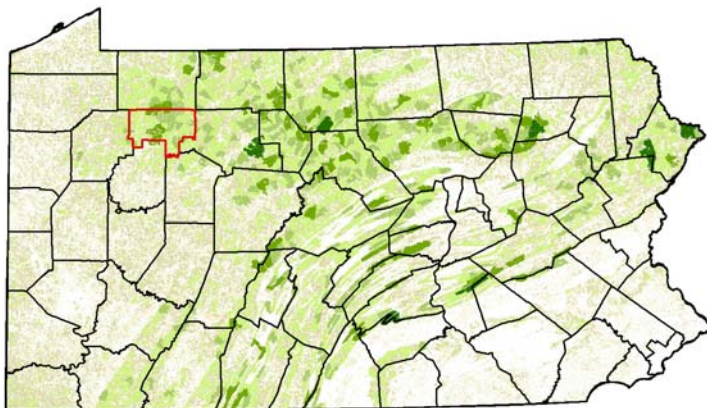
Humans are an integral part of natural history, where we function as ecosystem engineers, altering the landscape around us to suit our needs. Some species benefit from human-induced changes, such as birds that inhabit the early successional and edge habitats provided by utility corridors or disturbance-adapted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



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



B. Forest and wetland areas greater than one acre, fragmented by interstate, US, and state highways. Roads of this magnitude function as a barrier to all animals. The forest and wetland blocks shown here represent potential contiguous habitat for megafauna relatively insensitive to smaller-scale fragmenting features, such as black bear and white-tailed deer.



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

Figure 5. Forest and wetland areas of Pennsylvania shown at varying scales of fragmentation due to human-created linear landscape features.

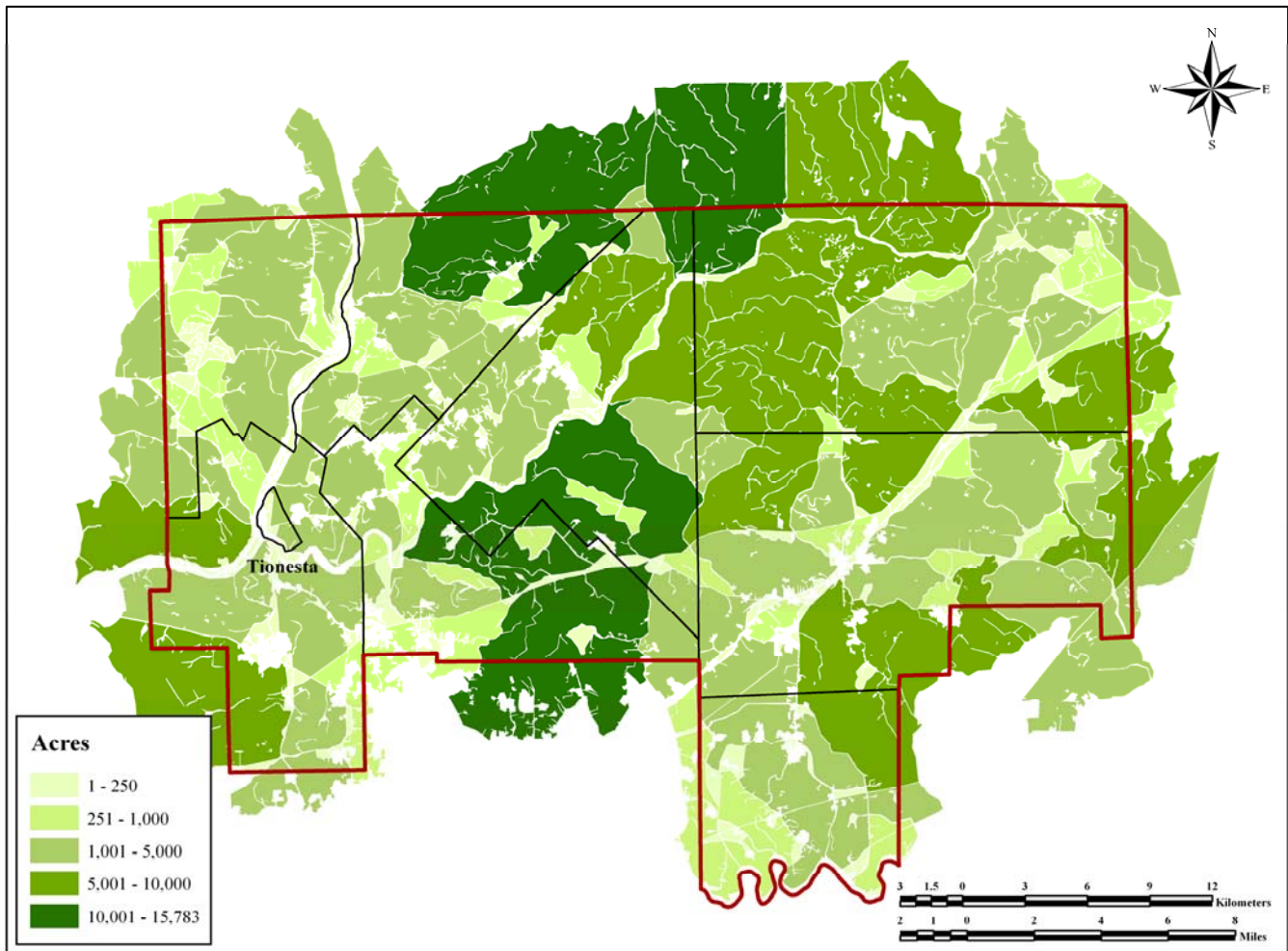


Figure 6. Areas of contiguous forest and wetland habitat in Forest County, Pennsylvania.

Landscape-scale Results

Landscape Analysis

Based on the National Land Cover Data Set for Pennsylvania (USGS 2001), forests and wetlands cover roughly 259,600 acres, or 94 percent of Forest County. Of that, 67 percent is interior forest habitat - defined as being over 100 m from either a fragmenting feature or forest edge (Goodrich et al. 2003). Hardwood forest accounts for 58 percent of the county's forest. The remainder is comprised of coniferous forest (0.7%), mixed conifer-hardwood forest (27%), shrub/scrub - areas dominated by true shrubs, forest in an early successional stage, or trees stunted from environmental conditions (0.7%), and wetlands (0.1%).

The results of the landscape analysis to identify contiguous areas of forest and wetland habitat in Forest County are shown in Figure 5. The vast majority of contiguous forest occurs in blocks of less than 250 acres (see Figure 7); of the 653 blocks that comprise the 1 to 250 acre size class, only 36 cover an area greater than 100 acres, and of those 36 forest blocks, only eight are larger than 200 acres. Roughly ten percent of the identified forest blocks are larger than 1,000 acres.

The forest blocks greater than 1,000 acres represent potential habitat for area-sensitive species. Robbins et al. (1989) found the minimum preserve size for forest birds to be 988 acres. This is not to say, however, that area-sensitive species will not be found in forested areas less than that which they require, but their reproductive success may be significantly reduced, resulting in population declines (Goodrich et al. 2003). During nesting season, the home range of a pair of northern goshawks may encompass an area ranging from 1,400 acres to 8,600

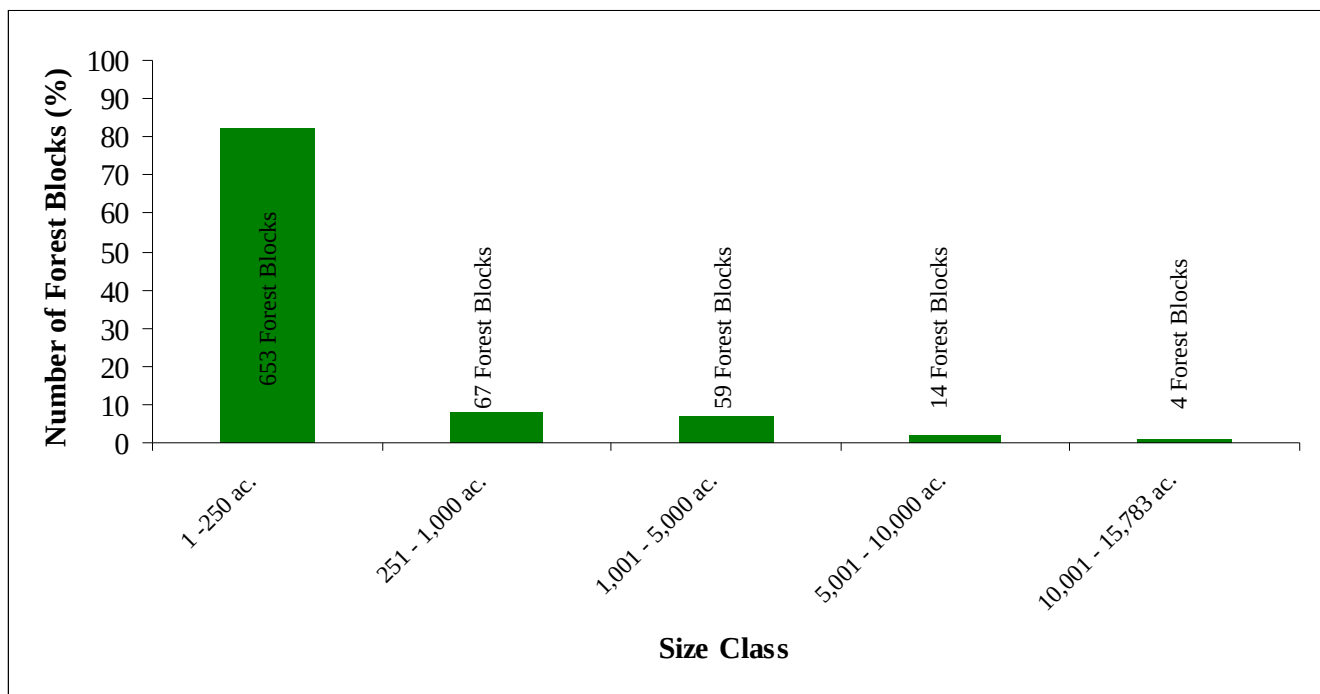


Figure 7. Distribution of forest blocks within Forest County across size classes.

acres (Squires & Reynolds 1997). Bobcat territories can extend up to 1,700 acres (Cizek 2002). Black bear males establish ranges large enough to secure mates as well as food. A male's home range averages 20,000 acres and typically encompasses 7-15 female territories (Rogers 1999). Anderson and Vickery (in press) suggest that a minimum forest area of 25,000 acres is required to both absorb damage from large-scale disturbances such as tornados and to sustain resident populations of area-sensitive species.

Landscape Conservation Areas

Landscape Conservation Areas (LCAs) represent large areas of the landscape that are of higher ecological quality than other areas of similar size. They may include large blocks of contiguous forest, extensive wetland complexes, landscape features linking rare element occurrences such as those recognized within Conservation Areas, and otherwise comparatively (relative to an individual county) undisturbed, intact portions of the landscape.

Three Landscape Conservation Areas have been designated around the three major streams flowing through Forest County. Each of these waterways supports an abundance of rare species that are dependent upon high-quality aquatic habitat conditions. Additionally, two LCAs encompass large areas of relatively unfragmented forest.

Allegheny River LCA

In 1992, the U.S. Congress granted three sections of the Allegheny River, totaling 86.6 miles, the designation of Wild and Scenic River. These sections were classified as Recreational to reflect the relatively high level of accessibility and development relative to other rivers in the Wild and Scenic Rivers System. The Allegheny River Landscape Conservation Area captures the approximately 47-mile segment from the Buckaloons Recreation Area at Irvine to the southern end of Alcorn Island at Oil City. The seven Allegheny Wilderness Islands, so designated in by Congress in 1984, also lie within this section of the Allegheny River. A. E. Ortmann, writing in 1909 on the destruction of the fresh-water fauna in western Pennsylvania, observed that above Oil City, Venango County, the Allegheny River was in good condition and formed a fine collecting ground for fish fauna and the fauna of freshwater mollusks. Today, this section of the Allegheny continues to support a rich diversity of fish and mussel

Freshwater Mussel Conservation

(Source: Walsh et al. 2007)

Freshwater mussels are generally indicative of habitat types that are rare in the Commonwealth. Mussel species are typically found in watersheds at least 75 sq. km. (29 sq. mi.) in size that are drained by medium or large sized streams. Mussel richness generally increases with increasing watershed size (Strayer and Jirka 1997), so the largest rivers in Pennsylvania, like the Ohio, Allegheny, Susquehanna, and Delaware Rivers tend to have the most species-rich mussel communities. Large streams and rivers of good quality without major habitat alterations are becoming increasingly rare.

Water quality threats to mussels include toxic and organic compounds released from industrial and municipal point sources. In recent decades, regulations of gross point source discharges have sufficiently improved water quality and allowed mussels to re-colonize some streams and rivers (Strayer and Jirka 1997). Non-point source pollution contributed from large areas, like farms and cities, can also threaten water quality for mussels. Agricultural practices can vary greatly, as can their influences on mussel communities. In many instances, mussels are seemingly undisturbed, compared to other aquatic organisms, by agricultural pollution. But excessive sedimentation and habitat alteration from agricultural practices can also be detrimental to mussel communities. Runoff from urban and suburban developments appears to be more damaging to mussels, most likely due to combined effects of altered hydrology, excess sediment and nutrients, and warm water temperatures (Strayer and Jirka 1997).

Dams impact mussel communities through hydrologic alteration, disrupted connectivity, habitat alteration, and changes in thermal properties. Dams restrict the movement of host fish and thus glochidia (larval mussels) carried by their hosts are similarly restricted in distribution. Alterations in the stream channel above and below the dam may potentially alter available habitat for mussel communities. Water quality and temperature can be largely altered in a reservoir. Impoundment management and drawdown plans can be important for maintaining mussel communities.

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

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

species. Currently, 68 species of fish – nine of which are considered species of special concern in Pennsylvania – occur within this 47-mile stretch of river. Additionally, populations of 24 species of freshwater mussels have also been documented; 13 of those species are considered as being of special concern in Pennsylvania, and of those, two species are also listed as Federally Endangered and two species are Candidates for Federal listing.

Clarion River LCA

The Clarion River LCA encompasses the 52-mile stretch of the Clarion River granted Wild and Scenic status by Congress in 1996. More specifically, 17 miles have been classified as Scenic and 34 miles are classified as Recreational. At the turn of the twentieth century, pollution from a number of industries along the river had essentially brought about the death of the Clarion River. Ortmann (1909) declared the Clarion as “possibly...one of the worst streams in the state” with regard to pollution. At that time, pollution from wood-pulp mills, tanneries, chemical factories, and coal mines in Elk County had turned the water “black like ink, [and it] retain[ed] its peculiar color all the way to where it empties into the Allegheny” (Ortmann 1909). Today, the free-flowing character of this section of the river maintains habitat able to support a rich diversity of fish and odonates, and a recovering freshwater mussel fauna.

Tionesta Creek LCA

The Tionesta Creek LCA includes the main stem of Tionesta Creek roughly from its confluence with Jake Run upstream to Lynch, plus Bluejay Creek and the tributaries flowing into these sections of Tionesta Creek and Bluejay Creek. At the turn of the twentieth century, Ortmann (1909) found the mouth of Tionesta Creek to be polluted by chemical waste and did not investigate further upstream. It was likely degraded along much of its length by lumber mills, tanneries, and oil and gas wells and their by-products. Today, 41 fish species and 5 species of freshwater mussels inhabit Tionesta Creek.

The Allegheny River LCA and the Tionesta Creek LCA represent mussel habitat that is significant within both a state and national context. Freshwater mussel populations are rapidly declining in North America. In the past 100 years, more than 10 percent of our continent’s mussels have become extinct. For mussel species in the United States, nearly 25 percent are listed as Federally endangered or threatened and 75 percent are listed as endangered, threatened or rare by individual states (Neddeau et al. 2005).

The boundaries of these LCAs capture the slopes that drain directly into the main stem of the river and the riparian zones of their tributaries, extending at least five kilometers upstream from the primary stream. Each LCA functions as supporting landscape for the multiple Conservation Areas that lie within its boundaries.

Riparian zones occur at the interface of terrestrial and aquatic ecosystems, and are among the most dynamic, diverse, and productive of ecological systems (Gregory et al. 1991; Naiman et al. 1993, cited in Williams 1996). Such riparian areas are particularly important in supporting the health of the aquatic community, and when forested, provide important habitat to terrestrial species as well. Forested riparian buffers function to stabilize stream hydrology, maintain the physical integrity of the stream channel, and intercept sediments and chemicals before they enter the stream. Riparian buffers are also critical in maintaining a natural cycle of nutrient input and uptake in the stream, providing a source of organic matter while filtering nutrients contained in runoff. In addition, a forested riparian buffer supports habitat conditions necessary for a diverse assemblage of native species in the stream; it regulates air and water temperatures, and provides food and cover for fish, amphibians, invertebrates, and other wildlife (Harding et al. 1998; Maryland DNR 1999). Forested riparian corridors also represent complex gradients that can include variation in elevation, frequency of flooding and duration, substrate conditions, nutrients, and light that produces a mosaic of plant communities extending from the stream into the forest (Williams 1996). Indeed, in Allegheny Plateau landscapes, the more frequently inundated areas of headwater riparian forests represent important centers of vascular plant diversity compared to mesic floodplains and adjacent hillslopes (Williams 1996).

Threats and Stresses

Maintaining suitable stream habitat is key to protecting all the rare aquatic species occurring within these Landscape Conservation Areas. Their continued success depends upon high water quality, the regulation of water temperature provided by forest cover, and the input of detritus and other organic material from the surrounding forest. Loss of forest cover along riparian corridors would likely result in physical degradation of the stream channels, erosion and sediment pollution in the river, higher water temperatures, and disruption of natural nutrient cycling linked to the river and its tributaries. If forest cover is substantially reduced within the watershed, water quality is likely to decline from increased sediment loads. Removal of forest cover on steep slopes is problematic because of the potential for increased runoff and erosion following storm events.

Invasive mussel species like the zebra mussel (*Dreissena polymorpha*) and the Asian clam (*Corbicula fluminea*) may be damaging to populations of native mollusks. Zebra mussels interfere with native mussels by attaching to individuals in large numbers and eventually killing them (Strayer and Jirka 1997). Non-native mussels may alter food resources and habitat (Hakenkamp et al. 2001) and may also cause endemic mussel populations to deteriorate.

Conservation Recommendations

Preserving forested stream corridors is key to maintaining high water quality. If possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat. Although the surrounding watershed is not as closely linked to the stream ecosystem as are the riparian zones, a high degree of forest cover should be maintained for additional protection of the water quality and ecological integrity of the aquatic ecosystems.

Minister Valley LCA

This area has been designated around a 12,493-acre forest block – of which 81 percent is interior forest. Of the four blocks of contiguous forest greater than 10,000 acres within the county, this forested area has the smallest perimeter-to-area ratio, or in other words, is least impacted by edge effects. A large portion of this LCA lies within the Allegheny National Forest, and has been designated as a wilderness study area in the 2007 Forest Management Plan.

Yellow Hammer LCA

This Landscape Conservation Area encompasses 15,783 acres of forest, making it the largest block of contiguous forest in the county. Approximately 73 percent of this LCA is interior forest. As with the adjacent Minister Valley LCA, a large portion of this LCA, 59 percent, lies within the Allegheny National Forest.

Seventy percent of the interior forest remaining in Pennsylvania is found in patches of 5,000 acres or less (Goodrich et al. 2003). Given that context, it is hard to place too much emphasis on the importance the interior forest within these LCAs. Not only does it provide potential habitat for a number of area-sensitive species, but the interior forest is important for the maintenance of vital ecosystem processes such as nutrient cycling, pollination, predator-prey interactions, and natural disturbance regimes (Heilman et al. 2002). In addition, large forested areas also serve to filter and regulate streamflow within watersheds and sequester large amounts of carbon as biomass.

Threats and Stresses

Activities such as development, road building, and large-scale timber harvesting that result in forest fragmentation will reduce the contiguity that makes this LCA ecologically significant. Landscape features that fragment the landscape range from all-terrain vehicle trails to state highways and their effects depend largely on a specific plant or animal species' threshold for disturbance. The structure of a forest, along with size and contiguity,

Table 5. Ownership of lands within Landscape Conservation Areas.

Landscape Conservation Area	Total Area (acres)	Private Ownership (acres)	Public Ownership (acres)			
			National Forest	State Game Lands	State Forests	State Parks
Allegheny River	48,176	34,296	9,600	3,984	296	0
Clarion River	40,122	17,677	8,881	9,906	1,300	2,358
Minister	12,688	3,052	9,636	0	0	0
Tionesta Creek	19,916	9,373	10,543	0	0	0
Yellow Hammer	16,392	4,457	9692	0	0	0

determines the suitability and quality of habitat for wildlife. A number of macroinvertebrates, birds, and mammals depend on the subcanopy, shrub, and herbaceous layers. Over-browsing by white-tailed deer has eliminated the tree seedling, sapling, and shrub layers, and greatly reduced herbaceous species diversity in large areas of forest in Pennsylvania. The longer over-browsing occurs, the more difficult it becomes to restore the original vegetation, in part because seed and other propagule supplies have been greatly reduced or eliminated (Latham et al. 2005).

Conservation Recommendations

A significant portion of the land encompassed by this LCA is located in the Allegheny National Forest (see Table 5), which presents land managers with the opportunity to coordinate sustainable management and biodiversity conservation. The U.S. Forest Service recognizes sustainability as one of the management goals in the National Forest.

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

Forest fragmentation can be minimized by utilizing existing disturbed areas for new projects rather than clearing additional forest, by consolidating roads and right-of-ways where multiple routes exist, and by restoring unused cleared areas such as abandoned roads or railroad tracks to forest. When planning development, it is preferable to avoid complete division of the LCA to minimize impacts. The impact of individual features such as oil and gas wells, roads, right-of-ways and other clearings can also be minimized by the use of ecologically informed best management practices in construction and maintenance.



Contiguous Forest and Forest Interior Birds

Large contiguous tracts of forest are declining throughout the region due to suburban sprawl and land development, such as building roads. The definition of forest interior, or core forest, as defined by the Pennsylvania Department of Conservation and Natural Resources (DCNR), is continuous forest that is 300 feet from a road or edge (2006). This critical habitat is declining on a statewide basis; seventy percent of Pennsylvania's core forest remaining, is found in small patches of 5,000 acres or less (PA DCNR 2006).

Forest interior dwelling bird species are dependent upon large tracts of forest for reproduction; these birds include neotropical migrant songbirds, residents, and short-distance migrants. Recent declines in these populations can be attributed to forest fragmentation and direct habitat loss (Jones et. al. 2000). Increased forest edges, created by forest management practices, such as logging and gas line development, can expose nesting birds to greater dangers such as brood parasitism and nest predation. For example, many nesting forest songbirds nesting near edges easily fall prey to nest parasitism by Brown-headed cowbirds (*Molothrus ater*), which eject host nest eggs and lay their own for other birds to rear (Robertson and Norman 1976). Such birds as Chestnut-sided warbler (*Dendroica pennsylvanica*) and Wood thrush (*Hylocichla mustelina*), cannot recognize cowbird eggs and the raise them as their own (Jones et al. 2000). Numerous studies have confirmed the negative impacts of forest fragmentation on forest interior bird species.

The avifaunal diversity of interior forest blocks is vast; the general composition of these communities includes a variety of warblers, vireos, owls, woodpeckers, and hawks. Birds of concern include Red-headed woodpecker (*Melanerpes erythrocephalus*), Wood thrush (*Hylocichla mustelina*), Olive-sided flycatcher (*Contopus cooperi*), Canada warbler (*Wilsonia canadensis*), Kentucky warbler (*Oporornis formosus*), and Louisiana waterthrush (*Seiurus motacilla*). Additional state-listed birds for Pennsylvania that depend on contiguous forest blocks are Northern goshawk (*Accipiter gentilis*), Long-eared owl (*Asio otus*), Northern saw-whet owl (*Aegolius acadicus*), Yellow-bellied flycatcher (*Empidonax flavescens*), Swainson's thrush (*Catharus ustulatus*), and Prothonotary warbler (*Protonotaria citrea*).

Common forest interior birds found in Forest County include the Scarlet tanager (*Pairanga olivacea*), Ovenbird (*Seiurus surocapillus*), Black-throated-green warbler (*Dendroica virens*), Black and white warbler (*Mniotilta vaira*), Acadian flycatcher (*Empidonax virescens*), Hairy woodpecker (*Picoides villosus*), Pileated woodpecker (*Dryocopus pileatus*), Broad-winged hawk (*Buteo platypterus*), and Barred owl (*Strix varia*), to name a few. In addition to conservation efforts for rare species, maintaining viable populations of common birds increases natural community diversity and habitat quality. Although conservation of rare and endangered species is important, there is also a need for sustaining populations of more common species. Efforts such as projects by Partners in Flight, The Audubon Society of Pennsylvania, and The North American Bird Conservation Initiative are focused on reversing the decline of neo-tropical landbird migrants and sustaining healthy populations of native birds (Rosenberg et al.1999).

To sustain viable populations of birds, forest structure must retain a diversity of microhabitats to be exploited by different species. The structural diversity of the forest, both horizontal (i.e., natural openings in the canopy) and vertical (i.e., shrub, understory, and canopy layers, large woody debris on the forest floor and standing snags) provides more types of feeding, perching, and nesting habitats. Contiguous forest tracts are inherently necessary to support a wider variety of breeding songbirds and more foraging areas for larger birds of prey, like the Northern goshawk. In addition, there are several forest management implications for the maintenance of healthy breeding populations of songbirds; this includes maximizing the size of forest tracts by cutting around the borders of the forest, keeping larger forest patches near other forest patches, creating irregular edges when timber harvesting, avoid clear-cutting by leaving some trees of varying species and different size classes, and retaining decaying and standing dead trees (Rodewald 2001).

Other Landscape-Scale Conservation Areas

Across the state, a number of organizations have undertaken conservation planning efforts at a landscape scale. The areas identified through these efforts frequently overlap with sites identified by County Natural Heritage Inventories, and serve to emphasize the importance of focusing conservation efforts in those areas. The results of three such planning efforts are included here in order to provide information relating to the natural heritage of Forest County that readers of this report may not otherwise be aware of.

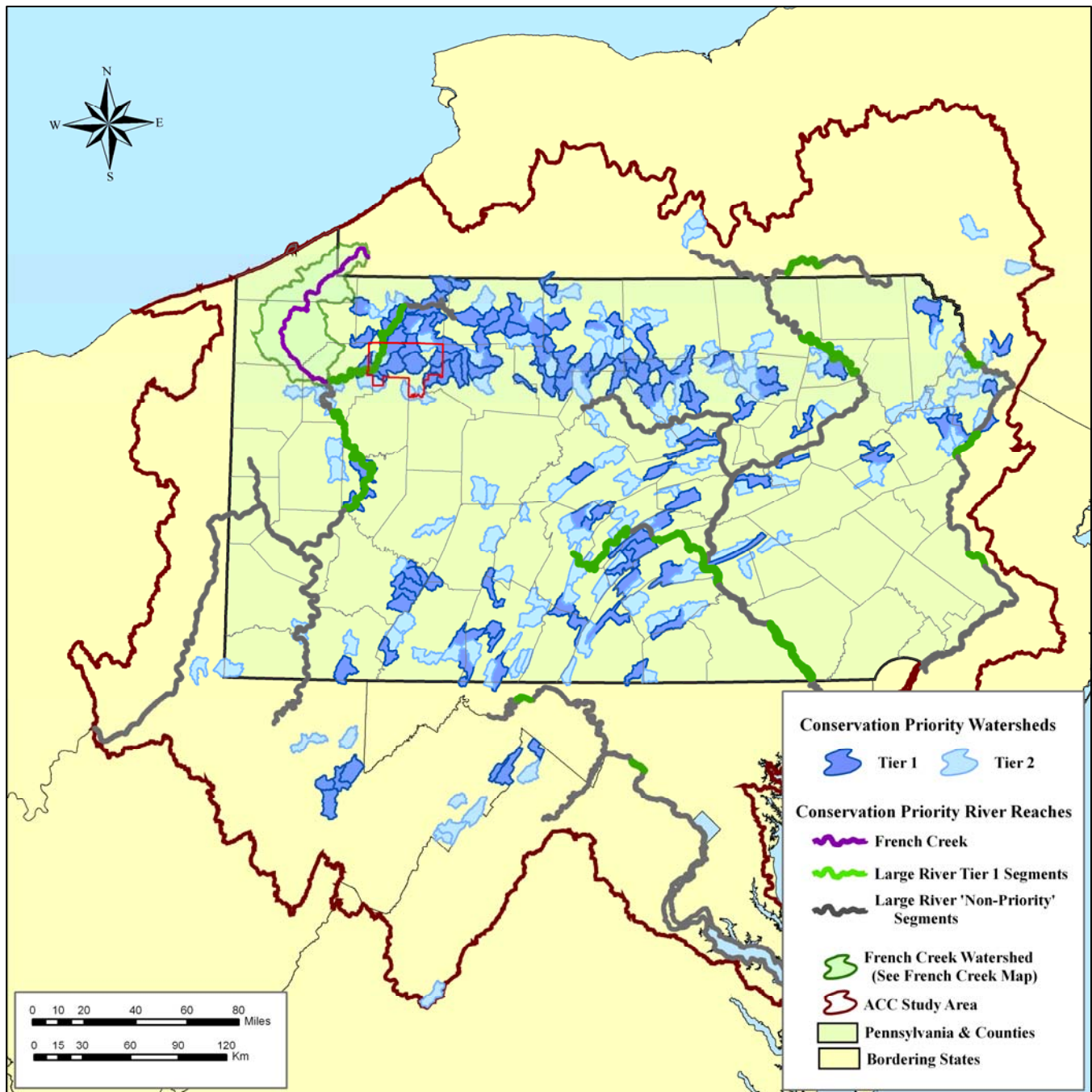


Figure 8. Conservation priority areas for Pennsylvania and surrounding watersheds identified by the Aquatic Community Classification Project (adapted from Walsh et al. 2007b).

Conservation Priority River Reaches and Watersheds

Note: the following project description is taken from Classifying Lotic Systems for Conservation: Project Methods and Results of the Pennsylvania Aquatic Community Classification Project (2007a) and User's manual and data guide to the Pennsylvania Aquatic Community Classification (2007b).

The Pennsylvania Aquatic Community Classification (ACC) was developed by the Pennsylvania Natural Heritage Program to create a schema of flowing water ecosystems in Pennsylvania and its watersheds. The ACC defines types of stream and river reaches based on aquatic communities, their habitats, and watershed properties. The project products were designed for natural resource applications including assessment, monitoring, resource planning and conservation.

Combining data from many parts of the Aquatic Community Classification project has resulted in a means of identifying the unique riverine conditions that designate certain watersheds to be of greater conservation concern than others. Some watersheds may be of importance due to a single occurrence of a natural feature, such as the presence of a fish rare species or a high quality mussel community, but watersheds that hold multiple traits of conservation value should be set apart as a higher protection priority.

Least Disturbed Streams (LDS) were selected based on evidence of little human disturbance as indicated by watershed and riparian landcover, mines and point pollution sources, road-stream crossings, and dams.

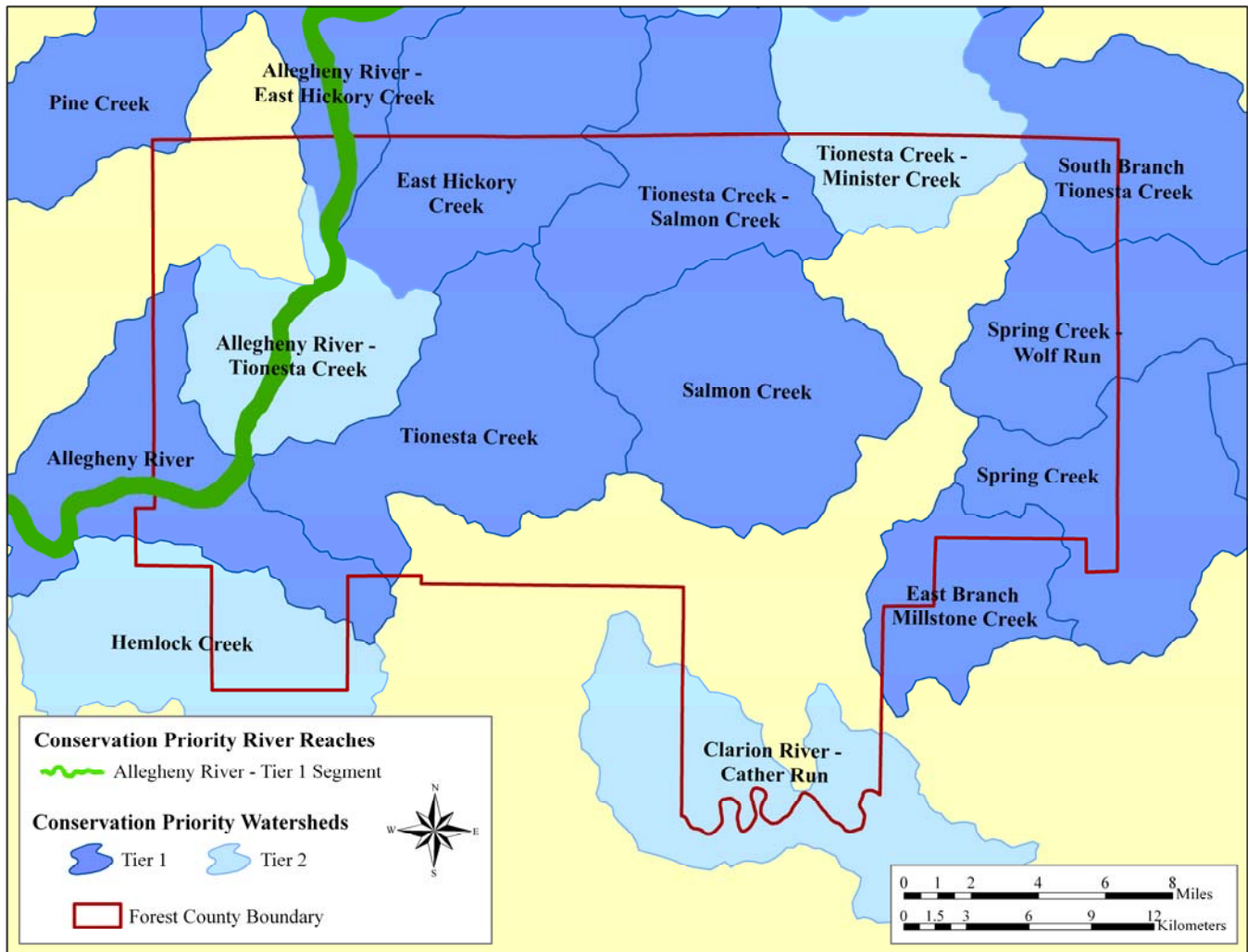


Figure 9. Conservation priority river reaches and watersheds within Forest County.

Watershed conservation and restoration priorities were indicated by the density of least disturbed streams, by community habitats, and community quality metrics. Conservation priority river reaches and watersheds were selected and then ranked as either Tier 1 or Tier 2 based on community types, metrics of community quality, and least-disturbed stream condition. The results of this analysis are illustrated in Figure 8; Figure 9 shows the conservation priority river reaches and watersheds identified within Forest County.

Least disturbed streams were common in areas that are largely forested areas and have less human influence than other regions. Concentrations of LDS streams were found in the north-central region of Pennsylvania and the West Branch of the Susquehanna River basin, in the forested watersheds of Laurel Highlands, in the upper Allegheny watershed, and the headwaters of the Delaware River watershed. Watershed conservation priorities included those with high concentrations of LDS. Priorities also included the best examples of select habitats with calcareous geology habitats, Waynesburg Hills Physiographic Section and Piedmont Physiographic Province, French Creek, and large river habitats.

Forest County has a very high concentration of high quality conservation priority watersheds relative to the rest of the state. One caveat, however, is that stream pH was not factored into the analysis due to a lack of data. The Allegheny plateau of northern Pennsylvania experiences acid deposition rates that are among the highest in North America [National Atmospheric Deposition Program (NADP) 2002]. The NADP/National Trends Network monitors a location in the Kane Experimental Forest; the mean hydrogen ion concentration of precipitation at this site, measured as pH, is among the most acidic of the more than 200 sites monitored nationwide. Thus, many of the headwater streams and watersheds otherwise considered to be of high quality in Forest County may be seriously impacted by acid precipitation. More information on the Aquatic Community Classification is available from the Pennsylvania Natural Heritage Program.

Important Bird Areas

An Important Bird Area (IBA) is a region designated by the Pennsylvania Chapter of the National Audubon Society that recognizes sites vital to promote proactive avian habitat conservation in Pennsylvania. Over 80 IBA sites encompassing over two million acres of public and private land have been identified. These areas include migratory staging areas, winter roost sites and prime breeding areas for songbirds, wading birds, shorebirds, and other species. Criteria used in determining IBAs include exceptional concentrations or diversity of birdlife, populations of species on the PA 'special concern' list, sites with representative, rare or unique bird habitats or site where long-term avian research is ongoing. More information on the IBA program is available from the Pennsylvania Chapter of the National Audubon Society.

Forest County includes a portion of one Important Bird Area (IBA): Cook Forest State Park. (Figure 11). The IBA extends beyond Forest County; therefore, features described below pertain to the entire IBA and are not necessarily confined to the county.

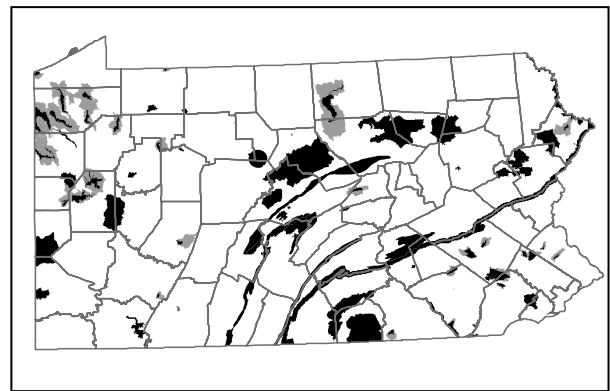


Figure 10. Important Bird Areas in Pennsylvania. Areas denoted in gray indication conservation areas that support ecological functions within the IBA.

Note: the following information is adapted from the Audubon Society of Pennsylvania IBA site descriptions (Audubon 2002).

Cook Forest State Park

This 6,668-acre site situated on the Clarion River contains at least four sizable stands of virgin old-growth forest, though second-growth mixed and riparian forests are now dominant. Steep, forested tributary valleys descend to

the river from the top of the plateau. The stands of old-growth hemlock-beech-white pine result in exceptional densities and diverse representation of breeding bird species that favor interior forest, including the Northern Goshawk and several wood warblers. The conifer stands are also highly productive sites for over-wintering birds.

This area satisfies the following IBA criteria:

- Unique birds include northern goshawk (B: 2+ pair), red crossbill (SM, W: 100+)
- Large old-growth forest supports birds such as blackburnian warbler (100+ pairs), black-throated green warbler (75+ pairs), magnolia warbler (50+ pairs), as well as winter finches.
- The Pennsylvania Society for Ornithology designated the site as a Special Areas Project Site, with the Seneca Rocks Audubon Society

Note: Numbers indicate single season maximum documented in recent years.

*SM= spring migration; FM= fall migration; B= breeding; W= winter

Conservation Concerns

Development on the periphery of the park threatens to reduce natural buffers to the interior forest, providing paths for introduction of forest pests and invasive species. Booming commercial canoeing on the Clarion River poses some threat to the riparian habitats through overuse.

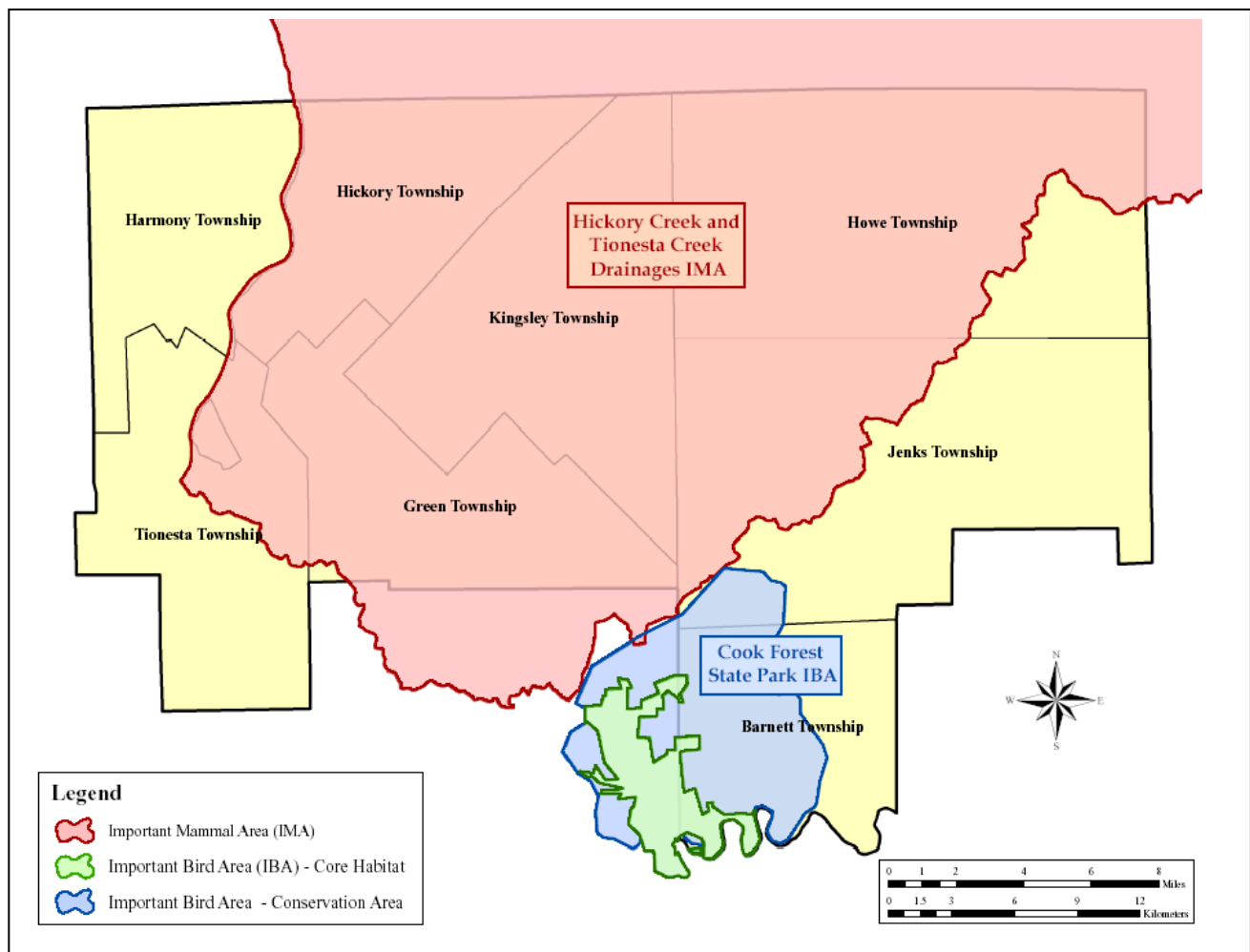


Figure 11. Important Bird Areas and Important Mammal Areas in Forest County, Pennsylvania.

Important Mammal Areas

The objective of the Important Mammal Area Project is to identify a network of sites throughout Pennsylvania that are essential for sustaining populations of wildlife species of concern. This process begins with the nomination of a site that is then reviewed by the Mammal Technical Committee of the Pennsylvania Biological Survey to determine if there is a need to protect the habitat for mammals of conservation concern. Once a site is selected for designation, a qualified mammalogist conducts an assessment of the area in order to detail priority habitat types, list mammal species located at the site, describe significant flora or fauna, describe conservation issues, outline research needs, note threats that may impact the site, list stakeholders involved with the site, and suggest conservation actions that will improve habitat for priority mammals.

Forest includes a portion of one Important Mammal Area (IMA): Hickory Creek and Tionesta Creek Drainages. As with the Cook Forest State Park IBA, this IMA extends beyond Forest County; therefore, features described below pertain to the entire IMA and are not necessarily confined to the county.

Note: the following information is adapted from the Hickory Creek and Tionesta Creek Drainages Important Mammal Areas Assessment Report.

Hickory Creek and Tionesta Creek Drainages IMA

Located mostly in Allegheny National Forest east of SR 62 in Warren County, this IMA includes the Tionesta Scenic Area, Tionesta Research Natural Area, Hearts Content Scenic Area, the Hickory Creek Wilderness Area, Chapman State Park, and State Game Land #29. It also includes private inholdings, with the largest landowner being The Collins Companies (Kane Hardwood). This IMA covers 316,774 acres of largely forested lands. The forest cover is primarily second-growth northern hardwoods, but includes much of Pennsylvania's remaining virgin forests with trees up to 400 years old (beech, hemlock, white pine, sugar maple). Bogs and swamps are also present. This tract is the largest area of old-growth forest between the Adirondacks and the Smoky Mountains. The area is drained by East Hickory and Middle Hickory Creeks, which support populations of native brook trout.

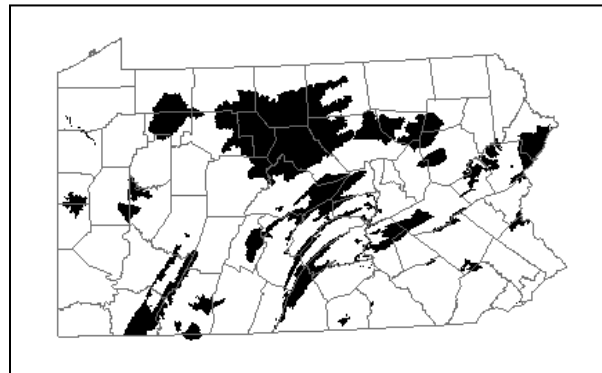


Figure 12. Important Mammal Areas in Pennsylvania. These areas denote areas of high mammal diversity or numbers of rare and endangered species.

This area satisfies the following IMA criteria:

- The site supports high-density populations: the fisher (*Martes pennanti*) population within this site is considered a core population.
- Site supports species or subspecies listed as endangered or threatened by the Pennsylvania Biological Survey: the site supports a confirmed viable resident population of fishers, which are listed as endangered.
- Site supports species or subspecies that are declining or vulnerable nationally or listed as candidate species by the Pennsylvania Biological Survey: the site supports a confirmed viable resident population of northern river otters (*Lontra canadensis*), which are listed as Candidate - At Risk. The Northern water shrew (*Sorex palustris albibarbis*), listed as a Pennsylvania - Rare species, has been recorded in at least two locations. Also occurring are the snowshoe hare (*Lepus americanus*, Candidate - At Risk), northern myotis (*Myotis septentrionalis*, listed as Rare), and silver haired bats (*Lasionycteris noctivagans*, Candidate - Rare).

Conservation Concerns

Contamination of Tionesta Creek by runoff from outhouses and inadequate waste treatment measures has been a problem in the past and may still affect water quality in some areas. A number of camps with inadequate or nonexistent septic systems have been eliminated from Kane Hardwood property and the Allegheny National Forest. The towns of Sheffield and Ludlow are either expanding their waste treatment systems or installing new ones. The consensus seems to be that water quality is much improved compared with 20-30 years ago. Severe over-browsing by white-tailed deer is negatively affecting the abundance and diversity of understory and forest floor plants, and interfering with tree regeneration in forest openings. Insect and disease agents of importance include chestnut blight, elm spanworm, and beech bark disease. The hemlock woolly adelgid is predicted to reach the area in the near future. The region receives a large amount of acid rain, but impacts on stream quality and aquatic invertebrates have not been analyzed. Oil and gas drilling (and associated infrastructure development), as well as logging, impact the habitat.



RESULTS BY MUNICIPALITY

Detailed maps and descriptions of Forest County's Conservation Areas (CAs) follow, organized by township. For each township, a summary table, map, and full report are provided. Townships are arranged alphabetically. Tionesta Borough is treated together with Tionesta Township.

Conservation Areas, Landscape Conservation Areas, and Public Lands are labeled on the township maps. Plant and animal species nomenclature follows that adopted by the Pennsylvania Biological Survey. Natural community descriptions follow Fike (1999).

Summary Table Conventions

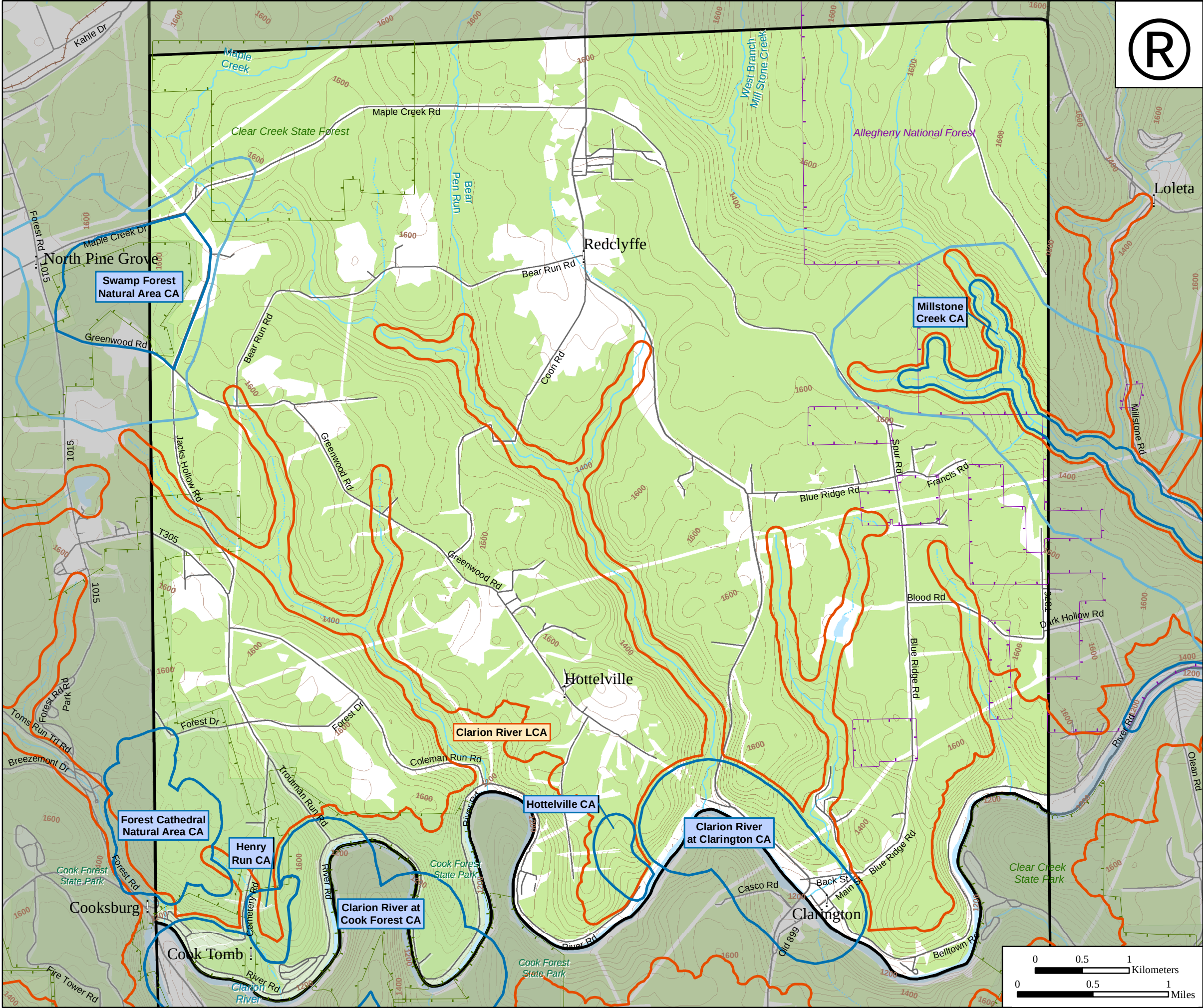
A summary table of sites precedes each map and lists identified Conservation Areas and Geologic Features.

- A categorical designation of a site's relative significance is listed after the site name. Table 1 (page ix) summarizes sites by significance category. Definitions of the significance categories are outlined in Table 3 (page 10).
- Listed under each site name are any state-significant natural communities and species of special concern that have been documented within the area.
 - See Appendix IV for a list of Natural Communities recognized in Pennsylvania.
 - Some species perceived to be highly vulnerable to intentional disturbance are referred to as “special animals” or “special plants” rather than by their species name. In addition, each of these species are assigned a number.
 - The Pennsylvania Natural Diversity Inventory (PNDI) ranks, and current legal status (detailed in Appendix III), are listed for each community and species.
- The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for protection.

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	PNDI Rank*		Legal Status*		Last Observed	Quality*
	Global	State	Federal	State		
<i>NATURAL HERITAGE AREAS:</i>						
Clarion River at Clarington CA			<i>Exceptional Significance</i>			
Green-faced Clubtail Dragonfly (<i>Gomphus viridifrons</i>)	G3	S1	---	---	1993	E
Maine Snaketail Dragonfly (<i>Ophiogomphus mainensis</i>)	G4	S3	---	---	1993	E
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1993	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1993	E
Rapids Clubtail Dragonfly (<i>Gomphus quadricolor</i>)	G3G4	S1S2	---	---	1993	E
Taiga Bluet Damselfly (<i>Coenagrion resolutum</i>)	G5	S1	---	---	1993	E
Clarion River at Cook Forest CA			<i>Exceptional Significance</i>			
Green-faced Clubtail Dragonfly (<i>Gomphus viridifrons</i>)	G3	S1	---	---	2005	E
Harpoon Clubtail Dragonfly (<i>Gomphus desertus</i>)	G4	S1S2	---	---	2005	E
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1993	E
Mustached Clubtail Dragonfly (<i>Gomphus adelphus</i>)	G4	S3S4	---	---	2005	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1993	E
Rapids Clubtail Dragonfly (<i>Gomphus quadricolor</i>)	G3G4	S1S2	---	---	1993	E
Uhler's Sundragon Dragonfly (<i>Helocordulia uhleri</i>)	G5	S3	---	---	1993	E
Forest Cathedral Natural Area CA			<i>County Significance</i>			
Hemlock (White Pine) Forest	GNR	S4	---	---	2006	E
Hemlock (White Pine) – Northern Hardwood Forest	GNR	S5	---	---	2006	E
Henry Run CA			<i>County Significance</i>			
Hemlock (White Pine) – Northern Hardwood Forest	GNR	S5	---	---	2006	E
Hottelville CA			<i>High Significance</i>			
Large Toothwort (<i>Cardamine maxima</i>)	G5	S1	---	---	1993	E
Millstone Creek CA			<i>Exceptional Significance</i>			
Harpoon Clubtail (<i>Gomphus desertus</i>)	G4	S1S2	---	---	1993	E
Maine Snaketail (<i>Ophiogomphus mainensis</i>)	G4	S3	---	---	1993	E
Midland Clubtail (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1993	E
Mustached Clubtail (<i>Gomphus adelphus</i>)	G4	S3S4	---	---	1993	E
Mountain Brook Lamprey (<i>Ichthyomyzon greeleyi</i>)	G3G4	S2	---	PT	2005	E
Ocellated Darner (<i>Boyeria grafiana</i>)	G5	S3	---	---	1993	E
Rapids Clubtail (<i>Gomphus quadricolor</i>)	G3G4	S1S2	---	---	1993	E
Ski-Tailed Emerald (<i>Somatochlora elongata</i>)	G5	S2	---	---	1993	E
Special Animal 5	G4	S1S2	---	PT	2005	E
Superb Jewelwing (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1993	E

(continued following map)



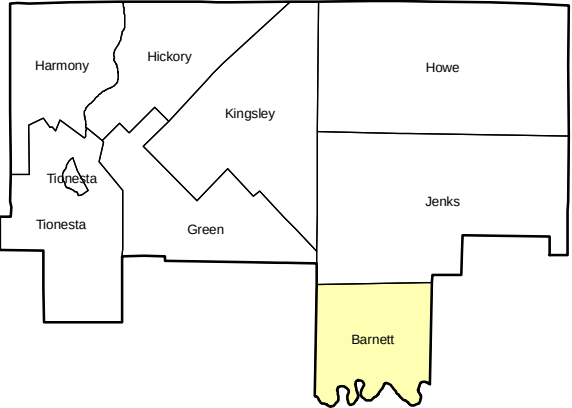
Forest County Natural Heritage Inventory Barnett Township

- Conservation Areas:**
- Clarion River at Clarington
 - Clarion River at Cook Forest
 - Forest Cathedral Natural Area
 - Hottelville
 - Millstone Creek
 - Swamp Forest Natural Area

- Landscape Conservation Areas:**
- Clarion River

- Public Lands:**
- Allegheny National Forest
 - Clear Creek State Forest
 - Cook Forest State Park

Overview



Legend



- Conservation Area (CA)
- Core Habitat
 - Supporting Landscape
- Landscape Conservation Area (LCA)
- State Lands
 - Allegheny National Forest
 - 40 ft. Contour Interval

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	PNDI Rank*		Legal Status**		Last Observed	Quality [‡]
	Global	State	Federal	State		
<i>NATURAL HERITAGE AREAS:</i>						
Millstone Creek CA (con't.)			<i>Exceptional Significance</i>			
Uhler's Sundragon (<i>Helocordulia uhleri</i>)	G5	S3	---	---	1993	E
Zebra Clubtail (<i>Stylurus scudderi</i>)	G4	S1S2	---	---	1993	E
Swamp Forest Natural Area						
Hemlock Palustrine Forest	GNR	S5	---	---	2006	---

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

‡Please refer to Appendix VI for an explanation of Quality ranks.

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Located in the southernmost portion of the county, Barnett Township borders Clarion County to the west; Elk County to the east, and to the south, the Clarion River separates it from Jefferson County. It lies entirely within the watershed of the Clarion River, with Maple Creek and West Branch Millstone Creek being the major tributaries flowing through the township. The township is 86 percent forested, with 70 percent of that being interior forest.

The forested landscape of Barnett Township provides habitat for the **Northern Goshawk** (*Accipiter gentilis*). This species ranges across a large territory and is vulnerable to poaching; therefore, no Conservation Areas have been mapped for it. See the fact sheet on page 39 for information on this species.

Clarion River at Clarington CA **Clarion River at Cook Forest CA** **Millstone Creek CA**

These Conservation Areas lie within the portion of the Clarion River that has been designated as Wild and Scenic, and the Millstone Creek Conservation Area extends beyond into a watershed that directly supports this relatively pristine section of the Clarion. At the turn of the twentieth century, A. E. Ortman described the Clarion River as an essentially dead ecological system (1909). The broad diversity of rare species found within these sites today emphasizes the remarkable recovery of the river. The Clarion River Landscape Conservation Area (LCA) essentially functions as supporting landscape for the aquatic-based Conservation Areas within its boundaries (see page 21 for further discussion of the LCA). The section of the Clarion River within the LCA supports a rich diversity of aquatic organisms, particularly odonates. Because certain species of concern are sometimes subject to unauthorized collection, or are particularly sensitive to human disturbance, one of the rare species documented within the Millstone Creek Conservation Area cannot be named in this report at the request of the jurisdictional agency, in order to provide some measure of protection.

The Clarion River at Clarington CA encompasses a section of the Clarion River that is primarily a wide, shallow run of moderate velocity over cobbles mixed with gravel. The northeastern shore, which falls within Forest County, is silty with occasional colonies of aquatic plants. The stream banks are steep and grassy, with shrub thickets and forest just upslope. A small, shrub-dominated seepage wetland is perched a few meters above the river, drained by a cool silt/sand rivulet. This section of the river provides habitat for six odonate species of concern: **ocellated darter** (*Boyeria grafiana*); **taiga bluet** (*Coenagrion resolutum*); **midland clubtail** (*Gomphus fraternus*); **rapids clubtail** (*G. quadricolor*); **green-faced clubtail** (*G. viridifrons*); and **Maine snaketail** (*Ophiogomphus mainensis*). It was at this site that the first known occurrence of freshwater mussels was documented since Ortman (1909) declared the Clarion River dead. Creeper mussel (*Strophitus undulatus*) was recorded here on three occasions over the course of the fieldwork that also documented the rare odonates listed above (Bier and Rawlins 1994).

The Clarion River at Cook Forest CA includes a section of the Clarion River upstream and downstream of Henry Run, as well as a small depression wetland above and adjacent to the river. The river here is relatively shallow with largely slow to moderate velocity flow over stones and boulders with gravel and small areas of silt/sand near the northern shore. Within this site, large boulders are frequently found along the banks and in shallow water. South-flowing Henry Run is the major tributary entering the portion of the Clarion River that lies within this site. This section of the river provides habitat for seven river-breeding dragonfly species of concern: **ocellated darter**; **mustached clubtail** (*Gomphus adelphus*); **harpoon clubtail** (*G. desertus*); **midland clubtail**; **rapids clubtail**; **green-faced clubtail**; and **Uhler's sundragon** (*Helocordulia uhleri*).

The Millstone Creek CA includes approximately six km (3.7 mi.) of Millstone Creek and a section of the Clarion River upstream and downstream of the confluence with Millstone Creek. Upstream, Millstone Creek is a cold, moderately high gradient stream with a variety of riffles, runs, and occasional eddy-pool habitats. The substrate includes stones, cobbles, and boulders, with occasional deposits of sand, gravel, and rarely silt. Streamside

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seepage pools are present and a forested wetland occurs near the midpoint of the site. At the mouth of Millstone Creek, much of the Clarion River is a deep, slowly flowing run. The substrate varies from silt-mud along the

banks, to stones and cobbles in faster water. Deep mud and silt-sand deposits are present in the lower portion of Millstone Creek. Shrubs and forest line the stream banks. Millstone Creek supports at least 21 species of odonates; of these, 10 are presently considered species of special concern. Additionally, the flowing waters of this Conservation Area support populations of **mountain brook lamprey** (*Ichthyomyzon greeleyi*) and **special animal 5** (please refer to the preceding summary table for a complete list of rare species found at this site).

Dragonflies, as with other members of the Order Odonata, have three stages in their life cycle: egg, nymph, and adult. Dragonflies oviposit their eggs in or near water. The species occurring within these Conservation Areas are river-breeding odonates that utilize clear, rapid, rocky streams and rivers with silt-bottomed pools. After the eggs hatch, the nymphs remain in the water through several instars (stages between moltings of the exoskeleton), feeding on small aquatic organisms until they eventually emerge from the water as terrestrial adults.



Mountain brook lamprey. Photo: Gary Meszaros

The Mountain Brook Lamprey inhabits gravel riffles and sandy runs of clean, clear, high-gradient streams. They have a complex life cycle that includes an extended larval stage before transformation into an adult stage. Eggs are laid in the middle and lower portions of gravel riffles. Once the larvae hatch, they burrow into beds of mixed sand and organic debris in pools and backwaters, where they filter-feed on microscopic organisms and detritus. The larval stage may last several years. These animals become sexually mature during the period of transformation from larva into adult. The adult does not feed, and immediately begins spawning, with death following shortly thereafter (NatureServe 2005).

Special animal 5 currently exists in many isolated populations, primarily east of the Mississippi River (Proulx 2007), and appears to be declining throughout its range. In Pennsylvania, it is known to occur only in the upper Allegheny River basin, where it has persisted for many years (PA DCNR [no date (a)]). This species prefers moderate- to large-size clear streams with strong current where individuals seek out rocky riffles and other high-flow areas with large cobble raceways. Spawning, triggered by higher water flows and higher stream temperatures, occurs in spring to early summer. The male stakes out a territory with rocks, gravel, and sand – habitat that is free of fine particulates such as silt that could suffocate eggs. The male courts a female by displaying his fins and swimming alongside her to coax her into his territory. If the male succeeds in luring her into his breeding ground, the pair then release eggs and milt into a gravel and sand mixture. Fertilized eggs hatch in about a week (Proulx 2007).

Threats and Stresses

All the rare species occurring within these Conservation Areas are dependent upon high-quality stream habitat for their continued success; each of these species are particularly vulnerable to siltation within riffle and run habitats. Runoff from dirt and gravel roads in close proximity to streams can contribute to physical degradation of stream channels and erosion and pollution of the streams. Loss of forest cover within riparian zones may also result in increased water temperatures and disruption of natural nutrient cycling linked to streams. Removal of forest cover on steep slopes is especially problematic because of the potential for increased runoff and erosion following storm events.

Conservation Recommendations

Several factors have no doubt led to the greatly improved water quality of the Clarion River since the turn of the

BARNETT TOWNSHIP

twentieth century. Highly polluting industries such as tanneries and chemical wood production have passed into the history of the Allegheny Plateau. Environmental laws, such as the Clean Water Act, have also contributed to the recovery of the Clarion. The Wild and Scenic designation ensures continued protection of these sections of the river. In the watershed beyond, if possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat within the tributaries flowing into the Clarion River. Millstone Creek, with its uncommon diversity of sensitive species, should receive consideration for special management aimed at protecting the aquatic habitat as well as the adjoining forest that provides foraging habitat for the odonates.

Forest Cathedral Natural Area CA **Henry Run CA** **Swamp Forest Natural Area CA**

These Conservation Areas are designated around remnants of old-growth forest within Cook Forest State Park. The park is noted for its stands of virgin white pine that arose following a catastrophic fire in 1644 (Dunwiddie et al. 1996).

As its name implies, the Forest Cathedral Natural Area CA encompasses the Forest Cathedral Natural Area, designated as a National Natural Landmark by the Secretary of the Interior in recognition of its ancient white pine and hemlock forests. Hemlock (white pine) forest covers roughly the northern half of the site. The canopy here is dominated by mature eastern hemlock (*Tsuga canadensis*), with individuals of yellow birch (*Betula allegheniensis*), American beech (*Fagus grandifolia*), and white oak (*Quercus alba*) scattered throughout. The southern half of the site is covered by hemlock (white pine) – northern hardwood forest. This differs from the hemlock (white pine) forest in the greater importance of deciduous hardwoods, but canopy species importance is somewhat variable within the area. In much of the area, mature American beech trees are dominant, with eastern hemlock forming an understory layer. In some areas red oak (*Quercus rubra*), black cherry (*Prunus serotina*), and red maple (*Acer rubrum*) are also present and may contribute significantly to canopy coverage. Throughout the site, the shrub and herbaceous layers are extremely sparse, and in many areas are completely lacking. Rhododendron (*Rhododendron maximum*) and witch-hazel (*Hamamelis virginiana*) occur occasionally in the shrub layer, and hay-scented fern (*Dennstaedtia punctilobula*), sedge (*Carex* sp.), and Indian pipe (*Monotropa uniflora*) occur very occasionally in the herbaceous layer.

The Henry Run CA takes in a remnant of old-growth hemlock (white pine) – northern hardwood forest remaining along Henry Run and adjacent uplands. The upland portion of the site has a closed canopy dominated by white pine (*Pinus strobus*) and eastern hemlock, with American beech (*Fagus grandifolia*), yellow birch, oak (*Quercus alba*, *Q. rubra*, *Q. montana*), hickory (*Carya* sp.), black gum (*Nyssa sylvatica*), and ash representing the hardwood component of the canopy. The canopy is relatively open within the riparian zone of Henry Run and the abundance and diversity of herbaceous species here is much greater than in the upland forest. There is a general lack of tree regeneration in the openings along the stream, suggesting over-browsing by deer.

The Swamp Forest Natural Area CA is the second of two Natural Areas designated within Cook Forest State Park. A perched water table has given rise to an old-growth **hemlock**



Hemlock palustrine forest within the Swamp Forest Natural Area.

BARNETT TOWNSHIP

palustrine forest that covers much of the Natural Area and extends beyond the park boundary along the southern and northeastern edges of the Natural Area. Eastern hemlock dominates the canopy almost exclusively, with occasional black birch (*Betula lenta*), yellow birch, and black gum (*Nyssa sylvatica*). Rhododendron and mountain laurel (*Kalmia latifolia*) form a moderately dense shrub layer. The forest floor is carpeted with *Sphagnum* spp. Herbaceous species are typical of those commonly occurring in hemlock palustrine forest, and include: cinnamon fern (*Osmunda cinnamomea*); sensitive fern (*Onoclea sensibilis*); teaberry (*Gaultheria procumbens*); swamp dewberry (*Rubus hispidus*); jewelweed (*Impatiens* sp.); tearthumb (*Polygonum arifolium*); and bugleweed (*Lycopus* sp.). The supporting landscape extends to the boundary of the immediate watershed hydrologically linked to the wetland.

Old-growth and younger forests typically differ in their age-structure, or the range of tree ages. Due to timber harvesting and subsequent regeneration in any given area, second- and third-growth forests typically have trees that are the same age. In comparison, old-growth forest that has been left in a natural state has trees that span a range of ages. Over time, natural disturbances such as wind, ice storms, insect and disease mortality, and fire result in openings in the canopy where regeneration starts anew, creating a mosaic of different-aged patches and the structural complexity that characterizes old-growth.

Old-growth forests also serve a number of ecological functions not necessarily filled by second- or third-growth forests. These functions include, but are not limited to: providing habitat for a wide range of organisms including birds, mammals, amphibians and reptiles, insects, gastropods, plants, fungi, lichens, and microbes; groundwater purification and storage; the formation of optimal forest soils through the accumulation of humus in the upper soil horizons, periodic mixing of horizons by uprooting of trees, and the formation of macropores – linear openings in the soil, having much greater permeability than the surrounding material overlying the bedrock; flood control by means of maximal absorptive capabilities and stream bank stabilization; protecting water quality through prevention of siltation; and providing a dependable source of coarse woody debris essential to the functioning of woodland stream ecosystems (Pennsylvania Wildlands Recovery Project 2003).

Threats and Stresses

Over-browsing by white-tailed deer has eliminated the tree seedling, sapling, shrub layers, and greatly reduced herbaceous species diversity in large areas of forest in Pennsylvania. Excessive deer herbivory can result in a lack of forest regeneration, a reduction in the diversity and density of forest understory, decreased songbird diversity, and a direct loss of rare plants (Yahner 1995). The longer over-browsing occurs, the more difficult it becomes to restore the original vegetation, in part because seed and other propagule supplies have been greatly reduced or eliminated (Latham et al. 2005). The lack of forest regeneration, coupled with depauperate shrub and herbaceous layers within each of these sites suggests that over-browsing by deer is a problem in this area.

In addition, the westward migration of the hemlock woolly adelgid (*Adelges tsugae*), currently documented in 42 counties in the eastern two-thirds of Pennsylvania (PA Bureau of Forestry 2006), poses a potential threat to the hemlock trees in the region. The hemlock woolly adelgid, native to Asia, is a sap-feeding insect that attacks both the eastern hemlock and the Carolina hemlock (*Tsuga caroliniana*). This insect pest can result in high levels of hemlock mortality, opening up the forest canopy and drastically altering the species composition of the forest community.

Eastern hemlock is a long-lived conifer, and its stands form a cool, damp habitat with low light levels in the understory. These dense stands possess a very different microclimate and unique species composition compared to more open forests. Hemlock-dominated forests are normally stable and resistant to plant invasions. The loss of *T. canadensis* from such forests can greatly alter the microclimate and soil conditions. Large-scale hemlock die-off affects species diversity, vegetation structure, stand environmental conditions, and ecosystem processes. For example, Ross et al. (2006) suggest that avian biodiversity may be at risk in eastern parks and forests, due to continued expansion of the hemlock woolly adelgid. They found that four insectivorous species, Acadian flycatcher (*Empidonax virens*), blue-headed vireo (*Vireo solitarius*), black-throated green warbler (*Dendroica virens*), and Blackburnian warbler (*Dendroica fusca*) are hemlock-associated species at risk from continued hemlock decline in the Delaware River valley and similar forests of the mid-Atlantic east slope. Another study

BARNETT TOWNSHIP

conducted in the Delaware Water Gap looked at the potential long-term impacts of hemlock forest decline on stream benthic macroinvertebrate assemblages. Their results suggest that hemlock decline may result in long-term changes in headwater ecosystems leading to reductions in both within-stream and park-wide benthic community diversity (Snyder et al. 2002). Orwig & Foster (1998) found that light reaching the forest floor through canopy breaks resulting from hemlock mortality led to increased density and average heights of black birch, red maple (*Acer rubrum*), black cherry, and several oak species (*Quercus* spp.). Canopy breaks also facilitated the establishment of invasive species such as Japanese barberry (*Berberis thunbergii*), Asiatic bittersweet (*Celastrus orbiculatus*), tree of heaven (*Ailanthus altissima*), and Japanese stilt grass (*Microstegium vimineum*). Hemlock woolly adelgid can disperse easily by wind, birds, mammals, and logging activities (McClure 1990). The rate of its spread is estimated at 30 km/yr (Orwig and Foster 1998).

Beech bark disease also poses a threat in the Forest Cathedral Natural Area CA and Henry Run CA, where American beech is a canopy species. Beech bark disease refers to a complex that consists of a sap-feeding scale insect and at least two species of *Nectria* fungi. Beech bark disease begins when American beech becomes infested with beech scale (*Cryptococcus fagisuga* Lind). The tiny scale insects, found on the tree trunk and branches, feed on sap in the inner bark. White wax covers the bodies of the scales, and when trees are heavily infested, they appear to be covered by white wool. Minute wounds and injuries caused by the scale insects eventually enable the *Nectria* fungus to enter the tree. *Nectria* kills areas of woody tissue, sometimes creating cankers on the tree stem and large branches. If enough tissue is killed, the tree will be girdled and die. Other trees may linger for several years, eventually succumbing to *Nectria* or other pathogens. Some infected trees will break off in heavy winds – a condition called "beech snap". Dense thickets of root sprouts are common after trees die or break. Three species of *Nectria* fungi are associated with beech bark disease in North America. *Nectria galligena* is a native pathogen that causes perennial cankers on many hardwood species. It rarely affects beech, however, unless beech scale is present. Another species, *Nectria coccinea* var. *faginata*, is an exotic pathogen that was introduced from Europe. Often, the native *Nectria* species is the first to invade trees infested by beech scale, followed by the exotic *Nectria* species. A third *Nectria* species, *N. ochroleuca*, has been found in association with beech bark disease in Pennsylvania, West Virginia and Ontario, Canada.

Although high populations of beech scale can weaken a tree, beech bark disease and mortality do not occur until *Nectria* invades infested trees. This usually happens 3 to 6 years after scales initially infest an area. It can take longer, however, if the area is a long distance from other beeches infected with *Nectria*, or if the amount of *Nectria* inoculum in the area is low. Once *Nectria* invasion begins, the largest trees and trees with heavy scale infestations (usually rough-barked trees) are most likely to be killed (McCullough et al. 2000). Shigo (1972, cited in Griffin et al. 2003) described the spread of beech bark disease as occurring in three stages. The "advancing front" consists of rising scale populations and low levels of *Nectria*. The "killing front" follows, characterized by large populations of scale, severe outbreaks of *Nectria* infection, and high beech mortality. Shigo's final stage, the "aftermath", consists of evidence of prior mortality, few older trees, and beech thickets made of small trees of sprout origin.

Conservation Recommendations

The park managers are well aware of the over-browsing problem and are actively managing for a reduction in the deer herd; most of the park is opened to deer hunting in season. In addition, periodic monitoring for the presence of beech bark disease and hemlock woolly adelgid, particularly the stands of old-growth, is recommended.

The most promising treatment for hemlock woolly adelgid infestations in large and/or remote forest stands is biological control, and Pennsylvania is a key participant in national efforts to manage the hemlock woolly adelgid by means of biological control. Two tiny non-native beetles, Lari (*Laricobuius nigrinus*) and Pt (*Pseudoscymnus tsugae*), show the most promise for controlling the pest. Having completed several years of successful tests in cooperation with the U. S. Forest Service, DCNR's Bureau of Forestry has embarked on a statewide Pt beetle release effort. If and when the adelgid reaches Cook Forest State Park, DCNR should consider the park a priority target for Pt beetle releases.

Northern Goshawk

Accipiter gentilis

.....

Pennsylvania Candidate Rare Species

State Rank: S2S3B (vulnerable to imperiled)

Global Rank: G5 (secure)

Identification:

The Northern Goshawk is a large forest raptor, occupying boreal and temperate forests throughout the entire Northern Hemisphere. It is the largest member of the genus *Accipiter* that occurs in North America. Males generally weigh between 1.4 and 2.4 pounds, average 22 inches in length, and have a wingspan ranging from 38.5 to 41 inches. Females are slightly larger, weighing, on average, between 1.9 and 3 pounds, and having a wingspan of 41 to 45 inches and an average length of 24 inches.

All accipiters, including northern goshawks, have a distinctive white grouping of feathers that form a band above the eye. In goshawks this band is thick and more pronounced than in the other members of the genus. The eye color of adult goshawks is red to reddish-brown, in juveniles eye color is bright yellow.

The colorings of adult male and female northern goshawks range from slate blue-gray to black. Their backs, the feathers at the leading edge of the wings, and heads are usually dark, and their undersides are white with fine, gray, horizontal barring. Their tails are light gray with three or four dark bands. The coloring of a juvenile goshawk is quite different than that of an adult. Their backs, the feathers at the leading edge of the wings, and heads are brown, and their undersides are white with vertical brown streaking.



Adult northern goshawk. Photo: Tim Kimmel

Habitat/Behavior:

In the eastern U.S., the northern goshawk nests in hardwood-hemlock (*Tsuga canadensis*) forests, where black birch (*Betula lenta*) and American beech (*Fagus grandifolia*) are preferred nest trees. They prefer mature forests consisting of a combination of old, tall trees with intermediate canopy coverage and small open areas within the forest for foraging. Each pair of goshawks build and maintain between three and nine nests within their home range, but use and defend only one (or less) per year. Northern goshawks are highly territorial and a mating pair will advertise their nesting territory by performing an elaborate aerial display before and during nest construction and/or repair. If their nesting area is encroached upon, they will defend it fiercely. Goshawks breed once yearly, usually between early April and mid-June. The female lays between 2 to 4 eggs that hatch in 28 to 38 days. The young may begin to fly when they are 35 to 46 days old. Juvenile fledglings may continue to be fed by their parents until they are about 70 days old.

The goshawk is a top predator and opportunistic hunter that preys on ground and tree squirrels, rabbits and hares, large passerines, woodpeckers, game birds, corvids, and occasionally reptiles and insects. Prey may be taken on the ground, in vegetation, or in the air.

Status:

In Pennsylvania, the northern goshawk is near the southern extent of its range in eastern North America.

Population trends are difficult to determine due to the paucity of historic quantitative data and because of biases inherent in the various survey methods used to track bird populations. Nesting range in the eastern U.S. is

Range of the Northern Goshawk in North America



currently expanding as second-growth forests mature.

Conservation Considerations:

Timber harvesting is the principal threat to breeding populations of northern goshawk. In addition to the relatively long-term impacts of removing nest trees and degrading habitat by reducing stand density and canopy cover, logging activities conducted near nests during the incubation and nestling periods can result in nest failure due to abandonment. Following canopy reduction by logging, goshawks are often replaced by other raptors including the red-tailed hawk (*Buteo jamaicensis*).

Because the goshawk is both a top predator and an ecological engineer, its decline contributes to the unraveling of forest ecosystems, stressing other forest dependent species. Northern goshawks play an important role in the forest food web as voracious predators of squirrels, jays, flickers, rabbits, snowshoe hares and songbirds. As builders of numerous, large nests, goshawks provide essential nesting opportunities for many species which can not build their own nests. Empty goshawk nests may be utilized by the great gray

owl (*Strix nebulosa*), Cooper's hawk (*Accipiter cooperii*), red-tailed hawk, great horned owl (*Bubo virginianus*), short-eared owl (*Asio flammeus*), squirrels, and many other species. Within a decade of goshawks being driven from a forest, their nests collapse from lack of maintenance and a precious wildlife habitat is lost.

References:

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BARNETT TOWNSHIP

Hottelville CA

This Conservation Area is designated around the riparian forest of an intermittently flowing stream that provides habitat for **large toothwort** (*Cardamine maxima*), a plant species of concern in Pennsylvania.

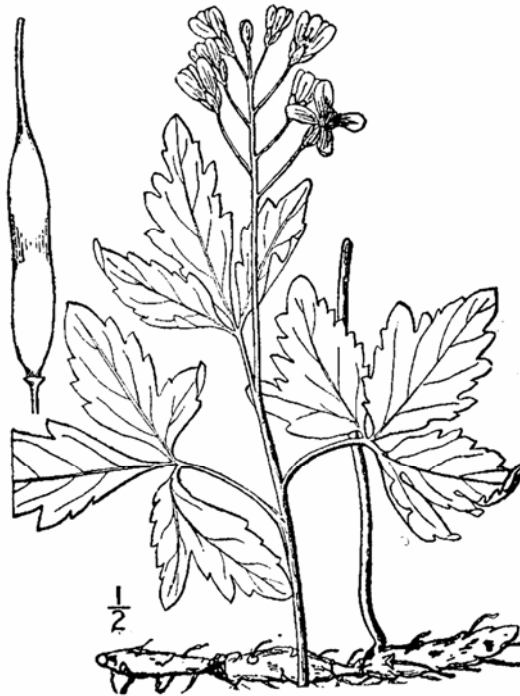
Large toothwort, a member of the mustard family, grows along a forested stream bank within this site. Little is known about the ecology of this species. It is believed by some to be a fertile hybrid between *Cardamine diphylla* and *Cardamine concatenata* (Gleason and Cronquist 1991). Large toothwort is considered to be globally secure, but is ranked as critically imperiled in Maine, Michigan, New Jersey, Nova Scotia, Pennsylvania, and Wisconsin (NatureServe 2007). To date, this species has only been documented at seven locations within Pennsylvania.

Threats and Stresses

Timbering and other forestry activities may affect this population of large toothwort through direct disturbance and opening up of the canopy. Canopy removal would alter light and moisture conditions, likely creating conditions unsuitable for the toothwort. Browsing deer may also pose a threat.

Conservation Recommendations

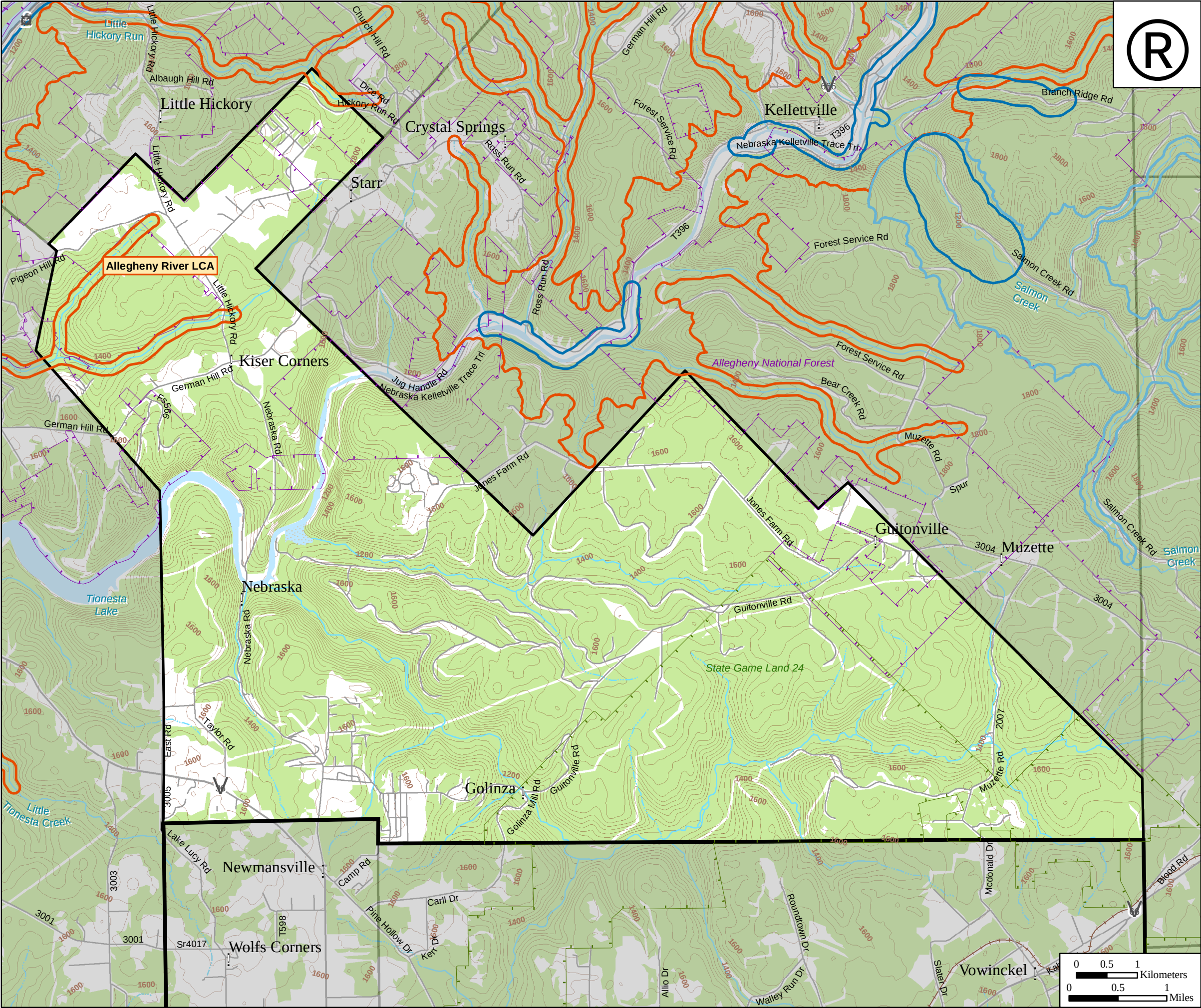
The landowners should be apprised of the presence of large toothwort on their lands, if they are not already aware of it, and encouraged to consider possible impacts to the species when planning any changes in how they're managing the forest within this site. A forested buffer of at least 100 m should be maintained around the population to preserve the moisture and light conditions required by the plant.



Line drawing of large toothwort (Source: USDA-NRSC PLANTS Database/Britton and Brown).

GREEN TOWNSHIP

NATURAL HERITAGE AREAS: none identified



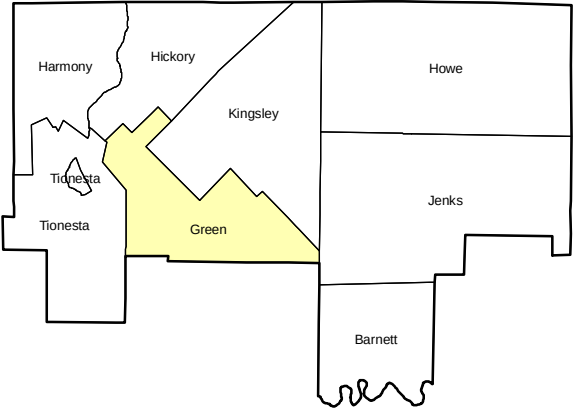
Forest County Natural Heritage Inventory Green Township

Conservation Areas:
None

Landscape Conservation Areas:
Allegheny River

Public Lands:
Allegheny National Forest
State Game Land 24

Overview



Legend



- Conservation Area (CA)
- Core Habitat
 - Supporting Landscape
- Landscape Conservation Area (LCA)
- State Lands
 - Allegheny National Forest
- 40 ft. Contour Interval



GREEN TOWNSHIP

Green Township, located on the southern edge of Forest County, shares a boundary with Clarion County. Public lands make up 35 percent of the township, with 3325 ac. belonging to the Allegheny National Forest and 6140 ac. owned by the PA Game Commission. Numerous headwater streams flow through narrow forested valleys before entering Tionesta Creek, Salmon Creek, and Coon Creek. Approximately 93 percent of the township is forested, with 59 percent of that being interior forest.

The heavily forested landscape of Green Township provides habitat for the **Northern Goshawk** (*Accipiter gentilis*). This species ranges across a large territory and is vulnerable to poaching; therefore, no Conservation Areas have been mapped for it. See page 39 for further discussion of this species.

No Conservation Areas were identified within Green Township.

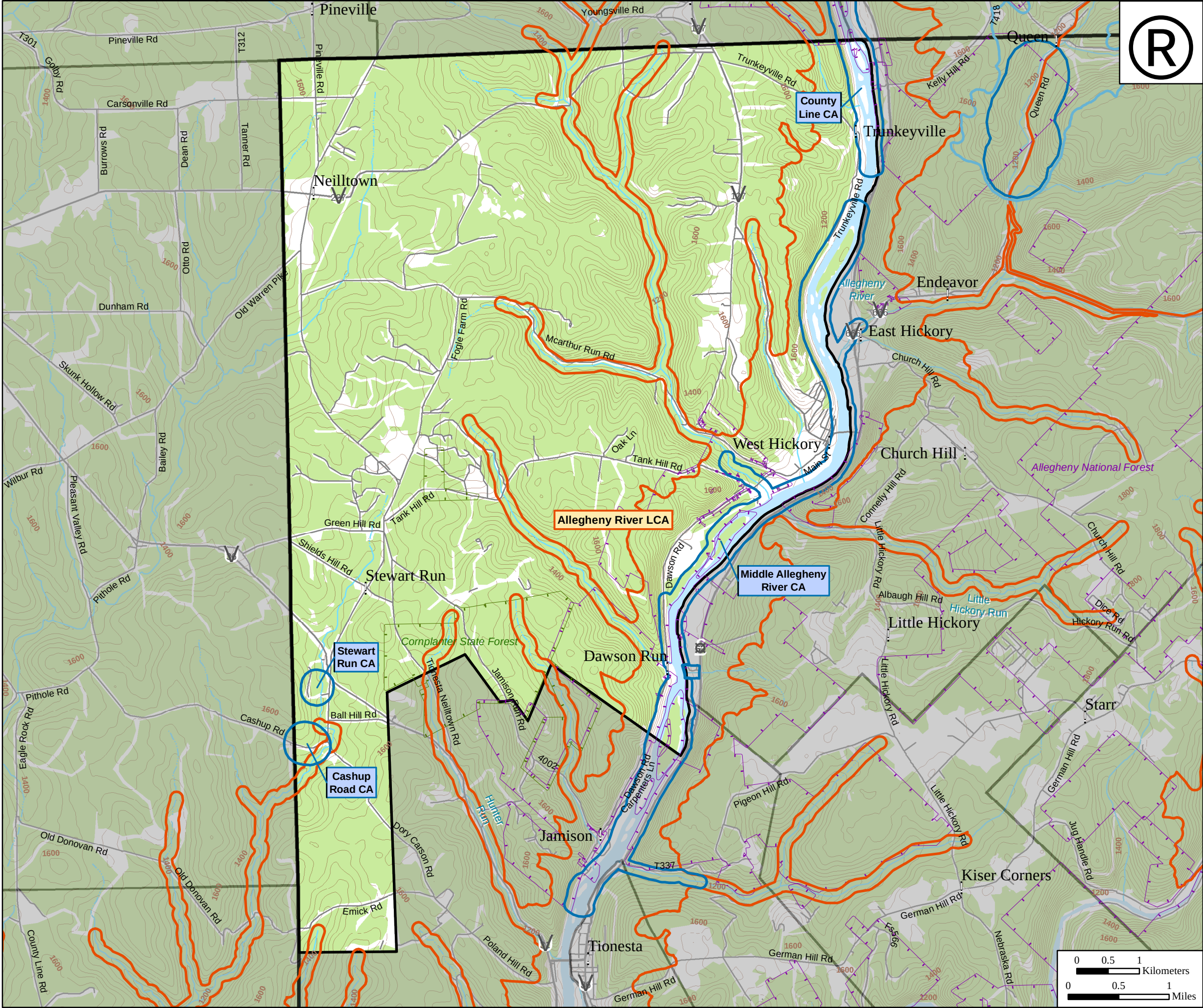


HARMONY TOWNSHIP

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
<i>NATURAL HERITAGE AREAS:</i>						
Cashup Road CA	<i>Notable Significance</i>					
American Columbo (<i>Swertia caroliniensis</i>)	G5	S1	---	PE	1996	E
County Line CA	<i>Exceptional Significance</i>					
Elktoe Mussel (<i>Alasmodonta marginata</i>)	G4	S4	---	---	2003	E
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	2003	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G1	S2	---	---	2003	E
Special Animal 1	G5	S2B	LT	PT	2001	E
Special Animal 4	G2	S1S3	LE	PE	2003	B
Special Animal 5	G2T2	S2	LE	PE	2004	A
Wavy-rayed Lampmussel (<i>Lampsilis fasciola</i>)	G4	S4	---	---	2003	E
East Hickory Creek CA	<i>High Significance</i>					
Harpoon Clubtail Dragonfly (<i>Gomphus descriptus</i>)	G4	S1S2	---	---	1994	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1994	E
Superb Jewelwing Damselfly (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1994	E
Middle Allegheny River CA	<i>Exceptional Significance</i>					
Elktoe Mussel (<i>Alasmodonta marginata</i>)	G4	S4	---	---	2003	E
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	2000	E
Special Animal 3	G4	S2	---	PT	1999	AB
Special Animal 4	G2	S1S3	LE	PE	2003	B
Special Animal 5	G4	S1S2	---	PT	1999	B
Special Animal 6	G3	S2S3	---	PT	1999	AB
Special Animal 7	G4	S1	---	PE	1995	B
Special Animal 8	G3	S2	---	PE	1999	B
Special Animal 9	G2T2	S2	LE	PE	2004	A
Special Animal 10	G1G2	S1S2	C	---	2003	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G1	S2	---	---	2003	E
Stalked Bulrush (<i>Scirpus pedicellatus</i>)	G4	S1	---	PT	2005	E
Wavy-rayed Lampmussel (<i>Lampsilis fasciola</i>)	G4	S4	---	---	2003	E
Stewart Run CA	<i>Notable Significance</i>					
American Columbo (<i>Swertia caroliniensis</i>)	G5	S1	---	PE	1996	E

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

[‡]Please refer to Appendix VI for an explanation of Quality ranks.



Forest County Natural Heritage Inventory Harmony Township

Conservation Areas:

- Cashup Road
- County Line
- Middle Allegheny River
- Stewart Run

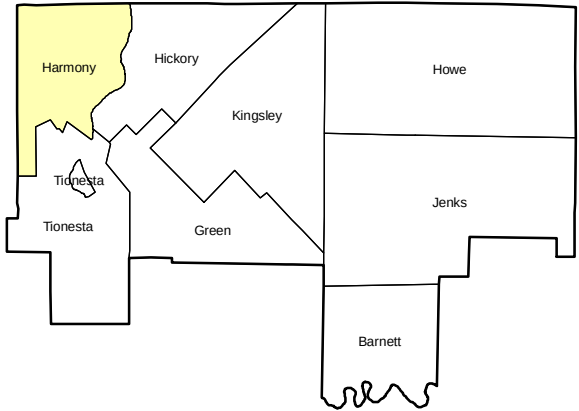
Landscape Conservation Areas:

- Allegheny River

Public Lands:

- Allegheny National Forest
- Cornplanter State Forest

Overview



Legend



- Conservation Area (CA)
 - Core Habitat
 - Supporting Landscape
- Landscape Conservation Area (LCA)
- State Lands
- Allegheny National Forest
- 40 ft. Contour Interval

HARMONY TOWNSHIP

Harmony Township forms the northwestern corner of Forest County, bounded by Erie County to the west, Warren County to the north, and the Allegheny River to the east. Approximately 94 percent of the township is forested, with 62 percent of that being interior forest. The topography of the township is defined by the rolling hills of a plateau descending eastward to the Allegheny River valley. Numerous streams drain southeastward through narrow valleys before emptying into the Allegheny. West Hickory Creek is the principal tributary of the Allegheny River, while the other tributaries are relatively short runs, flowing from depressions in the western plateau. Oil and gas development within the township is concentrated in the watersheds of Hunter Run, Dawson Run, and McArthur Run.

Cashup Road CA Stewart Run CA

These sites are designated around populations of **American columbo** (*Swertia caroliniensis*), a plant species of concern in Pennsylvania. This species occurs primarily west of the Appalachian Mountains, from western New York south to South Carolina and west to eastern Oklahoma (Gleason and Cronquist 1991). *S. caroliniensis* is considered globally secure, but is listed as critically imperiled in Pennsylvania, Oklahoma, and South Carolina. In Pennsylvania, this species has been documented in the northwestern counties of Butler, Forest, Lawrence, Mercer, and Venango (NatureServe 2006).

American columbo is a striking, robust, and long-lived perennial member of the gentian family. It grows and persists in a vegetative (rosette) state for several years before it flowers in a single burst of activity and then dies. This species is entomophilous, meaning that it is pollinated by insects. Its most effective pollinators are large bees and possibly wasps (Environment Canada 2006). Habitat for this species includes open deciduous woods, with calcareous soils, and abandoned fields (Rhoads and Klein 1993, Rhoads and Block 2000).

Threats and Stresses

Other than the general and pervasive effects of habitat loss, threats to this species are poorly known.

Conservation Recommendations

The current land use within the sites is compatible with maintaining these populations. The landowners should be apprised of the presence of American columbo on their lands, if they are not already aware of it, and encouraged to consider possible impacts to the species when planning any changes in how they're managing the occupied habitat.



American columbo in flower. Photo: Bonnie Isaac

East Hickory Creek CA

This Conservation Areas is discussed in detail under Hickory Township (page 49). It is designated around a portion of East Hickory Creek that provides habitat for three odonate species of special concern. Any impacts to water quality should be avoided within this region.

County Line CA Middle Allegheny River CA

These Conservation Areas lie within a 47-mile section of the Allegheny River that has been designated as Wild and Scenic by Congress. The Allegheny River Landscape Conservation Area (LCA) essentially functions as

HARMONY TOWNSHIP

supporting landscape for the aquatic-based Conservation Areas within its boundaries (see page 19 for further discussion of the LCA). This section of the river supports a rich diversity of aquatic organisms, particularly fish and freshwater mussels. Because certain species of concern are sometimes subject to unauthorized collection or disturbance, a number of the rare species documented within these sites cannot be named in this report at the request of the jurisdictional agency, in order to provide some measure of protection.

The County Line CA contains habitat that supports six species of mussels – two of which are federally listed – and one vertebrate species of special concern. Mussel species within this site include **elktoe** (*Alasmidonta marginata*), **long-solid** (*Fusconaia subrotunda*), **round pigtoe** (*Pleurobema sintoxia*), and **wavy-rayed lampmussel** (*Lampsilis fasciola*).

The riverine habitat contained within the Middle Allegheny River CA supports seven species of freshwater mussels, 5 fish, and one plant species of conservation concern. In addition, **stalked bulrush** (*Scirpus pedicellatus*) grows along the riverbank in this Conservation Area.

Freshwater mussels, primarily found in streams, are filter feeders that spend their adult lives in the substrate of stream or lake bottoms. Movement is accomplished either by means of a muscular foot or flood currents. A mussel filters oxygen and particulate matter from the water column by continuously siphoning water through its body. They feed on suspended organic matter, including detritus and plankton. Mussels have a rather complex life cycle involving four stages. The cycle begins when males release sperm into the water column. As the sperm passively drifts with the current, it may enter females when they are siphoning and consequently fertilize her eggs. During the second stage, the fertilized eggs develop into larvae, or glochidia. The glochidia are microscopic and are held in the female's gills for future release into the water column. They are parasitic and must attach to the gills or fins of a suitable host fish in order to survive once the female releases them. Once a glochidium attaches to a host, it remains for a period of days or months, depending upon the species, as it transforms into a juvenile mussel. Following the transformation, the juvenile releases from the host and sinks to the stream bottom. If the juvenile is lucky, it lands in suitable substrate where it feeds and grows into an adult (Cordeiro and Bowers-Altman [no date]). Because mussels are dependent upon good water quality and physical habitat conditions and an environment that will support populations of host fish, they are considered good indicators of the health of aquatic ecosystems.

Stalked bulrush, a member of the large Cyperaceae (Sedge) family, is a grass-like plant usually found growing in lowland marshes in stream valleys, edges of bogs, boggy meadows, and wet sandy shorelines (FNA 2003). Its range extends from Newfoundland south to Kentucky and west to Missouri (NatureServe 2006). In Pennsylvania, this species has been documented in the northwestern counties of Forest, McKean, Potter, Venango, and Warren (NatureServe 2006). *S. pedicellatus* is very similar in appearance to one of its most common congeners, woolgrass (*Scirpus cyperinus*), a species it often hybridizes with (FNA 2003). Within this site, stalked bulrush grows along the shoreline of the Allegheny River, where it experiences periodic high water flows and ice scour.

Threats and Stresses

The presence of numerous freshwater mussel populations throughout the middle Allegheny River is indicative of high water quality. Freshwater mussel populations have been declining over the past century throughout North America. Generally, the reason for this decline has been largely attributed to increased sedimentation, which renders stream bottoms unsuitable as mussel habitat. Erosion, caused in part by deforestation, poor agricultural practices, and destruction of riparian zones, has led to increased silt loads and shifting, unstable stream bottoms. Siltation and contaminants, such as heavy metals, pesticides, and acid mine drainage, have long been recognized as threats to mussels (Ortmann 1909; Ellis 1931; cited in Williams et al. 1993). Increases in siltation can also indirectly impact freshwater mussel communities by interfering with host fish – mussel interactions. Increased sedimentation can reduce the abundance, diversity, and reproduction of fish, including the host fish that are necessary for protection and dispersal of virtually all freshwater mussels during their larval stage. The increased turbidity associated with suspended sediment loads also interferes with the visual cues used by both adult mussels and host fish in the transfer of the glochidia or mussel larvae (Box and Mossa 1999).

HARMONY TOWNSHIP

Conservation Recommendations

The Wild and Scenic designation ensures continued protection of these sections of the river. In the watershed beyond, if possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat within the tributaries flowing into the Allegheny River. Currently, land use within the watershed is compatible with maintaining the high-quality conditions within this site. Any planning of future development within the watershed should seek to avoid potential impacts to both the physical character and water quality of the Allegheny River.



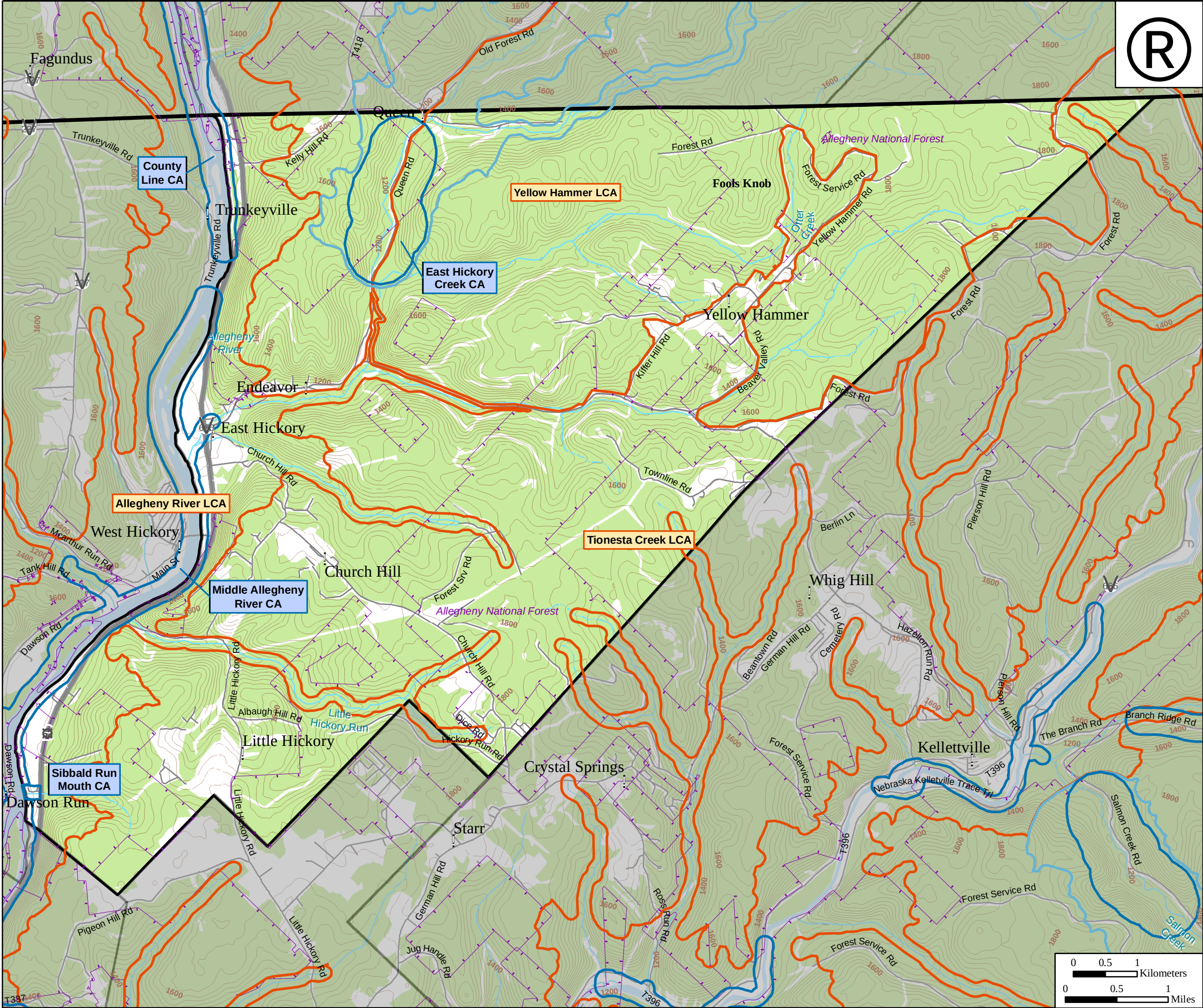
HICKORY TOWNSHIP

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
<i>NATURAL HERITAGE AREAS:</i>						
County Line CA			<i>Exceptional Significance</i>			
Elktoe Mussel (<i>Alasmodonta marginata</i>)	G4	S4	---	---	2003	E
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	2003	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G1	S2	---	---	2003	E
Special Animal 1	G5	S2B	LT	PT	2001	E
Special Animal 4	G2	S1S3	LE, XN	PE	2003	B
Special Animal 9	G2T2	S2	LE	PE	2004	A
Wavy-rayed Lampmussel (<i>Lampsilis fasciola</i>)	G4	S4	---	---	2003	E
East Hickory Creek CA			<i>High Significance</i>			
Harpoon Clubtail Dragonfly (<i>Gomphus desertus</i>)	G4	S1S2	---	---	1994	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1994	E
Superb Jewelwing Damselfly (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1994	E
Middle Allegheny River CA			<i>Exceptional Significance</i>			
Elktoe Mussel (<i>Alasmodonta marginata</i>)	G4	S4	---	---	2003	E
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	2000	E
Special Animal 3	G4	S2	---	PT	1999	AB
Special Animal 4	G2	S1S3	LE, XN	PE	2003	B
Special Animal 5	G4	S1S2	---	PT	1999	B
Special Animal 6	G3	S2S3	---	PT	1999	AB
Special Animal 7	G4	S1		PE	1995	B
Special Animal 8	G3	S2	---	PE	1999	B
Special Animal 9	G2T2	S2	LE	PE	2004	A
Special Animal 10	G1G2	S1S2	C	---	2003	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G1	S2	---	---	2003	E
Stalked Bulrush (<i>Scirpus pedicellatus</i>)	G4	S1	---	PT	2005	E
Wavy-rayed Lampmussel (<i>Lampsilis fasciola</i>)	G4	S4	---	---	2003	E
Sibbald Run Mouth CA			<i>County Significance</i>			
Butternut (<i>Juglans cinerea</i>)	G3G4	S4	---	N	2005	---

GEOLOGIC FEATURE: Fools Knob (Erosional Remnant)

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

‡Please refer to Appendix VI for an explanation of Quality ranks.



Forest County Natural Heritage Inventory Hickory Township

Conservation Areas:

- County Line
- East Hickory Creek
- Middle Allegheny River
- Sibbald Run

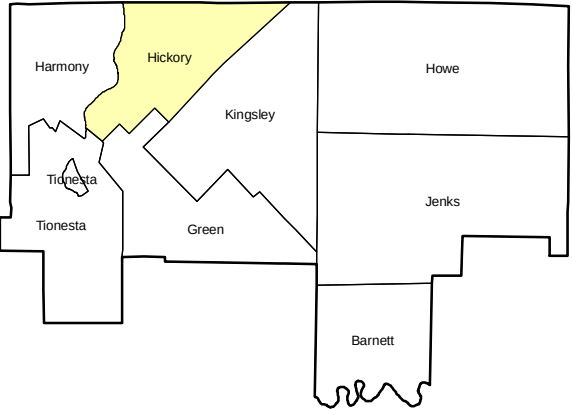
Landscape Conservation Areas:

- Allegheny River
- Tionesta Creek
- Yellow Hammer

Public Lands:

- Allegheny National Forest

Overview



Legend

Conservation Area (CA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

- State Lands
- Allegheny National Forest

40 ft. Contour Interval



HICKORY TOWNSHIP

Hickory Township, located along the northern edge of Forest County, is bounded by Warren County to the north and the Allegheny River to the west. The township lies entirely within the proclamation boundary of the Allegheny National Forest, with public lands accounting for 44 percent of the land ownership. Forest covers roughly 97 percent of the township, making Hickory Township one of the most heavily forested townships in the county. Fool's Knob, a feature of geological interest, is an erosional remnant located on the Allegheny National Forest, one mile (1.6 kilometers) due north of the village of Yellow Hammer.

County Line CA

Middle Allegheny River CA

These Conservation Areas are discussed under Harmony Township (pg 46). County Line CA is designated around a section of the Allegheny River that supports six freshwater mussel species and one vertebrate species of concern. Middle Allegheny River CA provides habitat occupied by seven mussel species, five fish species, and one plant species of conservation concern. Any impacts to water quality should be avoided within this region.

East Hickory Creek CA

The section of East Hickory Creek within this Conservation Area serves as habitat for at least three species of rare, river-breeding odonates: **Harpoon Clubtail** (*Gomphus desertus*); **Ocellated Darner** (*Boyeria grafiana*); and **Superb Jewelwing** (*Calopteryx amata*). This section of East Hickory Creek is a relatively shallow, medium gradient stream, with alternating stretches of riffles and runs and a few side pools. The substrate is predominately packed gravel and cobbles with scattered boulders, while some areas of the streambed consist of expanses of exposed bedrock.

The supporting landscape extends for five kilometers from the upstream boundary of the core of the site, and captures the riparian zone of the main stem of the creek plus tributaries and their riparian zones.

Dragonflies, as with other members of the Order Odonata, have three stages in their life cycle: egg, nymph, and adult. Odonates oviposit their eggs in or near water. The species occurring within this Conservation Area are river-breeding odonates that utilize clear, rapid, rocky streams and rivers with silt-bottomed pools. After the eggs hatch, the nymphs remain in the water through several instars (stages between moltings of the exoskeleton), feeding on small aquatic organisms until they eventually emerge from the water as terrestrial adults.

Threats and Stresses

As with all aquatic species, maintaining suitable stream habitat is key to the continued success of these species. Runoff from dirt and gravel roads in close proximity to streams can contribute to physical degradation of stream channels and erosion and sediment pollution in streams. Loss of forest cover within the core areas would likely result in physical degradation of the stream channels, erosion and sediment pollution in the streams, higher water temperatures, and disruption of natural nutrient cycling linked to the streams. If forest cover is substantially reduced within the watersheds, water quality is likely to decline from increased sediment loads. Removal of forest cover on steep slopes is especially problematic because of the potential for increased runoff and erosion following storm events.

Conservation Recommendations

Preserving forested stream corridors is key to maintaining high water quality. If possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat.

Although the surrounding watersheds are not as closely linked to the stream ecosystems as are the riparian zones, a high degree of forest cover should be maintained for additional protection of the water quality and ecological integrity of the aquatic ecosystems. Landowners engaged in timber harvesting within the watershed can refer to

HICKORY TOWNSHIP

Best Management Practices for Pennsylvania Forests, a brochure available online or through Penn State, for guidelines aimed at minimizing impacts due to timber harvesting.

Sibbald Run Mouth CA

This site, located on a river terrace in the Allegheny National Forest, encompasses old-field habitat and riparian forest. Several healthy, nut-producing butternuts (*Juglans cinerea*) grow in relatively close proximity to Sibbald Run. Butternut is not currently listed as a species of concern in Pennsylvania, but is under review for future listing.

Butternut is declining throughout its range due to a fungal disease known as butternut decline or butternut canker. Symptoms of the disease include dying branches and stems. Initially, cankers develop on branches in the lower crown. Young cankers are elongated, sunken areas commonly originating at leaf scars and buds, often with an inky black center and whitish margin. Older branch and stem cankers are perennial, found in bark fissures or covered by shredded bark, and bordered by successive callus layers (Anderson 1996). Spores developing on these dying branches are spread by rainwater to tree stems. Stem cankers develop 1-3 years after branches die. Diseased trees usually die within several years after infection (Rink 1990).



Butternut foliage with male and female flowers. Photo: Wayne Ray

Spores of the fungus are disseminated from fruiting bodies by rain splash and possibly by insects. Spores are produced throughout the growing season, and once airborne can survive and be dispersed long distances during favorable weather conditions of cool temperatures and overcast skies (Anderson 1996).

USDA Forest Service Inventory and Analysis forest inventory data show a dramatic decrease in the number of live butternut trees in the United States. Live butternut decreased by 58 percent in Wisconsin and 84 percent in Michigan in the last 15 years. A recent Wisconsin Department of Natural Resources survey revealed that 91 percent of the live butternuts throughout Wisconsin are diseased. Surveys in the southeast United States found that 77 percent of butternuts have been killed in North Carolina and Virginia, and infected trees continue to be found in new counties in most of the United States (Anderson 1996).

Threats and Stresses

As outlined in the discussion above, butternut canker poses a potential threat to healthy butternut trees.

This site also supports a robust population of multiflora rose (*Rosa multiflora*). This highly invasive species, native to Japan, Korea and Eastern China, was introduced to the eastern United States in 1866 as rootstock for ornamental roses. Beginning in the 1930s, the U.S. Soil Conservation Service promoted it for use in erosion control and as "living fences" to confine livestock. State conservation departments recommended multiflora rose as cover for wildlife. More recently, multiflora rose has been planted in highway median strips to serve as crash barriers and to reduce automobile headlight glare. Its tenacious growth habit was eventually recognized as a problem on pastures and unplowed lands, where it disrupted cattle grazing, and, more recently, as a pest of natural ecosystems. It is designated as a noxious weed in Pennsylvania (Swearingen et al. 2002).

Multiflora rose tolerates a wide range of soil, moisture, and light conditions and is able to invade fields, forests, prairies, some wetlands, and many other habitats. It grows aggressively and produces large numbers of fruits (hips) that are eaten and dispersed by a variety of birds. Dense thickets of multiflora rose exclude most native shrubs and herbs from establishing and may be detrimental to nesting of native birds (Swearingen et al. 2002).

HICKORY TOWNSHIP

Conservation Recommendations

Periodic monitoring for the onset of butternut canker on the healthy butternuts in this site is recommended. The Forest Service land managers may also want to consider taking measures to eradicate the multiflora rose. As well as improving the ecological health of the site, removing the multiflora rose would certainly make periodic monitoring of the butternut trees more easily accomplished.



Bald Eagle

Haliaeetus leucocephalus

Pennsylvania Species of Concern

State Rank: S2B (imperiled)

Global Rank: G4 (apparently secure)

Identification:

The Bald Eagle is a large raptor with a body length up to 32 inches and a wingspan up to 80 inches. Males and females are similar in plumage. The most notable features are a white head and upper neck, whiter tail, dark brown body, and a heavy yellow bill. Juveniles are dark brown overall, and gradually acquire adult plumage over a period of four years. Juveniles have a dark bill and cere, dark brown body plumage, including head and tail, variable amounts of white on the undertail coverts, belly, and back.

Range:

Bald Eagles have extensive breeding populations in Alaska, with major populations in the coastal regions. This species breeds throughout most of Canada, especially along coastal areas. In the continental United States, Bald Eagles breed extensively along the Atlantic Coast from Florida to the Maritime Provinces of Canada. Also, this species breeds in the Great Lake States in Minnesota, Michigan, and Wisconsin, and in the Pacific Northwest (California, Oregon, and Washington). Breeding populations occur along the Gulf Coast in Louisiana and Texas. In Pennsylvania, Bald Eagle populations have been increasing, and can now be found throughout Pennsylvania, with most sightings concentrated in the northwestern and southeastern corners of the state.



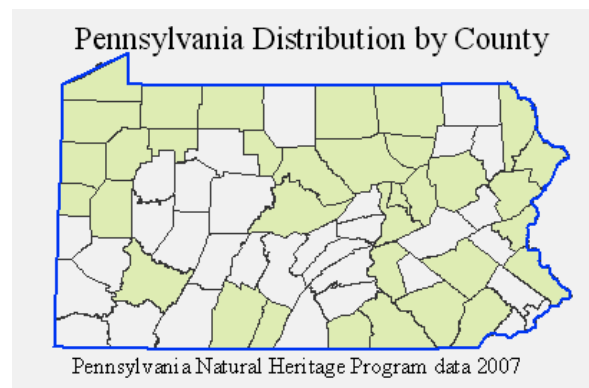
Adult Bald Eagle. (Photo: Ron Austing)

Habitat:

This species is typically associated with forested areas adjacent to large bodies of water. Bald Eagles nest in trees, rarely on cliff faces, and ground nest in treeless areas. The majority of Bald Eagle nesting areas are found in mature and old-growth forests with some habitat edge, usually within 2 kilometer to water with suitable foraging opportunities. The quality of foraging areas is defined by diversity, abundance, and vulnerability of the prey base, structure of aquatic habitats, such as the presence of shallow water, and the absence of human development and disturbance. In Pennsylvania, this species nests on islands in major rivers and in forested areas and erected platforms along major rivers, reservoirs, large wetlands, lakes, ponds, and streams.

Conservation Status:

This species was recently removed from the Federal Threatened and Endangered Species List. Bald Eagles breeding in Pennsylvania have made a major contribution to the federal delisting of this species. In the 1970's, Bald Eagle nesting pairs were at an all time low of two due to the effect of the insecticide DDT and pollution of major waterways. Since then, this species has made a comeback, and recently, over 100 nests have been recorded across the state. Continued success of the breeding areas will depend on protection from human persecution and environmental contaminants. Other threats include water quality degradation, disturbance of nesting areas, and disease. If ecological conditions in Pennsylvania continue to improve, there is no reason why this species will not increase nesting populations to increase assurance that Bald Eagles will be around for generations to come.



References:

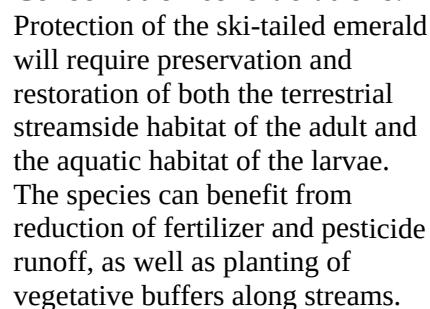
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Pennsylvania Natural Heritage Program

Global Rank: G5 (secure)

Photo: Dave Czaplak

Map by NatureServe



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HOWE TOWNSHIP

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
NATURAL HERITAGE AREAS:						
Bluejay Creek CA			High Significance			
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	2005	E
Brookston CA			Notable Significance			
Queen-of-the-Prairie (<i>Filipendula rubra</i>)	G4G5	S1S2	---	TU	2005	E
Iron City Bog CA			County Significance			
Hemlock – Mixed Hardwood Palustrine Forest	GNR	S3S4	---	---	2005	---
Lynch CA			High Significance			
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	2005	E
Northern Pygmy Clubtail (<i>Lanthus parulus</i>)	G4	S3S4	---	---	2005	E
Special Animal 2	G4	S2	---	PT	2004	E
Mayburg CA			High Significance			
Special Animal 2	G4	S2	---	PT	2004	E
Special Animal 3	G4	S2	---	PT	1999	AB
Special Animal 6	G3	S2S3	---	PT	1999	AB
Minister Creek CA			Exceptional Significance			
Harpoon Clubtail Dragonfly (<i>Gomphus descriptus</i>)	G4	S1S2	---	---	1994	E
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1994	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1995	E
Ski-tailed Emerald Dragonfly (<i>Somatochlora elongate</i>)	G5	S2	---	---	1994	E
Special Animal 2	G4	S2	---	PT	1995	E
Superb Jewelwing Damselfly (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1995	E
Seldom Seen Corners CA			High Significance			
Indian Skipper Butterfly (<i>Hesperia sassacus</i>)	G5	S3S4	---	---	1994	E
Long Dash Butterfly (<i>Polites mystic</i>)	G5	S3	---	---	1994	E

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

[‡]Please refer to Appendix VI for an explanation of Quality ranks.

Forest County Natural Heritage Inventory Howe Township

Conservation Areas:

- Bluejay Creek
- Brookston
- Iron City
- Lynch
- Mayburg
- Minister Creek
- Salmon Creek
- Seldom Seen Corners
- Spring Creek

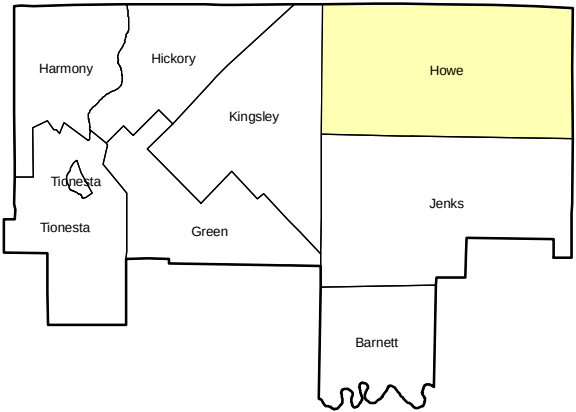
Landscape Conservation Areas:

- Minister
- Tionesta Creek

Public Lands:

- Allegheny National Forest

Overview



Legend

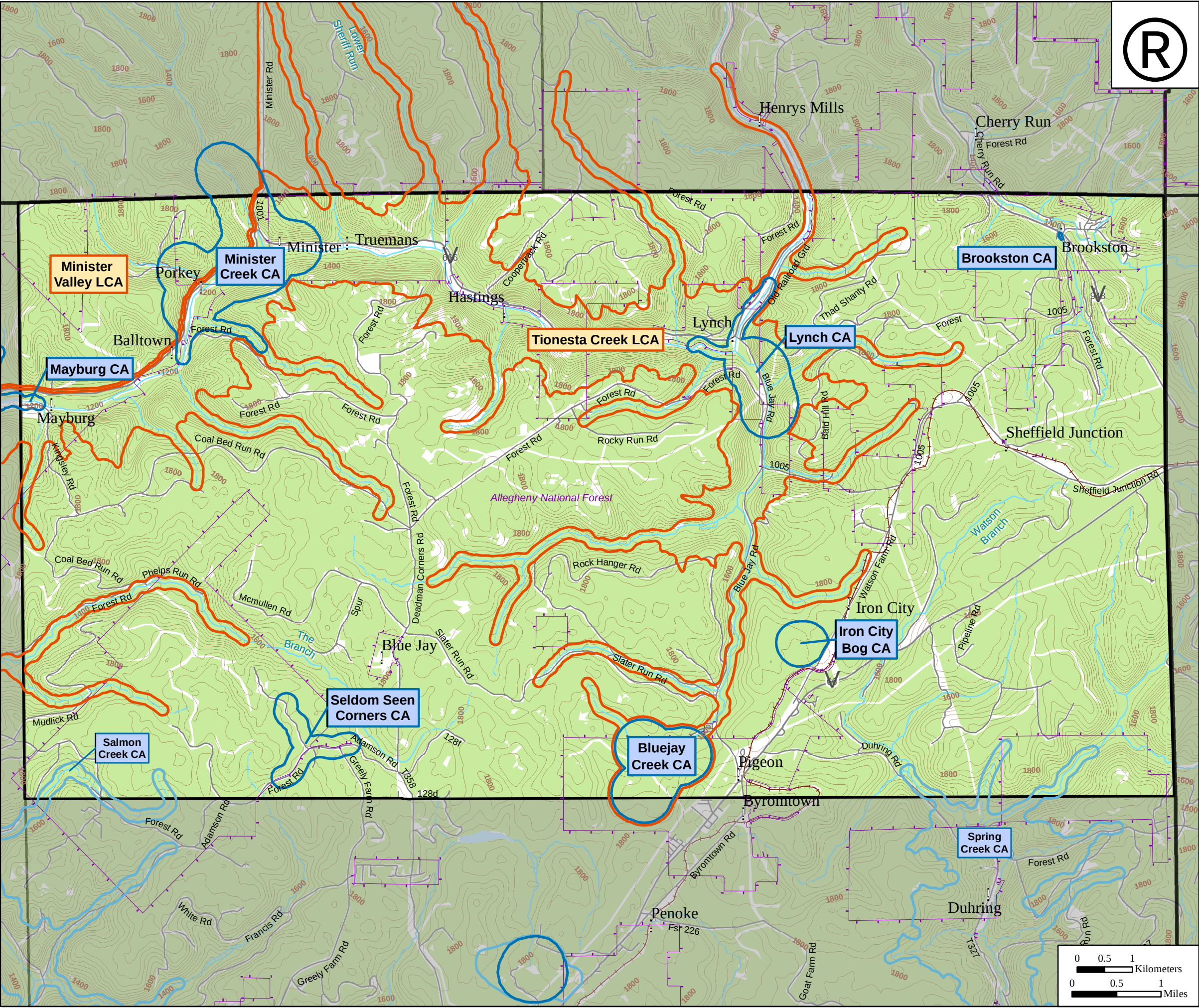
Conservation Area (CA)

- Core Habitat
- Supporting Landscape

Landscape Conservation Area (LCA)

- State Lands
- Allegheny National Forest

40 ft. Contour Interval



HOWE TOWNSHIP

Howe Township, the largest township in the county, forms the northeast corner of Forest County, bordered by Warren County to the north and Elk County to the east. The largest township in county, Howe lies entirely within the proclamation boundary of the Allegheny National Forest, with private inholdings accounting for only 26 percent of the landownership in the township. Forest makes up almost 99 percent of the land cover for the township, much of it comprised of large forest blocks greater than 5000 acres in size. This contiguous forest provides habitat for interior forest species than require large patches of habitat. Tionesta Creek, Salmon Creek, and Bluejay Creek are the major streams flowing through Howe Township.

Brookston CA

This site is designated around a roadside ditch and adjacent wet area, located at the intersection of a gas pipeline and utility lines, that supports a population of **queen-of-the-prairie** (*Filipendula rubra*), a plant considered imperiled to critically imperiled in Pennsylvania.

Queen-of-the-prairie, a member of the rose family, is a clonal species that can be found growing in calcareous fens, moist meadows, thickets, and roadsides of the northcentral United States (Aspinwall and Christian 1992, Rhoads and Klein 1993). This species approaches the eastern extent of its range in Pennsylvania. *F. rubra* reproduces asexually by underground rhizomes and sexually by seed. Individual ramets, or members of a clone, grow from one to two meters tall; a single clone may spread over scores of square meters (Aspinwall and Christian 1992). The showy flowers of queen-of-the-prairie make it an attractive garden plant, and a number of nurseries throughout the nation offer it for sale. The population at this site is presumably naturally established but may be an escape from a nearby garden.



Showy inflorescence of queen-of-the-prairie. Photo: Robert Bierman, WISFLORA.

Threats and Stresses

In addition to the scarcity of preferred habitat, a principal reason for the rarity of this species is its limited ability to reproduce sexually. *F. rubra* is self-incompatible (Aspinwall and Christian 1992), or in other words, when pollen from one flower of a clone pollinates another flower within the same clone, non-viable seed is most often the result. Because genetically different populations of queen-of-the-prairie tend to be widely separated from one another, cross-pollination does not often occur within this species.

Purple loosestrife (*Lythrum salicaria*), a highly invasive, fast-growing wetland plant, is growing within the site alongside queen-of-the-prairie. Once established, this species is difficult to eradicate and will displace native species. A native of Europe, this species has no natural predators or diseases in North America.

The queen-of-the-prairie at this site could be impacted by activities associated with roadside maintenance such as mowing, herbicide use, or (excessive) use of road salt. Any activities with the potential to alter the hydrology of the immediate area, such as ditching for water control, could also negatively impact the plant.

Conservation Recommendations

Informing road maintenance crews about the presence of queen-of-the-prairie at this site would be a good first step in protecting the plant population. Maintenance activities should be evaluated for their effects on the plants growing near to the road. Upkeep of the roadside should be restricted to mowing. If possible, mowing should not occur until after the plants have flowered and any viable seeds there may be have matured, in order to increase the possibility of a viable seed bank for maintenance or expansion of the population.

HOWE TOWNSHIP

In habitats where just a few isolated purple loosestrife plants exist or the infestation is localized in a very small area (less than 1 acre), digging up the plants is the best way to control it. In the process, however, it is important to remove all purple loosestrife roots as thoroughly as possible, without overly disturbing the surrounding soil or vegetation. The population at this site is small, and the eradication of it is a project that a public service organization such as the Boy Scouts or Girl Scouts may be interested in undertaking.

Iron City Bog

This Conservation Area is delineated around a relatively small seepage wetland complex located in a saddle between two knolls. The open-canopy overstory of the wetland approximates the **hemlock – mixed hardwood palustrine forest** described by Fike (1999), a vulnerable to apparently secure natural community in Pennsylvania. The northern portion of the bog supports a stunted hemlock forest. The southern portion is open and dominated by cinnamon fern (*Osmunda cinnamomea*), cotton grass (*Eriophorum* sp.), with teaberry (*Gaultheria procumbens*) and swamp dewberry (*Rubus hispidus*) growing on hummocks among scattered hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*). Red maple (*Acer rubrum*) saplings, and yellow birch (*Betula allegheniensis*) and American beech (*Fagus grandifolia*) seedlings are occasional in the sub-canopy. *Sphagnum* spp. form a dense carpet throughout. Dense hemlock forest borders the wetland, except to the south, where a red pine (*Pinus resinosa*) plantation marks the wetland edge. The core of this site also includes the immediate watershed draining into the wetland complex.



Open, *Sphagnum* and cinnamon fern dominated portion of Iron City Bog. Cotton grass appears as floating small white tufts.

Threats and Stresses

This site is under no present threat. The wetland at the core of this site lies entirely within the Allegheny National Forest. However, the hemlock woolly adelgid (*Adelges tsugae*) does pose a serious potential threat to this site. Infestations of this insect pest can result in high levels of hemlock mortality, opening up the forest canopy and thus altering the light and hydrologic regimes of the wetland.

Conservation Recommendations

Any land management decisions regarding the watershed this site should take into consideration potential impacts to the wetland, including alterations to the light, temperature, and hydrologic regimes. Periodic monitoring for hemlock woolly adelgid is recommended, as well as further surveys to document amphibian and insect species utilizing the wetland.

Bluejay Creek CA

Lynch CA

Minister Creek CA

These Conservation Areas lie within Tionesta Creek and one of its major tributaries, and thus also fall within the Tionesta Creek Landscape Conservation Area (LCA). The LCA essentially functions as supporting landscape for the aquatic-based Conservation Areas within its boundaries (see page 21 for further discussion of the Tionesta Creek LCA). The section of Tionesta Creek within the LCA supports a rich diversity of aquatic organisms, particularly odonates and fish. Because certain species of concern are sometimes subject to unauthorized

HOWE TOWNSHIP

collection, or are particularly sensitive to human disturbance, one of the rare species documented within these sites cannot be named in this report at the request of the jurisdictional agency, in order to provide some measure of protection.

Bluejay Creek Conservation Area, located at the headwaters of Blue Jay Creek, encompasses a graminoid-dominated, former beaver-impounded wetland. The unnamed tributary of Bluejay Creek that meanders through the site, along with the adjacent riparian zone, provide habitat for the **midland clubtail dragonfly** (*Gomphus fraternus*).

The Lynch Conservation Area encompasses a section of Tionesta Creek and its tributary Bluejay Run that provides habitat for three aquatic species of conservation concern: **midland clubtail**, **northern pygmy clubtail** (*Lanthus parvulus*), and **special animal 2**.

Minister Conservation Area includes portions of Tionesta Creek and Minister Creek and riparian forest that serve as habitat for **special animal 2** and five species of rare and imperiled odonates: **harpoon clubtail dragonfly** (*Gomphus descriptus*), **midland clubtail dragonfly**, **ocellated darter dragonfly** (*Boyeria grafiana*), **ski-tailed emerald dragonfly** (*Somatochlora elongate*), and **superb jewelwing damselfly** (*Calopteryx amata*). Tionesta Creek is a small, medium gradient river with frequent riffles or light rapids. Its substrate consists largely of cobbles and boulders with lesser amounts of gravel and sand (Bier et al. 1997). Minister Creek is a shallow, medium to high gradient stream with many riffles and runs and alternating side pools. Substrates consist of coarse gravel and cobbles, with some sand and occasional boulders (Bier et al. 1997).

Dragonflies, as with other members of the Order Odonata, have three stages in their life cycle: egg, nymph, and adult. Dragonflies oviposit their eggs in or near water. The species occurring within these Conservation Areas are river-breeding odonates that utilize clear, rapid, rocky streams and rivers with silt-bottomed pools. After the eggs hatch, the nymphs remain in the water through several instars (stages between moltings of the exoskeleton, feeding on small aquatic organisms until they eventually emerge from the water as terrestrial adults.

Special animal 2 is locally and discontinuously distributed in Pennsylvania, Illinois, Ohio, West Virginia, Virginia, Tennessee and North Carolina. In Pennsylvania, it is known to occur only in the middle Allegheny River basin and several of its larger tributaries. The habitat for this species is clean, medium to large size rivers with swift flow and high bottom velocities, with a substrate of large rocks, rubble and coarse to fine gravel. During its spring to early summer spawning period, special animal 2 apparently migrates long distances from the lower reaches of its stream habitat to upstream reaches. Males select sites around large stones in swift riffles where they establish small, vaguely defined territories. Females approach these sites from downstream, and after attracting the attention of a male by swimming in short, quick movements, each female apparently leads a male in a chase. She then returns to his nest-stone and burrows into the fine gravel there, where the pair spawns. The female may deposit up to 100 eggs during each of several similar episodes with the same male, but may also repeat the procedure with other males. Food items for this species consist mostly of small macroinvertebrates inhabiting riffles (PA DCNR [no date (b)]).

Threats and Stresses

All the rare species occurring within these Conservation Areas are dependent upon high-quality stream habitat for their continued success; each of these species are particularly vulnerable to siltation within riffle and run habitats. Runoff from dirt and gravel roads in close proximity to streams can contribute to physical degradation of stream channels and erosion and pollution of in the streams. Loss of forest cover within riparian zones may also result in increased water temperatures and disruption of natural nutrient cycling linked to streams (see page 21 for a discussion of how riparian buffers function to protect water quality). Removal of forest cover on steep slopes is especially problematic because of the potential for increased runoff and erosion following storm events.

Conservation Recommendations

HOWE TOWNSHIP

Preserving forested stream corridors is key to maintaining high water quality. If possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat.

Although the surrounding watersheds are not as closely linked to the stream ecosystems as are the riparian zones, a high degree of forest cover should be maintained for additional protection of the water quality and ecological integrity of the aquatic ecosystems. Landowners engaged in timber harvesting within the watershed can refer to *Best Management Practices for Pennsylvania Forests*, a brochure available online or through Penn State, for guidelines aimed at minimizing impacts due to timber harvesting.

Mayburg CA

This Conservation Area is discussed in detail on page 65 under Kingsley Township. It is designated around a portion of East Hickory Tionesta Creek that provides habitat for three fish species of special concern. Any impacts to water quality should be avoided within this region.

Seldom Seen Corners CA

This site captures roadside habitat and surrounding second-growth deciduous forest that supports populations of **Indian skipper butterfly** (*Hesperia sassacus*) and **long dash butterfly** (*Polites mystic*), invertebrate species of conservation concern in Pennsylvania.



Indian skipper butterfly. Photo: Will Cook

Butterflies undergo four stages in their life cycle: egg, caterpillar, pupa, and adult. Once an adult female has mated, she seeks out the species of host plant appropriate for her species on which to lay her fertilized eggs. Most species lay their eggs on a plant that the newly hatched caterpillar will eat. When an egg hatches, a small caterpillar emerges and spends all its time eating and growing. As a caterpillar grows, it sheds its exoskeleton – usually three or four times – over the course of two to three weeks. During the caterpillar stage, the animal is highly vulnerable to predation by wasps and birds, parasitization by wasps or flies, or infection by fungal or viral pathogens; most caterpillars do not survive to the next stage of development. Once a caterpillar has reached full size, it attaches itself to a support and encases itself in a hard outer shell (chrysalis), and becomes a pupa.

While in the pupa stage, the butterfly transforms into an adult. When the adult inside the chrysalis is fully formed, the chrysalis splits and the adult butterfly emerges (Glassberg 1999).

Habitat for Indian skipper is old fields, pastures, and clearings. The caterpillars live in silken tubes at the base of grass clumps and leave them to feed. The older caterpillars overwinter and in the spring pupate in a loose cocoon. Various grasses, including little bluestem (*Andropogon scoparius*), panic grass (*Panicum* sp.), and red fescue (*Festuca rubra*) serve as caterpillar host plants. The adults nectar from flowers, including blackberry (*Rubus* sp.), henbit (*Lamium amplexicaule*), lithospermum (*Lithospermum* spp.), phlox (*Phlox* spp.), and viper's bugloss (*Echium vulgare*), all of which are plants typically found in disturbed roadside habitat (Opler et al. 2006)

Long dash inhabits open, moist areas including meadows, marshes, streamsidings, and wood edges. Females deposit eggs singly on or near bluegrasses (*Poa* spp.), host plants for the caterpillars. The caterpillars feed on leaves and live in shelters of tied leaves. Adult long dash butterflies nectar on flowers including common milkweed (*Asclepias syriaca*), selfheal (*Prunella vulgaris*), mountain laurel (*Kalmia latifolia*), and tick trefoil



Male long dash nectaring on a *Geranium*. Photo: Will Cook

HOWE TOWNSHIP

(*Desmodium* spp.).

Threats and Stresses

These species face no apparent threats within this site.

Conservation Recommendations

This site lies partially in National Forest lands and partially in private forestlands. Any road maintenance conducted within this Conservation Area should take into account that the roadside itself is functioning as habitat for state-rare lepidopterans. Herbicide applications should not be applied along roadsides that support the host plants discussed above.

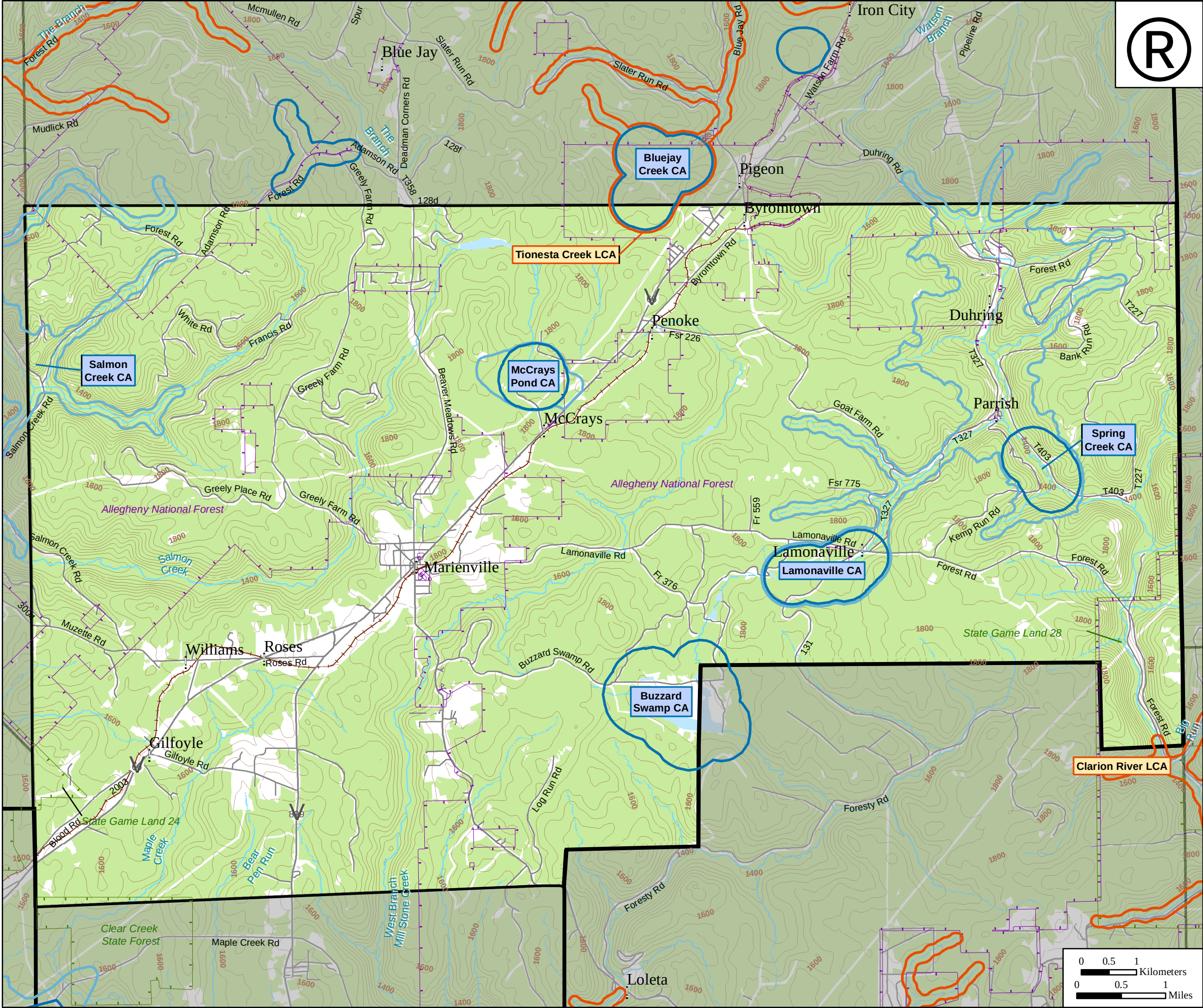


JENKS TOWNSHIP

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
NATURAL HERITAGE AREAS:						
Bluejay Creek CA			High Significance			
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	2005	E
Buzzard Swamp CA			Exceptional Significance			
Amber-winged Spreadwing Damselfly (<i>Lestes eurinus</i>)	G4	S3	---	---	2004	E
American Emerald Dragonfly (<i>Cordulia shurtleffii</i>)	G5	S3S4	---	---	2004	E
Arctic Skipper Butterfly (<i>Carterocephalus palaemon</i>)	G5	S2	---	---	2003	E
Azure Bluet Damselfly (<i>Enallagma aspersum</i>)	G5	S3S4	---	---	2004	E
Coral Hairstreak Butterfly (<i>Satyrrium titus</i>)	G5	S3S4	---	---	2004	E
Eyed Brown Butterfly (<i>Satyrodes eurydice</i>)	G4	S1S3	---	---	2004	E
Gray Comma Butterfly (<i>Polygonia progne</i>)	G5	SU	---	---	2004	E
Harris' Checkerspot Butterfly (<i>Chlosyne harrisii</i>)	G4	S3	---	---	2003	E
Northern Pearly-eye Butterfly (<i>Enodia anthedon</i>)	G5	S3S4	---	---	2004	E
Silver-bordered Fritillary Butterfly (<i>Boloria selene</i>)	G5	S1S3	---	---	2003	E
Sweetflag Spreadwing Damselfly (<i>Lestes forcipatus</i>)	G5	S3S4	---	---	2004	E
Lamonaville CA			High Significance			
Mustached Clubtail Dragonfly (<i>Gomphus adelphus</i>)	G4	S3S4	---	---	2005	E
Rapids Clubtail Dragonfly (<i>Gomphus quadricolor</i>)	G3G4	S1S2	---	---	2005	E
McCrays Pond CA			High Significance			
Bog Sedge (<i>Carex paupercula</i>)	G5	S3	---	PT	2005	E
Comet Darner Dragonfly (<i>Anax longipes</i>)	G5	S1S2	---	---	2005	E
Salmon Creek CA			Exceptional Significance			
Harpoon Clubtail Dragonfly (<i>Gomphus desertus</i>)	G4	S1S2	---	---	1994	E
Maine Snaketail Dragonfly (<i>Ophiogomphus mainensis</i>)	G4	S3	---	---	1994	E
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1994	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1994	E
Superb Jewelwing Damselfly (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1994	E
Zebra Clubtail (<i>Stylurus scudderii</i>)	G4	S1S2	---	---	1994	E
Spring Creek CA			High Significance			
American Emerald Dragonfly (<i>Cordulia shurtleffii</i>)	G5	S3S4	---	---	2005	E
Harpoon Clubtail Dragonfly (<i>Gomphus desertus</i>)	G4	S1S2	---	---	2005	E
Mocha Emerald Dragonfly (<i>Somatochlora linearis</i>)	G5	S1	---	---	2005	E
Northern Pygmy Clubtail Dragonfly (<i>Lanthus parvulus</i>)	G4	S3S4	---	---	2005	E

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

[‡]Please refer to Appendix VI for an explanation of Quality ranks.



Forest County Natural Heritage Inventory Jenks Township

Conservation Areas:

- Bluejay Creek
- Buzzard Swamp
- Lamonaville
- McCrays Pond
- Salmon Creek
- Spring Creek

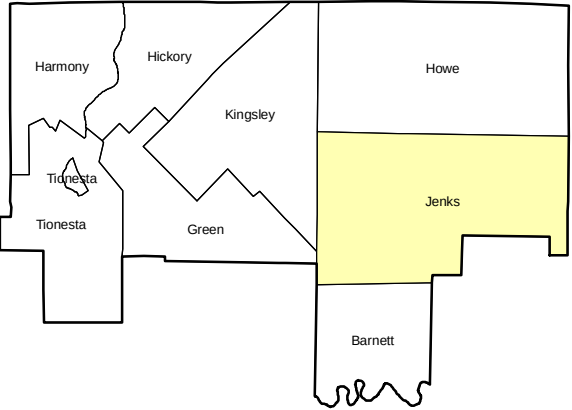
Landscape Conservation Areas:

- Clarion River
- Tionesta Creek

Public Lands:

- Allegheny National Forest
- Clear Creek State Forest
- State Game Land 24
- State Game Land 28

Overview

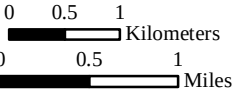


Legend

- Conservation Area (CA)
 - Core Habitat
 - Supporting Landscape
- Landscape Conservation Area (LCA)
- State Lands
- Allegheny National Forest
- 40 ft. Contour Interval



Pennsylvania Natural Heritage Program



JENKS TOWNSHIP

Jenks Township, the second largest township in Forest County, borders Elk County to the east. Forest covers approximately 97 percent of the township, with 67 percent of that being interior forest. Seventy percent of the township is under public ownership. The divide between the Clarion River watershed and the Tionesta Creek watershed roughly bisects the township along a northeast/southwest diagonal.

The forested landscape of Jenks Township provides habitat for the **Northern Goshawk** (*Accipiter gentilis*). This species ranges across a large territory and is vulnerable to poaching; therefore, no Conservation Areas have been mapped for it. See the fact sheet on page 39 for information on this species.

Bluejay Creek CA

This Conservation Area is discussed under Howe Township (page 56). It is designated around a nameless tributary of Bluejay Creek that provides habitat for **midland clubtail dragonfly** (*Gomphus fraternus*). Any impacts to water quality should be avoided within and upstream of this site.

Buzzard Swamp CA Lamonaville CA

The Buzzard Swamp Conservation Area lies within the 1,122-acre Buzzard Swamp Wildlife Management Area in the Allegheny National Forest. The wildlife management area encompasses a complex of habitats including 15 man-made impoundments, open grassland, small wetlands, and forest. Through a cooperative agreement with the Pennsylvania Game Commission, it is intensively managed for high populations of wildlife species, especially waterfowl, furbearers, and warm water fish (USFS 2007). The diverse habitat within this site also supports populations of seven butterfly species and four odonate species of conservation concern (please see the preceding summary table for a complete list).

Located just northeast of Buzzard Swamp, the Lamonaville CA encompasses a wetland complex at the headwaters of Wolf Run. A beaver impoundment adjacent to a graminoid-dominated wetland provides habitat for **mustached clubtail dragonfly** (*Gomphus adelphus*) and **rapids clubtail dragonfly** (*Gomphus quadricolor*).

Odonates have three stages in their life cycle: egg, nymph, and adult. Dragonflies and damselflies typically lay their eggs in water. The amber-winged spreadwing, American emerald, azure bluet, and sweetflag spreadwing are pond-breeding odonates that prefer ponds, lakes, marshes, and occasionally slow-flowing streams. The mustached clubtail and rapids clubtail typically utilize clear rocky streams and rivers with silt-bottomed pools. After the eggs hatch, the nymphs remain in the water through several instars, feeding on small aquatic organisms until they eventually grow wings and emerge from the water as terrestrial adults (Dunkle 2000).

Threats and Stresses

The damselfly, dragonfly, and butterfly species found within these sites face no apparent threats.

Conservation Recommendations

The current management of the sites is compatible with maintaining the populations of the rare insects documented here.

McCrays Pond CA

The core of this site is an artificial impoundment bordered by open meadow and hemlock forest that provides habitat for the pond-breeding **comet darner dragonfly** (*Anax longipes*), a critically imperiled to imperiled species in Pennsylvania. A floating *Sphagnum* mat lies along a portion of the southern edge of the pond. A hemlock swamp occurs where a finger of bog extends from the *Sphagnum* mat into the surrounding hemlock-white pine forest. The swamp is characterized by pit and mound microtopography, and at the time of the survey, many of the pits held cool, standing water. Within a small, saturated opening in a cinnamon fern-dominated portion of the

JENKS TOWNSHIP

hemlock swamp, a small population of **bog sedge** (*Carex paupercula*) was found growing on a sphagnous hummock along with cinnamon fern (*Osmunda cinnamomea*), swamp dewberry (*Rubus hispidus*), bearded shorthusk grass (*Brachyelytrum erectum*), and slender mannagrass (*Glyceria melicaria*).

Threats and Stresses

This Conservation Area is under no imminent threat.

Conservation Recommendations

The current management is compatible with maintaining the populations of the sensitive species present at this site.

Salmon Creek CA

This Conservation Areas is discussed in detail under Kingsley Township (page 66). It is designated around a portion of Salmon Creek that provides habitat for six odonate species of conservation concern. Any impacts to water quality should be avoided within this region.



Bog sedge. Photo: Svein Astrom

Spring Creek CA

This Conservation Area is delineated around a section of Spring Creek and an adjacent beaver impoundment that supports four dragonfly species of concern: **American emerald** (*Cordulia shurtleffii*), **harpoon clubtail** (*Gomphus desertus*), **mocha emerald** (*Somatochlora linearis*), and **northern pygmy clubtail** (*Lanthus parvulus*). The supporting landscape extends for five kilometers from the upstream boundary of the core of the site, and captures the riparian zone of the main stem of the creek plus tributaries and their riparian zones.

Threats and Stresses

The river-breeding odonates occurring within this site are dependent upon high-quality stream habitat for their continued success. Runoff from dirt and gravel roads in close proximity to streams can contribute to physical degradation of stream channels and erosion and pollution of the streams. Loss of forest cover within riparian zones may also result in increased water temperatures and disruption of natural nutrient cycling linked to streams (see page 21 for a discussion of how riparian buffers function to protect water quality). Removal of forest cover on steep slopes is especially problematic because of the potential for increased runoff and erosion following storm events.

Conservation Recommendations

Preserving forested stream corridors is key to maintaining high water quality. If possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat.

Although the surrounding watershed is not as closely linked to the stream ecosystems as are the riparian zones, a high degree of forest cover should be maintained for additional protection of the water quality and ecological integrity of the aquatic ecosystems.



Mustached clubtail

Gomphus adelphus

Pennsylvania Rare Species

Identification:

The mustached clubtail is a small (4.3 to 4.8 millimeters, or about two inches, long) dragonfly patterned in black and yellowish green. The upper surface of the head is black and the thorax yellow with black stripes, notably a black band running back to front on the upper surface that divides into two stripes towards a yellow collar at the front of the thorax. The abdomen is black.

Habitat/Behavior:

Mustached clubtail adults are found near riffles in clear streams and sometimes along lakeshores, where they often rest on low vegetation. The larvae are aquatic, burrowing into streambeds below riffles. The species ranges from Quebec and Ontario south to North Carolina and Tennessee, and west into Minnesota.

State Rank: S3S4 (vulnerable to apparently secure)

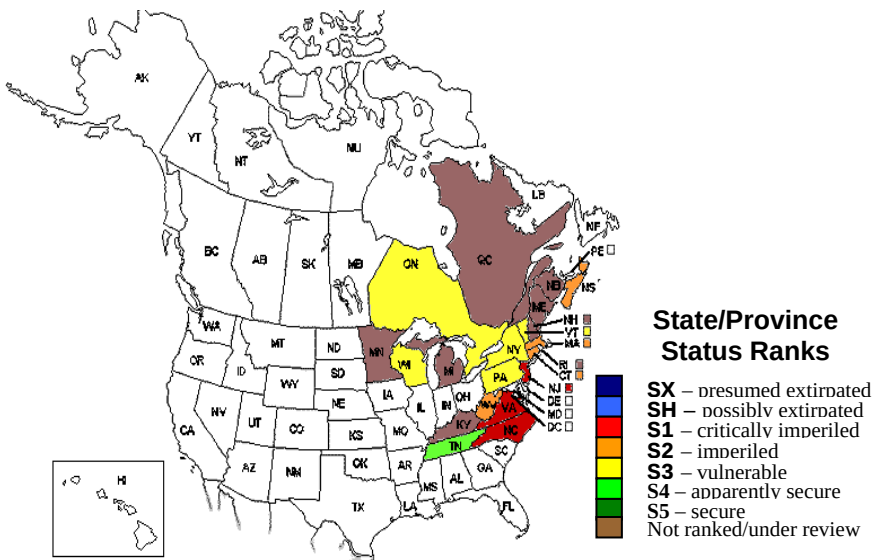
Global Rank: G4 (apparently secure)



Photo by David Westover, from Kondratieff 2000

North American Range and Conservation Status

Map by NatureServe



Status:

Because their life cycle involves both terrestrial and aquatic phases, dragonflies are particularly sensitive to disturbances of stream and lake habitats. Water pollution can harm the larvae; clearing of stream- and lake-shore vegetation deprives the adults of habitat.

Conservation considerations:

Protection of the mustached clubtail will require preservation and restoration of both the terrestrial streamside habitat of the adult and the aquatic habitat of the larvae. The species can benefit from reduction of fertilizer and pesticide runoff, as well as planting of vegetative buffers along streams.

References:

- Kondratieff, B. C. (coordinator). 2000. "Dragonflies and Damselflies (Odonata) of the United States" [web application]. Version 12DEC2003. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available online: <http://www.npwr.usgs.gov/resource/distr/insects/dfly/dflyusa.htm>.
- NatureServe. 2004. "NatureServe Explorer: An online encyclopedia of life [web application]." Version 4.1. NatureServe, Arlington, Virginia. Available online: <http://www.natureserve.org/explorer>.
- Needham, J. G., M. J. Westfall, Jr., and M. L. May. 2000. *Dragonflies of North America*, Revised Edition. Washington: Scientific Publishers. Pp. 340-341.

KINGSLEY TOWNSHIP

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
NATURAL HERITAGE AREAS:						
Branch Trail CA			High Significance			
Harris’ Checkerspot Butterfly (<i>Chlosyne harrisii</i>)	G4	S3	---	---	1994	E
Kelletville CA			High Significance			
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G4	S2	---	---	1994	E
Lower Tionesta Creek CA			High Significance			
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	1994	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G4	S2	---	---	1994	E
Mayburg CA			High Significance			
Special Animal 2	G4	S2	---	PT	2004	E
Special Animal 3	G4	S2	---	PT	1999	AB
Special Animal 6	G3	S2S3	---	PT	1999	AB
Salmon Creek CA						
Harpoon Clubtail Dragonfly (<i>Gomphus desertus</i>)	G4	S1S2	---	---	1994	E
Maine Snaketail Dragonfly (<i>Ophiogomphus mainensis</i>)	G4	S3	---	---	1994	E
Midland Clubtail Dragonfly (<i>Gomphus fraternus</i>)	G5	S2S3	---	---	1994	E
Ocellated Darner Dragonfly (<i>Boyeria grafiana</i>)	G5	S3	---	---	1994	E
Superb Jewelwing Damselfly (<i>Calopteryx amata</i>)	G4	S2S3	---	---	1994	E
Zebra Clubtail (<i>Stylurus scudderii</i>)	G4	S1S2	---	---	1994	E

GEOLOGIC FEATURE: Stony Point (Erosional Remnant)

*Please refer to Appendix V for an explanation of Element Ranks and Legal Status.

*Please refer to Appendix VI for an explanation of Quality ranks.

Forest County Natural Heritage Inventory Kingsley Township

Conservation Areas:

- Branch Trail
- Kellettville
- Lower Tionesta Creek
- Mayburg
- Salmon Creek

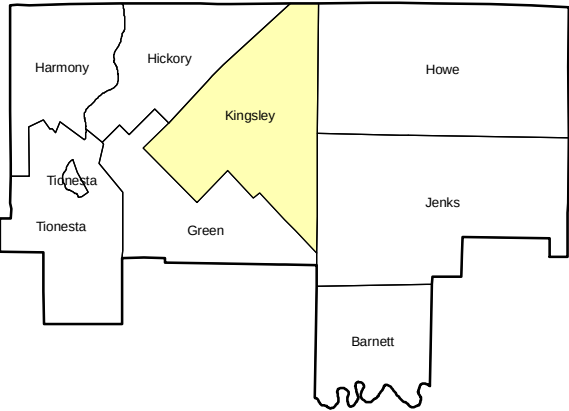
Landscape Conservation Areas:

- Minister
- Tionesta Creek
- Yellow Hammer

Public Lands:

- Allegheny National Forest
- State Game Land 24

Overview



Legend

Conservation Area (CA)

Core Habitat

Supporting Landscape

Landscape Conservation Area (LCA)

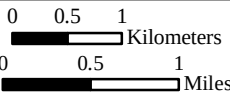
State Lands

Allegheny National Forest

40 ft. Contour Interval



Pennsylvania Natural Heritage Program



KINGSLEY TOWNSHIP

Kingsley Township is located along the northern edge of Forest County, where it borders Warren County. Forest makes up 89 percent of the total land use in Kingsley Township, and includes portions three blocks of contiguous forest greater than 12,000 acres in area. The township lies entirely within the proclamation boundary of the Allegheny National Forest, with private inholdings making up 33 percent of land ownership. Efforts should be made to preserve intact large forest blocks whenever possible in order to maintain habitat for area-sensitive interior forest species. Stony Point, a feature of geological interest, is an erosional remnant located on the Allegheny National Forest, approximately one half mile (one kilometer) southeast of Kelletville.

Branch Trail CA

This site, located in the Allegheny National Forest, captures roadside habitat and surrounding second-growth deciduous forest that supports a population of **Harris' checkerspot butterfly** (*Chlosyne harrisii*), an invertebrate species of conservation concern in Pennsylvania. The site is characterized by young deciduous forest with patches of damp meadow along the road.

Habitat for Harris' checkerspot includes moist areas such as marshes, bog edges, pastures, and meadows. Flat-topped white aster (*Aster umbellatus*) serves as the host plant for the caterpillars, which feed on leaves communally in a web. Partially grown caterpillars hibernate at the base of the host plant (Opler et al. 2006). The adults at this site have been observed nectaring at roadside ox-eye daisies (*Chrysanthemum leucanthemum*).

Threats and Stresses

This species faces no apparent threats within this site.

Conservation Recommendations

Any road maintenance conducted within this Conservation Area should take into account that the roadside itself is functioning as habitat for state-rare lepidopterans. Herbicide applications should not be applied along roadsides that support the host plants discussed above.

Kelletville CA

Lower Tionesta Creek CA

Mayburg CA

These Conservation Areas lie within the main stem of Tionesta Creek. Tionesta Creek is a small, medium gradient river, with frequent riffles or light rapids. The substrate consists largely of cobbles and boulders with lesser amounts of gravel and sand. Occasional portions of the streambed are dominated by coarse to medium gravel, generally more suitable to mussels (Bier et al. 1997). The Tionesta Creek Landscape Conservation Area (LCA) functions as supporting landscape for each of the aquatic-based Conservation Areas within its boundaries (see page 21 for further discussion of the LCA). Because certain species of concern are sometimes subject to unauthorized collection, or are particularly sensitive to human disturbance, the three rare species documented within the Mayburg Conservation Area cannot be named in this report cannot be named in this report at the request of the jurisdictional agency, in order to provide some measure of protection.

Tionesta Creek within the Kelletville CA supports **round pigtoe** (*Pleurobema sintoxia*), a mussel species of conservation concern in Pennsylvania. Within the Lower Tionesta Creek CA, the creek provides habitat occupied by **round pigtoe** and **long-solid** (*Fusconaia subrotunda*), another mussel species of concern.

The section of Tionesta encompassed within the Mayburg Conservation Area provides habitat for **special animal 2**, **special animal 3**, and **special animal 6**, each listed as a Pennsylvania Threatened species by the Pennsylvania Biological Survey.

KINGLSEY TOWNSHIP

Freshwater mussels, primarily found in streams, are filter feeders that spend their adult lives in the substrate of stream or lake bottoms. Movement is accomplished either by means of a muscular foot or flood currents. A mussel filters oxygen and particulate matter from the water column by continuously siphoning water through its body. They feed on suspended organic matter, including detritus and plankton. Mussels have a rather complex life cycle involving four stages. The cycle begins when males release sperm into the water column. As the sperm passively drifts with the current, it may enter females when they are siphoning and consequently fertilize her eggs. During the second stage, the fertilized eggs develop into larvae, or glochidia. The glochidia are microscopic and are held in the female's gills for future release into the water column. They are parasitic and must attach to the gills or fins of a suitable host fish in order to survive once the female releases them. Once a glochidium attaches to a host, it remains for a period of days or months, depending upon the species, as it transforms into a juvenile mussel. Following the transformation, the juvenile releases from the host and sinks to the stream bottom. If the juvenile is lucky, it lands in suitable substrate where it feeds and grows into an adult (Cordeiro and Bowers-Altman [no date]). Because mussels are dependent upon good water quality and physical habitat conditions and an environment that will support populations of host fish, they are considered good indicators of the health of aquatic ecosystems.

Special animal 2 is locally and discontinuously distributed in Pennsylvania, Illinois, Ohio, West Virginia, Virginia, Tennessee and North Carolina. In Pennsylvania, it is known to occur only in the middle Allegheny River basin and several of its larger tributaries. The habitat for this species is clean, medium to large size rivers with swift flow and high bottom velocities, with a substrate of large rocks, rubble and coarse to fine gravel. During its spring to early summer spawning period, special animal 2 apparently migrates long distances from the lower reaches of its stream habitat to upstream reaches. Males select sites around large stones in swift riffles where they establish small, vaguely defined territories. Females approach these sites from downstream, and after attracting the attention of a male by swimming in short, quick movements, each female apparently leads a male in a chase. She then returns to his nest-stone and burrows into the fine gravel there, where the pair spawns. The female may deposit up to 100 eggs during each of several similar episodes with the same male, but may also repeat the procedure with other males. Food items for this species consist mostly of small macroinvertebrates inhabiting riffles (PA DCNR [no date (b)]).

Special animal 3 occurs primarily in the Ohio River basin, extending into the lower Great Lakes basin and upper St. Lawrence drainages. It also occurs in southeastern Kansas, southwestern Missouri, eastern Oklahoma, Arkansas and northern Louisiana (Carman and Goforth 2000). Although the range of special animal 3 is large, this species often occurs in isolated populations. In Pennsylvania, it is known from Lake Erie and larger tributaries, and the upper part of the Allegheny River drainage. This species inhabits large clean streams and rivers with moderate current and bottoms consisting of large rocks, fine gravel and sand. Spawning takes place in spring to mid-summer. Males select and establish small territories downstream from large stones scattered over a clean sand-small gravel bottom. Females move into these territories, burrow into the gravel behind each stone, and spawn here with various males. Small numbers of eggs are deposited and fertilized with each spawning, until up to 400 eggs are laid. This species feeds on small aquatic insect larvae, as well as algae and organic detritus (PA DCNR [no date (c)]).

Special animal 6 occurs along the western side of the Appalachian Mountains in the Ohio, Tennessee and Allegheny River drainages, from southwestern New York down to North Carolina and Tennessee. In Pennsylvania, this species is known only from scattered sites in the Allegheny River and French Creek headwaters (PA DCNR [no date (d)]). The preferred habitat of special animal 6 is moderate to large-sized clear streams with swift currents and bottoms of gravel and boulders. Little is known about the life history of this species, but it is believed that it spawns in the spring between March and May (NY DEC [no date]). Adults feed on small crayfish and larger insect larvae (PA DCNR [no date (d)]).

Salmon Creek CA

The Salmon Creek Conservation Area captures a section of the stream and riparian forest that provides habitat for

KINGLSEY TOWNSHIP

six odonate species of conservation concern: **harpoon clubtail dragonfly**, **Maine snaketail dragonfly** (*Ophiogomphus mainensis*), **midland clubtail dragonfly**, **ocellated darner dragonfly**, **superb jewelwing damselfly**, and **zebra clubtail dragonfly** (*Stylurus scudderi*). Salmon Creek is a medium gradient, 5-15 meter wide stream consisting largely of riffle habitats and adjacent side-pools. Substrates commonly include areas of gravel, with silt and sand in quiet waters. The supporting landscape extends for five kilometers from the upstream boundary of the core of the site, and captures the riparian zone of the main stem of the creek plus tributaries and their riparian zones. The species occurring within this Conservation Areas are river-breeding odonates that utilize clear, rapid, rocky streams and rivers with silt-bottomed pools (Dunkle 2000).

Threats and Stresses

The aquatic animals occurring within each of these sites are dependent upon high-quality stream habitat for their continued success. Freshwater mussel populations have been declining over the past century throughout North America. Generally, the reason for this decline has been largely attributed to increased sedimentation, which renders stream bottoms unsuitable as mussel habitat. Erosion, caused in part by deforestation, poor agricultural practices, and destruction of riparian zones, has led to increased silt loads and shifting, unstable stream bottoms (see page 21 for a discussion of how riparian buffers function to protect water quality). Silt and contaminants, such as heavy metals, pesticides, and acid mine drainage, have long been recognized as threats to mussels (Ortmann 1909; Ellis 1931; cited in Williams et al. 1993). Increases in siltation can also indirectly impact freshwater mussel communities by interfering with host fish – mussel interactions. Increased sedimentation can reduce the abundance, diversity, and reproduction of fish, including the host fish that are necessary for protection and dispersal of virtually all freshwater mussels during their larval stage. The increased turbidity associated with suspended sediment loads also interferes with the visual cues used by both adult mussels and host fish in the transfer of the glochidia or mussel larvae (Box and Mossa 1999).

Conservation Recommendations

Preserving forested stream corridors is key to maintaining high water quality. If possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat. Although the surrounding watershed is not as closely linked to the stream ecosystem as are the riparian zones, a high degree of forest cover should be maintained for additional protection of the water quality and ecological integrity of the aquatic ecosystems.

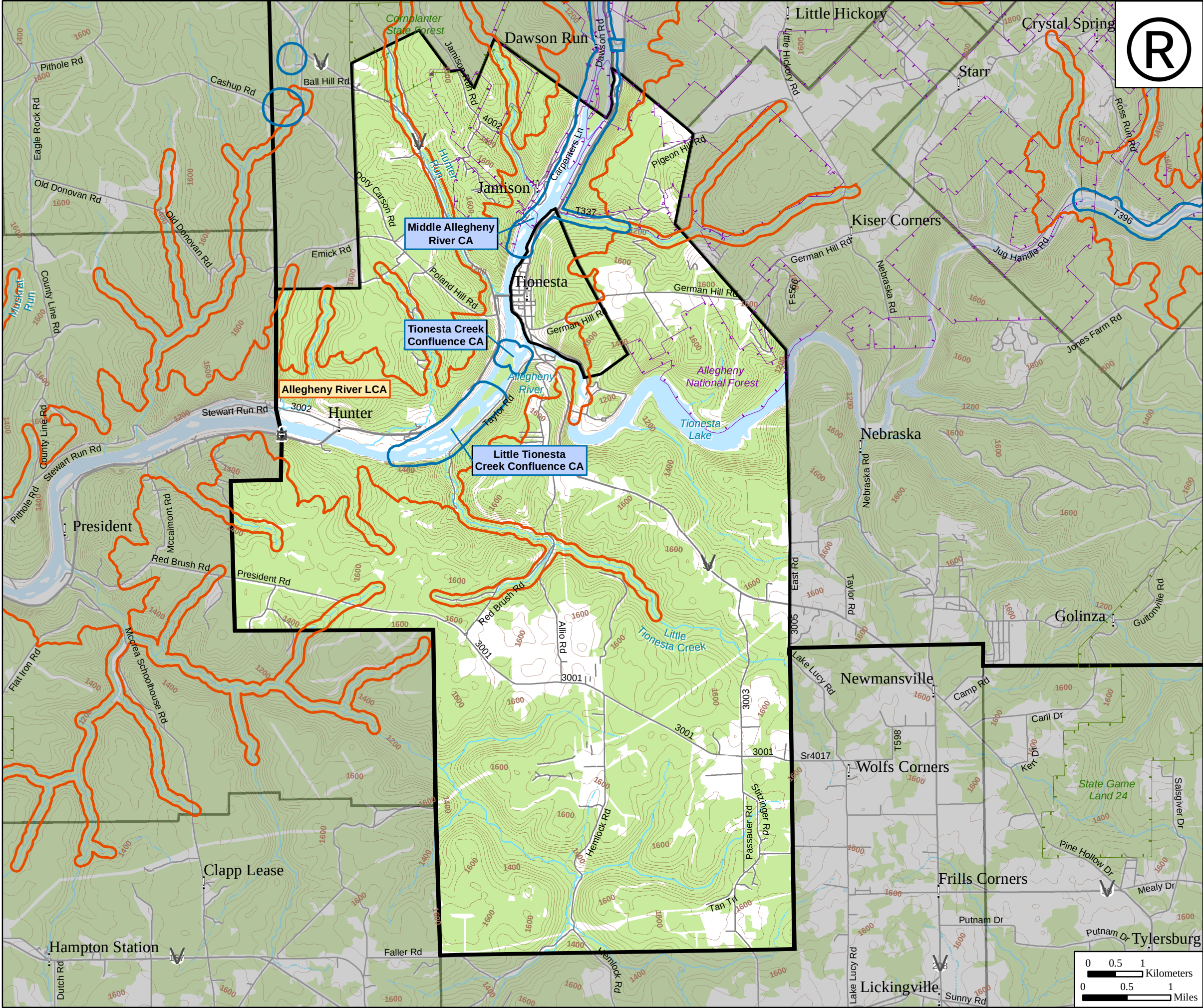


TIONESTA TOWNSHIP & TIONESTA BOROUGH

	PNDI Rank*		Legal Status*		Last Observed	Quality [‡]
	Global	State	Federal	State		
<i>NATURAL HERITAGE AREAS:</i>						
Middle Allegheny River CA			<i>Exceptional Significance</i>			
Elktoe Mussel (<i>Alasmodonta marginata</i>)	G4	S4	---	---	2003	E
Long-solid Mussel (<i>Fusconaia subrotunda</i>)	G3	S1	---	---	2000	E
Special Animal 3	G4	S2	---	PT	1999	AB
Special Animal 4	G2	S1S3	LE, XN	PE	2003	B
Special Animal 5	G4	S1S2	---	PT	1999	B
Special Animal 6	G3	S2S3	---	PT	1999	AB
Special Animal 7	G4	S1		PE	1995	B
Special Animal 8	G3	S2	---	PE	1999	B
Special Animal 9	G2T2	S2	LE	PE	2004	A
Special Animal 10	G1G2	S1S2	C	---	2003	E
Round Pigtoe Mussel (<i>Pleurobema sintoxia</i>)	G1	S2	---	---	2003	E
Stalked Bulrush (<i>Scirpus pedicellatus</i>)	G4	S1	---	PT	2005	E
Wavy-rayed Lampmussel (<i>Lampsilis fasciola</i>)	G4	S4	---	---	2003	E
Tionesta Creek Confluence CA			<i>High Significance</i>			
Redhead Pondweed (<i>Potamogeton richardsonii</i>)	G5	S3	---	PT	1999	E
Little Tionesta Creek Confluence CA						
Special Animal 1	G5	S2B	LT	PT	2005	BC
Special Animal 11	G3	S1	C	PE	1991	E

*Please refer to Appendix V for an explanation of Element ranks.

[‡]Please refer to Appendix VI for an explanation of Quality ranks.



Forest County Natural Heritage Inventory

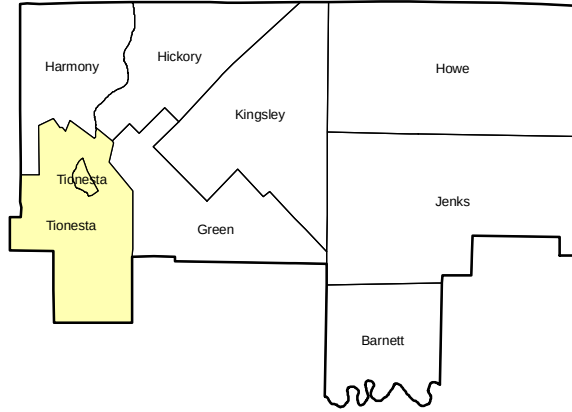
Tionesta Borough & Tionesta Township

Conservation Areas:
Little Tionesta Creek
Middle Allegheny River
Tionesta Creek Confluence

Landscape Conservation Areas:
Allegheny River

Public Lands:
Allegheny National Forest
Complanter State Forest

Overview



Legend

- Conservation Area (CA)
 - Core Habitat
 - Supporting Landscape
- Landscape Conservation Area (LCA)
- State Lands
- Allegheny National Forest
- 40 ft. Contour Interval



TIONESTA TOWNSHIP

Tionesta Township forms the southwest corner of Forest County, bordered by Clarion County to the south and Venango County to the west. Forest covers approximately 67 percent of the township, making it the least forested township in Forest County. However, much of the forest is contiguous over large areas, which gives rise to habitat connectivity that is beneficial for interior forest species. Conversely, agriculture makes up 11 percent of the total land use in the township, the highest in the county. Public lands make up a relatively small portion of Tionesta Township.

TIONESTA BOROUGH

Tionesta Borough, located at the confluence of Tionesta Creek and the Allegheny River, lies within the boundaries of Tionesta Township. The landscape of Tionesta, despite it being the largest population center in the county, remains largely forested. No Conservation Areas were described within Tionesta Borough, but it does lie within the Allegheny River LCA. An important issue related to ecological health for the borough is appropriate management of stormwater and sewage to minimize impacts to area waterways.

Middle Allegheny River CA

This Conservation Areas is discussed under Harmony Township (page 46). This site is designated around a section of the Allegheny River that provides habitat for seven mussel species, five fish species, and one plant species of conservation concern. Any impacts to water quality should be avoided within this region.

Little Tionesta Creek Confluence CA Tionesta Creek Confluence CA

These Conservation Areas lie within a 47-mile section of the Allegheny River that has been designated as Wild and Scenic by Congress. The Allegheny River Landscape Conservation Area (LCA) essentially functions as supporting landscape for the aquatic-based Conservation Areas within its boundaries (see page 19 for further discussion of the LCA). This section of the river supports a rich diversity of aquatic organisms, particularly fish and freshwater mussels. Because certain species of concern are sometimes subject to unauthorized collection, or are particularly sensitive to human disturbance, the rare species documented within Little Tionesta Creek Confluence CA cannot be named in the site description at the request of the jurisdictional agency, in order to provide some measure of protection.

The Little Tionesta Creek Confluence CA provides habitat for **special animal 1**, a Federally Threatened species, and **special animal 11**, a Candidate for Federal listing. Because certain species of concern are sometimes subject to unauthorized collection, or are particularly sensitive to human disturbance, the rare species documented within this Conservation Area cannot be named in the report at the request of the jurisdictional agency, in order to provide some measure of protection.

The riverine habitat within the Tionesta Creek Confluence Conservation Area supports a population of **redhead pondweed** (*Potamogeton richardsonii*), a plant species of conservation concern. Its range extends from Quebec to Alaska, south to Pennsylvania, Indiana, Illinois, Colorado, and California (Gleason and Cronquist 1991). In Pennsylvania, its distribution extends throughout the state, but is concentrated in the Allegheny River, French Creek, Susquehanna River, and Delaware River (PNDI). Redhead pondweed is a submergent aquatic plant that grows in ponds and streams. The fruit of this species can be locally important food source for a variety of waterfowl. The leaves and stems are colonized by invertebrates and offer foraging opportunities and cover for fish (Langlade County Land Records & Regulations Department).

Freshwater mussels, primarily found in streams, are filter feeders that spend their adult lives in the substrate of stream or lake bottoms. Movement is accomplished either by means of a muscular foot or flood currents. A mussel filters oxygen and particulate matter from the water column by continuously siphoning water through its body. They feed on suspended organic matter, including detritus and plankton. Mussels have a rather complex life cycle involving four stages. The cycle begins when males release sperm into the water column. As the sperm

TIONESTA TOWNSHIP

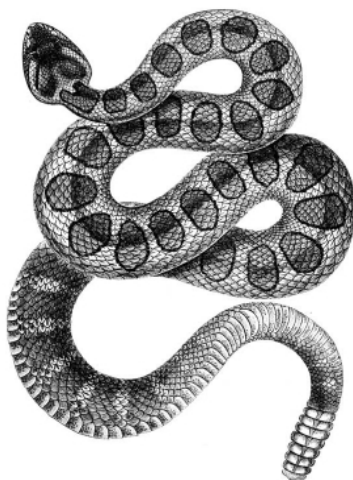
passively drifts with the current, it may enter females when they are siphoning and consequently fertilize her eggs. During the second stage, the fertilized eggs develop into larvae, or glochidia. The glochidia are microscopic and are held in the female's gills for future release into the water column. They are parasitic and must attach to the gills or fins of a suitable host fish in order to survive once the female releases them. Once a glochidium attaches to a host, it remains for a period of days or months, depending upon the species, as it transforms into a juvenile mussel. Following the transformation, the juvenile releases from the host and sinks to the stream bottom. If the juvenile is lucky, it lands in suitable substrate where it feeds and grows into an adult (Cordeiro and Bowers-Altman [no date]). Because mussels are dependent upon good water quality and physical habitat conditions and an environment that will support populations of host fish, they are considered good indicators of the health of aquatic ecosystems.

Threats and Stresses

The presence of numerous freshwater mussel populations throughout the middle Allegheny River is indicative of high water quality. Freshwater mussel populations have been declining over the past century throughout North America. Generally, the reason for this decline has been largely attributed to increased sedimentation, which renders stream bottoms unsuitable as mussel habitat. Erosion, caused in part by deforestation, poor agricultural practices, and destruction of riparian zones, has led to increased silt loads and shifting, unstable stream bottoms. Siltation and contaminants, such as heavy metals, pesticides, and acid mine drainage, have long been recognized as threats to mussels (Ortmann 1909; Ellis 1931; cited in Williams et al. 1993). Increases in siltation can also indirectly impact freshwater mussel communities by interfering with host fish – mussel interactions. Increased sedimentation can reduce the abundance, diversity, and reproduction of fish, including the host fish that are necessary for protection and dispersal of virtually all freshwater mussels during their larval stage. The increased turbidity associated with suspended sediment loads also interferes with the visual cues used by both adult mussels and host fish in the transfer of the glochidia or mussel larvae (Box and Mossa 1999).

Conservation Recommendations

The Wild and Scenic designation ensures continued protection of these sections of the river. In the watershed beyond, if possible, timbering and road development or other construction activities should be kept well away from riparian corridors in order to avoid degrading important aquatic and streamside habitat within the tributaries flowing into the Allegheny River. Currently, land use within the watershed is compatible with maintaining the high-quality conditions within this site. Any planning of future development within the watershed should seek to avoid potential impacts to both the physical character and water quality of the Allegheny River.



GENERAL RECOMMENDATIONS

The following are general recommendations for protection of natural heritage areas (NHAs) within a county. Approaches to protecting a NHA are wide-ranging and factors such as land ownership, time constraints, and tools/resources available should be considered when prioritizing protection of these sites. Prioritization works best when incorporated into a long-term, large-scale plan, however, opportunities may arise that do not conform to a plan and the decision on how to manage or protect a natural heritage area may be made on a site-by-site basis. Keep in mind that personnel in our program or staff from state natural resource agencies are available to discuss more specific options as needed.

1. **Consider conservation initiatives for NHAs on private land.**

Conservation easements protect land while leaving it in private ownership. An easement is a legal agreement between a landowner and a conservation or government agency that permanently limits a property's use in order to protect its conservation values. It can be tailored to the needs of both landowner and conservation organization and will not be extinguished with new ownership. Tax incentives may apply to conservation easements donated for conservation purposes.

Lease and management agreements also allow the landowner to retain ownership and temporarily ensure protection of land. There are no tax incentives for these conservation methods. A lease to a land trust or government agency can protect land temporarily and ensure that its conservation values will be maintained. This can be a first step to help a landowner decide if they want to pursue more permanent protection methods. Management agreements require landowner and land trust to work together to develop a plan for managing resources such as plant or animal habitat, protection of a watershed, forest or agricultural land with land trust offering technical expertise.

Land acquisition by a conservation organization can be at fair market value or as a bargain sale in which a sale is negotiated for a purchase price below fair market value with tax benefits that reduce or eliminate the disparity. 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 lands should be examined for acquisition when a NHA is present on either property and there is a need of additional land to complete protection of the associated natural features.

Fee simple acquisition is when a buyer purchases land outright and has maximum control over the use and management of the property and its resources. This conservation initiative is appropriate when the property's resources are highly sensitive and protection cannot be guaranteed using other conservation approaches.

Unrestricted donations of land are welcomed by land trusts. The donation of land entitles the donor to a charitable deduction for the full market value, as well as a release from the responsibility of managing the land. If the land is donated because of its conservation value, the land will be permanently protected. A donation of land that is not of high biological significance may be sold, with or without restrictions, to a conservation buyer and the funds used to further the land trust's conservation mission.

Local zoning ordinances are one of the best-known regulatory tools available to municipalities. Examples of zoning ordinances a municipality can adopt include: overlay districts where the boundary is tied to a specific resource or interest such as riverfront protection and floodplains, and zoning to protect stream corridors and other drainage areas using buffer zones.

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

Many of the already-protected NHAs are in need of additional management recommendations to ensure the continued existence of the associated natural elements. Incorporate site-specific recommendations into existing management plans or prepare new plans. Recommendations may include: removal of exotic plant species; leaving the area alone to mature and recover from previous disturbance; creating natural areas within existing parks; limiting land-use practices such as mineral extraction, residential or industrial development, and agriculture; and implementing sustainable forestry practices. For example, some species simply require continued availability of a natural community while others may need specific management practices such as canopy thinning, mowing, or burning to maintain their habitat requirements.

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

3. Protect bodies of water.

Protection of reservoirs, wetlands, rivers, and creeks is vital for ensuring the health of human communities and natural ecosystems; especially those that protect biodiversity, supply drinking water, and are attractive recreational resources. Many rare species, unique natural communities or locally significant habitats occur in wetlands and water bodies and are directly dependent on natural hydrological patterns and water quality for their continued existence. Ecosystem processes also provide clean water supplies for human communities and do so at significant cost savings in comparison to water treatment facilities. Hence, protection of high quality watersheds is the only way to ensure the viability of natural habitats and water quality. Scrutinize development proposals for their impact on entire watersheds, not just the immediate project area. Cooperative efforts in land use planning among municipal, county, state, and federal agencies, developers, and residents can lessen the impact of development on watersheds.

4. Provide for buffers around NHAs.

Development plans should provide for natural buffers between disturbances and NHAs. Disturbances may include construction of new roads and utility corridors, non-sustainable timber harvesting, and 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. Staff at the Pennsylvania Natural Heritage Program (PNHP) or natural resources agencies can provide further guidance regarding buffer considerations appropriate for various kinds of natural resources within NHAs, e.g., barren community, wetland, water body, or forest.

Watersheds or subwatersheds where natural communities and species of 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.

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

The reclamation of previously disturbed areas, or brownfields development, for commercial and industrial projects presents one way to encourage economic growth while allowing ecologically sensitive areas to remain undisturbed. Cluster development can be used to allow the same amount of development on much less land and leave much of the remaining land intact for wildlife and native plants. By compressing development into already disturbed areas with existing infrastructure (villages, roads, existing ROW's), large pieces of the landscape can be maintained intact. If possible, networks or corridors of woodlands or greenspace should be preserved linking sensitive natural areas to each other.

6. Encourage the formation of grassroots organizations.

County and municipal governments can do much of the work necessary to plan for the protection and management of natural areas identified in this report. However, grassroots organizations are needed to assist with obtaining funding, identifying landowners who wish to protect their land, and providing information about easements, land acquisition, and management and stewardship of protected sites. Increasingly, local watershed organizations and land trusts are taking proactive steps to accomplish conservation at the local level. When activities threaten to impact ecological features, the responsible agency should be contacted. If no agency exists, private groups such as conservancies, land trusts and watershed associations should be sought for ecological consultation and specific protection recommendations.

7. Manage 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 Nature Conservancy's Weeds on the Web at <http://tncweeds.ucdavis.edu/>
 - The Virginia Natural Heritage Program's invasive plant page at <http://www.dcr.state.va.us/dnh/invinfo.htm>
 - The Missouri Department of Conservation's Missouri Vegetation Management Manual at <http://www.conservation.state.mo.us/nathis/exotic/vegman/>
 - U.S. Department of the Interior, National Park Service invasive species monitoring resources at: <http://science.nature.nps.gov/im/monitor/invasives.htm> (under construction).
- The following site is a national invasive species information clearinghouse listing numerous other resources on a variety of related topics: <http://www.invasivespecies.gov/>

8. Promote community education.

Educating the public about the environment and its protection is key to meeting the recommendations in this section. Without a sense of involvement and investment in environmental programs, public support will be hard to earn. By making educational resources readily available to the public, sponsoring booths and outreach activities during local community events, and promoting public programs and events about the environment, active public application of these recommendations is promoted.

9. Incorporate CNHI information into planning efforts.

Through internal planning, decision-making related to land-use development, and participation in regional planning initiatives, counties and municipalities could profoundly shape the land and landscapes of Pennsylvania. Natural Heritage Areas can be readily included in comprehensive plans, greenway and open space plans, parks and recreation plans, and regional planning initiatives, which are good examples of planning efforts that reach beyond county boundaries.



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APPENDIX I

Pennsylvania Natural Heritage Program (PNHP)

The Pennsylvania Natural Heritage Program (PNHP) was established in 1982 as a joint effort of the Western Pennsylvania Conservancy, the Pennsylvania Department of Conservation and Natural Resources (formerly the Pennsylvania Department of Environmental Resources), the Bureau of Forestry, and the Pennsylvania Science Office of The Nature Conservancy. PNHP is part of a network of "Natural Heritage Programs" that utilize common methodology developed by The Nature Conservancy and refined through NatureServe – the organization that represents the network of Natural Heritage Programs – and the individual programs themselves. Natural Heritage Programs have been established in each of the 50 United States, as well as in Canada and Latin America.

PNHP collects and stores geographical and baseline ecological information about rare plants, rare animals, unique plant communities, significant habitats, and geologic features in Pennsylvania. Presently, the PNHP database is Pennsylvania's chief storehouse of such information with approximately 9,000 detailed occurrence records that are stored as computer files. Additional data are stored in extensive manual files documenting over 150 natural community types, more than 800 plant and animal species, and about 1100 managed areas. As part of its function, PNHP provides reviews of projects that require permits as issued by the Pennsylvania Department of Environmental Protection. This environmental review function of the PNHP is referred to as the Pennsylvania Natural Diversity Inventory or PNDI.

As part of the information maintained by PNHP, a system of "global ranks" and "state ranks" is used to describe the relative degree of rarity for species and natural communities. This system is especially useful in understanding how imperiled a resource is throughout its range, as well as understanding the state rarity for resources that do not have official state status such as invertebrate animals and natural communities of organisms. A summary of global and state ranks can be found in Appendix V.

PNHP is valuable for its ability to supply technically sound data that can be applied in making natural resource decisions, thereby streamlining the decision making process. Information on the occurrences of elements (species and natural communities) of special concern gathered from museums, universities, colleges, and recent fieldwork by professionals throughout the state is used by PNHP to identify the areas of highest natural integrity and significance in Forest County.



Field Survey Form

Site Description (incl snags, woody debris, scat, etc.):

Wildlife Observations:

Overstory Dominant(s): _____

Understory Dominant(s): _____

Herb Layer Dominant(s): _____

Impacts/Threats: _____

[illegible]

SE = seedling SA = sapling U = understory O = overstory SH = shrub

Site #: _____ Source Code: _____ Date: _____

[illegible]

APPENDIX III

State Endangered Species Categories, Global and State Element Ranks

State legislative acts have provided the authority and means for the designation of endangered, threatened, rare, etc. species lists. Those acts and status summaries follow. However, not all of the species or natural communities considered by conservation biologists (e.g., Pennsylvania Biological Survey) as "special concern resources" are included on the state or federal lists. In this county inventory report, "N" denotes those special concern species that are not officially recognized by state or federal agencies. Therefore: N = No current legal status, but is considered to be of special concern in Pennsylvania, or is under review for such consideration, by conservation biologists. Contact the Pennsylvania Natural Heritage Program for more information.

APPENDIX III_a

Federal Status

All Plants and Animals: Legislative Authority: U.S. Endangered Species Act (1973), U.S. Fish and Wildlife Service, February 21, 1990, Federal Register.

LE = Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.

LT = Listed Threatened - Taxa that are likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges.

PE = Proposed Endangered - Taxa already proposed to be listed as endangered.

PT = Proposed Threatened - Taxa already proposed to be listed as threatened.

{N = No current legal status, but is considered to be of special concern in Pennsylvania, or is under review for such consideration, by conservation biologists. Contact the Pennsylvania Natural Diversity Inventory for more information.}

APPENDIX III_b

Pennsylvania Status

Native Plant Species: Legislative Authority: Title 25 Chapter 82, Conservation of Native Wild Plants, January 1, 1988; Pennsylvania Department of Environmental Resources.

PE = Pennsylvania Endangered - Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that are classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.

PT = Pennsylvania Threatened - Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent their future decline, or if the species is greatly exploited by man.

- PR = Pennsylvania Rare - Plant species which are uncommon within this Commonwealth because they may be found in restricted geographic areas or in low numbers throughout this Commonwealth.
- PX = Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plants may or may not be in existence outside the Commonwealth.
- PV = Pennsylvania Vulnerable - Plant species which are in danger of population decline within this Commonwealth because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.
- TU = Tentatively Undetermined - A classification of plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.

{N = No current legal status, but is considered to be of special concern in Pennsylvania, or is under review for such consideration, by conservation biologists. Contact the Pennsylvania Natural Heritage Program for more information.}

Animals - The following state statuses are used by the Pennsylvania Game Commission (Legislative Authority: Title 34, Chapter 133 pertaining to wild birds and mammals, Game and Wildlife Code, revised Dec. 1, 1990) and by the Pennsylvania Fish and Boat Commission (Legislative Authority: Title 30 Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms, Fish and Boat Code, revised February 9, 1991):

PE = Pennsylvania Endangered

Birds & mammals - Species in imminent danger of extinction or extirpation throughout their range in Pennsylvania if the deleterious factors affecting them continue to operate. These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat is so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherality places them in potential danger of precipitous declines or sudden extirpation throughout their range in Pennsylvania; or 3) species that are classified as "Pennsylvania Extirpated", but which are subsequently found to exist in Pennsylvania as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public Law 93-205 (87 Stat. 884), as amended.

Fish, amphibians, reptiles & aquatic organisms - All species declared by: 1) the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species List published in the Federal Register; or 2) are declared by the Pennsylvania Fish and Boat Commission, Executive Director to be threatened with extinction and appear on the Pennsylvania Endangered Species List published by the Pennsylvania Bulletin.

PT = Pennsylvania Threatened

Birds & mammals - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the casual factors affecting the organism are abated. These are: 1) species whose population within the Commonwealth are decreasing or are heavily depleted by adverse factors and while not actually endangered, are still in critical condition; 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that are

identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public Law 93-205 (87 Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

Fish, amphibians, reptiles & aquatic organisms - All species declared by: 1) the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens, and appear on a Threatened Species List published in the Federal Register; or 2) are declared by the Pennsylvania Fish and Boat Commission Executive Director to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published in the Pennsylvania Bulletin.

{N = No current legal status, but is considered to be of special concern in Pennsylvania, or is under review for such consideration, by conservation biologists. Contact the Pennsylvania Natural Heritage Program for more information.}

Internal Fish and Boat Commission Status Category:

PC = Pennsylvania Candidate - Species that exhibit the potential to become Endangered or Threatened in the future. Pennsylvania populations of these taxa are: 1) "rare" due to their decline, distribution, restricted habitat, etc.; 2) are "at risk" due to aspects of their biology, certain types of human exploitation, or environmental modification; or, 3) are considered "undetermined" because adequate data is not available to assign an accurate status.

This category is unofficial and has no basis in any law (i. e., Chapter 75, Fish and Boat Code), as do the Endangered and Threatened categories.

Invertebrates - Pennsylvania Status: No state agency is assigned to develop regulations to protect terrestrial invertebrates, although a federal status may exist for some species. Aquatic invertebrates are regulated by the Pennsylvania Fish And Boat Commission, but have not been listed to date.

Although no invertebrate species are presently state listed, conservation biologists unofficially assign numerous state status and/or state rank designations. NOTE: Invertebrate species are regularly considered under the U.S. Endangered Species Act for federal status assignments.

APPENDIX III_c

Global and State Ranking

Global and State Ranking is a system utilized by the network of 50 state natural heritage programs in the United States. Although similar to the federal and state status designations, the ranking scheme allows the use of one comparative system to "rank" all species in a relative format. Unlike state or federal status designation guidelines, the heritage ranking procedures are also applied to natural community resources. Global ranks consider the imperilment of a species or community throughout its range, while state ranks provide the same assessment within each state. Although there is only one global rank used by the heritage network, state ranks are developed by each state and allow a "one-system" comparison of a species or communities imperilment state by state. For more information, contact the Pennsylvania Natural Heritage Program.

Global Element Ranks

- G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
- G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (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.
- G? = Not ranked to date.

State Element Ranks

- S1 = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation from the state.
- S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).
- S4 = Apparently secure in state, with many occurrences.
- S5 = Demonstrably secure in state and essentially ineradicable under present conditions.
- SA = Accidental (occurring only once or a few times) or casual (occurring more regularly But not every year) in state, including species which only sporadically breed in the state.
- SE = An exotic established in state; may be native elsewhere in North America (e.g., house finch or catalpa in eastern states).

SH = Of historical occurrence in the state, perhaps having not been verified in the past 20 years, and suspected to be still extant.

SN = Regularly occurring, usually migratory and typically nonbreeding species for which no significant or effective habitat conservation measures can be taken in the state.

SR = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SU = Possibly in peril in state but status uncertain; need more information.

SX = Apparently extirpated from the state.

SZ= Not of significant conservation concern in the state, invariably because there are no (zero) definable element occurrences in the state, although the taxon is native and appears regularly in the state.

S? = Not ranked to date.

NOTE: The study of naturally occurring biological communities is complex and natural community classification is unresolved both regionally and within Pennsylvania. The Global and State Ranking of natural communities also remains difficult and incomplete. Although many natural community types are clearly identifiable and are ranked, others are still under review and appear as G? and/or S?

APPENDIX IV

Classification of Natural Communities in Pennsylvania

The status of natural community classification in Pennsylvania:

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

Community Ranks

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

FIKE 1999 TYPES

COMMUNITY NAME	GLOBAL RANK	STATE RANK
TERRESTRIAL FORESTS:		
Hemlock (white pine) forest	G5	S4
Serpentine pitch pine – oak forest	G2	S1
Serpentine Virginia pine – oak forest	G2	S1
Pitch Pine – mixed oak forest	G?	S4
Virginia pine – mixed hardwood forest	G?	S5
Dry white pine (hemlock) – oak forest	G?	S4
Hemlock (white pine) – northern hardwood forest	G?	S5
Hemlock (white pine) – red oak – mixed hardwood forest	G?	S4
Hemlock – tuliptree – birch forest	G?	S4
Rich hemlock – mesic hardwoods forest	G?	S2S3
Dry oak –heath forest	G?	S4S5
Dry oak – mixed hardwood forest	G?	S3
Red oak – mixed hardwood forest	G?	S5
Northern hardwood forest	G?	S4

COMMUNITY NAME	GLOBAL RANK	STATE RANK
<i>TERRESTRIAL FORESTS (con't.):</i>		
Black cherry – northern hardwood forest	G?	S4
Tuliptree – beech – maple forest	G?	S4
Sugar maple – basswood forest	G?	S4
Mixed mesophytic forest	G?	S1S2
Sweet gum – oak coastal plain forest	G?	S1
Red maple (terrestrial) forest	G?	S5
Black-gum ridgetop forest	G?	S3
Aspen/gray (paper) birch forest	G?	S?
Black locust forest	G?	SW
<i>PALUSTRINE FORESTS:</i>		
Black Spruce- tamarack peatland forest	G?	S3
Red Spruce palustrine forest	G?	S3
Hemlock palustrine forest	G5	S3
Hemlock – mixed hardwood palustrine forest	G?	S3S4
Red spruce – mixed hardwood palustrine forest	G?	S3
Bottomland oak – hardwood palustrine forest	G5	S2
Red maple – black-gum palustrine forest	G5	S3S4
Red maple – black ash palustrine forest	G?	S2S3
Red maple – magnolia Coastal Plain palustrine forest	G?	S1
Great Lakes Region lakeplain palustrine forest	G?	S1
Sycamore – (river birch)- box elder floodplain forest	G?	S3
Silver maple floodplain forest	G?	S3
Red maple – elm – willow floodplain swamp	G?	S2
<i>TERRESTRIAL WOODLANDS:</i>		
Pitch pine – heath woodland	G4	S2
Pitch pine – scrub oak woodland	G4	S2
Red spruce rocky summit	G?	S1
Pitch pine – rhodora – scrub oak woodland	G?	S1
Pitch pine – mixed hardwood woodland	G4	S2S3
Virginia pine – mixed hardwood shale woodland	G?	S2
Red-cedar – mixed hardwood rich shale woodland	G?	S1S2
Dry oak – heath woodland	G4	S3
Birch (black-gum) rocky slope woodland	G?	S2
Yellow oak – redbud woodland	G?	S2
Great Lakes Region scarp woodland	G?	S1S2
Great Lakes Region bayberry – cottonwood community	G?	S1
<i>PALUSTRINE WOODLANDS:</i>		
Pitch pine – leatherleaf woodland	G?	S2
Black spruce – tamarack palustrine woodland	G?	S2
Red spruce palustrine woodland	G?	S2S3
Red maple – highbush blueberry palustrine woodland	G5	S4
Red maple – sedge palustrine woodland	G5	S4
Red maple – mixed shrub palustrine woodland	G?	S4

COMMUNITY NAME	GLOBAL RANK	STATE RANK
<i>TERRESTRIAL SHRUBLANDS:</i>		
Red-cedar – prickly pear shale shrubland	G?	S2
Red-cedar – pine serpentine shrubland	G2	S1
Red-cedar – redbud shrubland	G?	S2
Low heath shrubland	G4	S1
Low heath – mountain ash shrubland	G?	S2
Scrub oak shrubland	G4	S3
Rhodora – mixed heath – scrub oak shrubland	G?	S1
<i>PALUSTRINE SHRUBLANDS:</i>		
Buttonbush wetland	G?	S4
Alder – ninebark wetland	G?	S3
Alder – sphagnum wetland	G5	S4
Highbush blueberry – meadow-sweet wetland	G5	S5
Highbush blueberry – sphagnum wetland	G?	S5
Leatherleaf – sedge wetland	G?	S3
Leatherleaf – bog rosemary	G?	S2
Leatherleaf – cranberry peatland	G?	S2S3
Water-willow (<i>Decodon verticillatus</i>) shrub wetland	G?	S3
River birch – sycamore floodplain scrub	G?	S4
Poison sumac – red-cedar – bayberry fen	G2	S1
Buckthorn – sedge (<i>Carex interior</i>) – golden ragwort fen	G2G3	S1
Great Lakes Region scarp seep	G?	S1
Great Lakes Region bayberry – mixed shrub palustrine shrubland	G?	S1
<i>TERRESTRIAL HERBACEOUS OPENINGS:</i>		
Side-oats gramma calcareous grassland	G2	S1
Calcareous opening/cliff	G?	S2
Serpentine grassland	G?	S1
Serpentine gravel forb community	G?	S1
Great Lakes Region dry sandplain	G?	S1
<i>HERBACEOUS WETLANDS:</i>		
Bluejoint – reed canary grass marsh	G?	S5
Cat-tail marsh	G?	S5
Tussock sedge marsh	G?	S3
Mixed forb marsh	G3G4	S3
Herbaceous vernal pond	G?	S3S4
Wet meadow	G?	S5
Bulrush marsh	G?	S3
Great Lakes Region palustrine sandplain	G?	S1
Prairie sedge – spotted joe – pye – weed marsh	G?	S1S2
Open sedge (<i>Carex stricta</i> , <i>C. prairea</i> , <i>C. lacustris</i>) fen	G?	S1
Golden Saxifrage – sedge rich seep	G?	S2
Skunk cabbage – golden saxifrage forest seep	G?	S4S5
Serpentine seepage wetland	G?	S1
Golden saxifrage – Pennsylvania bitter-cress spring run	G?	S3S4
Sphagnum – beaked rush peatland	G?	S3
Many fruited sedge – bladderwort peatland	G?	S2
Water-willow (<i>Justicia americana</i>) – smartweed riverbed community	G?	S4
Riverside ice scour community	G?	S1S2

COMMUNITY NAME	GLOBAL RANK	STATE RANK
<i>HERBACEOUS WETLANDS (con't.):</i>		
Big bluestem – Indian grass river grassland	G?	S3
Pickernel-weed – arrow-arum – arrowhead wetland	G3G4	S4
Spatterdock – water lily wetland	G?	S4

COMMUNITY COMPLEXES: Complexes not ranked

Acidic Glacial Peatland Complex
Great Lakes Region Scarp Complex
Erie Lakeshore Beach-Dune-Sandplain Complex
Mesic Till Barrens Complex
Serpentine Barrens Complex
Ridgetop Acidic Barrens Complex
River Bed-Bank-Floodplain Complex

SMITH 1991 TYPES

COMMUNITY NAME	GLOBAL RANK	STATE RANK
<i>SUBTERRANEAN COMMUNITIES:</i>		
Solution Cave Terrestrial Community	G?	S3
Solution Cave Aquatic Community	G?	S3
Tectonic Cave Community	G?	S3S4
Talus Cave Community	G?	S2S4
<i>DISTURBED COMMUNITIES:</i>		
Bare Soil	G?	S?
Meadow/Pastureland	G?	S?
Cultivated Land	G?	S?
Successional Field	G?	S?
Young Miscellaneous Forest	G?	S?
Conifer Plantation	G?	S?
<i>ESTUARINE COMMUNITIES:</i>		
Deepwater Subtidal Community	G?	S1
Shallow-Water Subtidal Community	G?	S1
Freshwater Intertidal Mudflat	G3G4	S1
Freshwater Intertidal Marsh	G3G4	S1
<i>RIVERINE COMMUNITIES:</i>		
Low-Gradient Ephemeral/Intermittent Creek	G?	S5
Low-Gradient Clearwater Creek	G?	S3S4
Low-Gradient Clearwater River	G?	S2S3
Low-Gradient Brownwater Creek	G?	S2S3
Medium-Gradient Ephemeral/Intermittent Creek	G?	S5
Medium-Gradient Clearwater Creek	G?	S3

COMMUNITY NAME	GLOBAL RANK	STATE RANK
<i>RIVERINE COMMUNITIES (CON'T):</i>		
Medium-Gradient Clearwater River	G?	S?
Medium-Gradient Brownwater Creek	G?	S3
High-Gradient Ephemeral /Intermittent Creek	G?	S5
High-Gradient Clearwater Creek	G?	S3
High-Gradient Clearwater River	G?	S?
High-Gradient Brownwater Creek	G?	S?
Waterfall and Plungepool	G?	S3S4
Spring Community	G?	S1S2
Spring Run Community	G?	S1S2
<i>LACUSTRINE COMMUNITIES:</i>		
Glacial Lake	G?	S1
Nonglacial Lake	G?	S2
Artificial Lake	---	---
Natural Pond	G?	S2S3
Artificial Pond	---	---
Stable Natural Pool	G?	S?
Ephemeral/Fluctuating Natural Pool	G?	S1
Artificial Pool	---	---
Ephemeral/Fluctuating Limestone Sinkhole	G?	S1

APPENDIX V

Sources of Information on County Occurrences of Plant and Animal Species

Currently, there exists no all-inclusive list of species occurring within Pennsylvania. Below is a list of sources of species including information on county occurrences.

Amphibians and Reptiles:

The Pennsylvania Online Herpetological Atlas, available online: <http://webspace.ship.edu/tjmare/resources.htm>.

Hulse, A. C., C.J. McCoy, and E. J. Censky. 2001. *Amphibians and Reptiles of Pennsylvania and the Northeast*. Cornell University Press, Ithaca, NY. 419 p.

Birds:

Brauning, D.W. (editor). 1992. *Atlas of Breeding Birds in Pennsylvania*. University of Pittsburgh Press, Pittsburgh. 484 p. Available online: http://www.carnegiemnh.org/atlas/about_book.htm.

Insects:

Pennsylvania Aquatic Insects (primarily flies), available online:
<http://paaquaticfliesrus.bd.psu.edu/webroot/index.asp>

List of Butterflies of Pennsylvania, available online:
<http://www.thebutterflysite.com/pennsylvania-butterflies.shtml>

Dragonflies and Damselflies (Odonata) of the United States, Odonata of Pennsylvania, available online:
<http://www.npwrc.usgs.gov/resource/distr/insects/dfly/pa/toc.htm>

Mammals:

Merritt, J. F. 1987. *Guide to the Mammals of Pennsylvania*. University of Pittsburgh Press, Pittsburgh, PA. 408 p.

Plants:

Rhoads, A. F. and W. M. Klein, Jr. 1993. *The vascular flora of Pennsylvania: an annotated checklist and atlas*. American Philosophical Society Memoirs Vol. 207. 636 p.
Also available online: <http://www.paflora.org/>

Museum collections are an excellent source of species occurrence information. The collections are typically organized by taxonomic group into separate departments or sections within the museum.

Academy of Natural Sciences of Philadelphia
1900 Benjamin Franklin Parkway
Philadelphia, PA 19103
(215) 299-1000
<http://www.anasp.org/research/biodiv/index.php>

Carnegie Museum of Natural History
4400 Forbes Avenue
Pittsburgh, PA 15213
(412) 622-3131
<http://www.carnegiemnh.org/research/index.html>

The State Museum of Pennsylvania
300 North Street
Harrisburg, PA 17120
(717) 787-4980
<http://www.statemuseumpa.org/home.html>

The Cleveland Museum of Natural History
1 Wade Oval Drive, University Circle
Cleveland OH 44106-1767
(800) 317-9155
http://www.cmnh.org/site/conservation_BiologicalCollections.aspx

In addition, a significant collection of Pennsylvania bryophytes (mosses, liverworts, & hornworts) is located at the Missouri Botanical Garden. The New York Botanical Garden has a large collection of Pennsylvania fungi.

Universities with significant collections of western Pennsylvania species:

The Pennsylvania State University
Biology Department
208 Mueller Lab
University Park, PA 16802
(814) 863-0278
<http://www.bio.psu.edu/home/>

Youngstown State University
Department of Biological Sciences, Ward Beecher Hall
One University Plaza
Youngstown, OH 44555
(330) 941-3601
<http://www.as.ysu.edu/~biology/>

APPENDIX VI

Sustainable Forestry Information Sources

The **Pennsylvania Forest Stewardship Program** is a voluntary program that assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. Participation in the program is open to private landowners who own between 5 and 1,000 acres of forestland. For more information, go to <http://www.cas.psu.edu/docs/casdept/forest/stewardship/1page.html> or contact:

Jim Finley, Assistant Director for Extension
The Pennsylvania State University
School of Forest Resources
7 Ferguson Building
University Park, PA 16802
(814) 863-0401
E-mail: fj4@psu.edu

The **Forest Land Enhancement Program** complements the Forest Stewardship Program by providing landowners with cost-share dollars to implement their management plans and follow-up technical assistance to encourage the achievement of their long-term forest management goals. For more information, contact:

Jim Stiehler, Forest Stewardship Coordinator
DCNR - Bureau of Forestry
137 Penn Nursery Rd.
Spring Mills, PA 16875
(814) 364-5157
E-mail: jstiehler@state.pa.us

The **Forest Legacy Program** acts to purchase conservation easements or title from willing private landowners. In this program, federal funding is administered through the state Bureau of Forestry to foster protection and continued use of forested lands that are threatened with conversion to non-forest uses. Emphasis is given to lands of regional or national significance. For more information, go to <http://www.fs.fed.us/spf/coop/programs/loa/flep.shtml> or contact:

Gene Odato, Chief, Rural & Community Forestry Station
DCNR – Bureau of Forestry
6th Floor, Rachel Carson State Office Building
P.O. Box 8552
Harrisburg, PA 17105-8552
(717) 787-6460
E-mail: godato@state.pa.us

The **Sustainable Forestry Initiative** (SFI) program is a voluntary, industry-driven effort developed to ensure that future generations will have the same abundant, healthy, and productive resources we enjoy today. Created in 1995 by the American Forest and Paper Association (the national trade organization representing the United States forest products industry), SFI is a program of comprehensive forestry and conservation practices. Through the SFI of PA program, landowners receive the information they need to enhance their ability to make good forest management decisions, and loggers learn safer, more productive skills and proper environmental practices. For more information, go to <http://www.sfiofpa.org/> or contact:

SFI® of PA
315 S. Allen Street, Suite 418
State College, PA 16801
(814) 867-9299 or (888) 734-9366
E-mail: sfi@penn.com

Forest Landowner Associations provide information and educational programs to help members better manage their forest resources. Currently, there are no such organizations within Forest County, but several adjoining counties do have forest landowner associations. For more information, contact:

Clarion County Forest Stewardship Council
PO Box 200
Shippensburg, PA 16254

North Central Forest Landowners Association
(Cameron, Elk, McKean, and Potter Counties)
PO Box 141
Port Allegany, PA 16743

The **Forest Stewardship Volunteer Initiative Project** has an excellent web site providing general information and links to publications on sustainable forestry. Available online: <http://vip.cas.psu.edu/index.html>.

Forest Certification Program Information

Forest certification programs are important tools in safeguarding the long-term ecological health of forest resources. These programs develop a set of criteria for sustainable forest management, and offer accreditation to forest managers and producers of forest products if they demonstrate that their operations are consistent with the standards. The companies can then market their products with the stamp of the certification agency. The Forest Stewardship Council (FSC; <http://www.fsc.org/>), an international stakeholder-owned network dedicated to promoting responsible management of the world's forests, offers a comprehensive certification program. Because the program's growing popularity is leading to requests for ecological information, and because there is a great deal of convergence between the regional FSC standards and the information provided in the Natural Heritage Inventory (NHI), we offer the following comparison of NHI information and FSC standards to facilitate the use of the NHI report as a tool in certification. FSC standards are developed individually by region by a local working group; Pennsylvania falls within the Appalachian Region.

The NHI report information is most applicable to principles 6, 7, and 9 of the FSC's Appalachian Regional Working Group standards (AWG-FSC 2005).

Principle 6: Environmental Impact

6.1 Assessment of environmental impacts:

The NHI report provides the following relevant information:

- Sites hosting Vulnerable, Imperiled, and Critically Imperiled Plant Community Types (G1-G3, S1-S3 according to NatureServe and Natural Heritage Databases).
- Threatened and Endangered species according to state and federal listings, as well as species ranked G1-G3 and S1-S3 according to NatureServe and Natural Heritage Databases
- The LCA, IBA and IMA designations are a resource to assess landscape-level ecological impacts.

6.2 Safeguards for unique species & their habitats.

The NHI report identifies the habitat requirements of species meeting the above-listed criteria through the Biological Diversity Area designations, and recommendations regarding the compatibility of some forest management operations in these habitats are included. The report does not identify connectivity needs between populations.

6.4 Protection of representative samples of existing ecosystems

The BDAs and the natural communities described in the NHI report are a good reference for identifying representative samples of existing ecosystems. The report also provides context for understanding the conservation significance of these ecosystems. However, as the report focuses only on those sites of highest conservation concern in the county, it is not a comprehensive listing of all existing ecosystem types.

Principle 7: Management Plan

The information contain in the NHI report can serve as baseline ecological data for use in developing a management plan.

Principle 9: High Conservation Value Forests

The criteria recommended for the identification of High Conservation Value Forests (HCVF) are identical to the criteria used to identify Conservation Areas in the NHI report, with one exception. The FSC standards include roadless areas of 500 acres or greater as High Conservation Value Forests, while such areas receive no NHI designation.