

A NATURAL HERITAGE INVENTORY OF PHILADELPHIA COUNTY, PENNSYLVANIA

December 2008





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Submitted to:

City of Philadelphia

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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.

PREFACE

The Philadelphia County Natural Heritage Inventory is a document compiled and written by the Pennsylvania Natural Heritage Program (PNHP) of the Western Pennsylvania Conservancy (WPC). It contains information on the general locations of rare, threatened, and endangered species, of the highest quality natural areas in the county, and area in need of restoration to native habitat. It is not an inventory of all open space and is based on the best available information. It is intended as a conservation tool and should in no way be treated or used as a field guide.

Accompanying each site description are general management and restoration recommendations that would help to ensure the protection and continued existence of these natural communities, rare plants, and animals and enhance the quality of existing greenspace and open space. The recommendations are based on the biological needs of these elements (communities and species) and the efforts necessary to maintain the health of the natural system in general. The recommendations are strictly those of the Western Pennsylvania Conservancy and do not necessarily reflect the policies of the state or the policies of the City of Philadelphia, for which the report was prepared.

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

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

Although an attempt was made through meetings, research, and informal communications to locate the sites most important to the conservation of biodiversity within the county, it is likely that some things were missed. Anyone with information on sites that may have been overlooked or the location of species of concern should contact the responsible agency (see Executive Summary page ix).

The results presented in this report represent a snapshot in time, highlighting the sensitive natural areas within Philadelphia and areas with a high potential for ecological restoration. The sites in the Philadelphia County Natural Heritage Inventory have been identified to help guide wise land use and county planning. The Philadelphia County Natural Heritage Inventory is a planning tool, but is *not* meant to be used as a substitute for environmental review, since information is constantly being updated as natural resources are both destroyed and discovered. Applicants for building permits and Planning Commissions should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted via a link on 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

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

The report benefited from the help of local naturalists, conservationists, and institutions who gave generously of their time. Thanks to all the help and support given by:

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Sincerely,
Andrew Strassman
Pennsylvania Natural Heritage Program

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

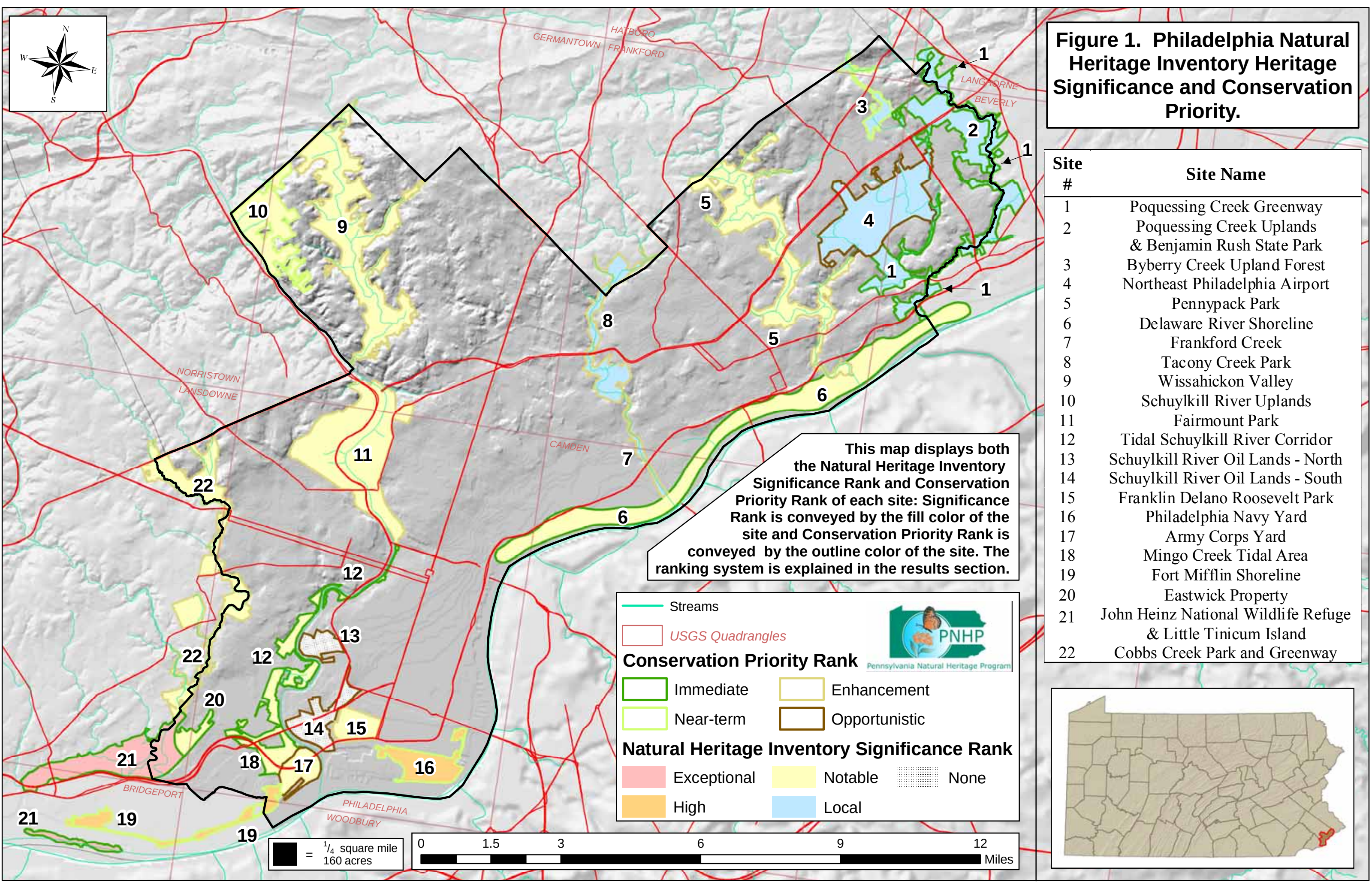


Table 1.

Alphabetical Site Index Numbered Roughly Northeast to Southwest.

Site #	Site Name	USGS Quadrangle(s)	Conservation Priority*	Natural Heritage Significance*	Page #
17	Army Corps Yard	Philadelphia	Opportunistic	Notable	90
3	Byberry Creek Upland Forest	Hatboro, Frankford	Near-term	Local	116
22	Cobbs Creek Park and Greenway	Lansdowne, Philadelphia	Enhancement	Notable	67
6	Delaware River Shoreline	Beverly, Camden, Frankford, Philadelphia,	Immediate	Notable	133
20	Eastwick Property	Lansdowne, Philadelphia	Immediate	Notable	82
11	Fairmount Park	Germantown, Philadelphia	Enhancement	Notable	68
19	Fort Mifflin Shoreline	Bridgeport, Philadelphia, Woodbury	Near-term	High	86
7	Frankford Creek	Camden, Frankford	Enhancement	Local	128
15	Franklin Delano Roosevelt Park	Philadelphia	Enhancement	Notable	69
21	John Heinz National Wildlife Refuge & Little Tinicum Island	Bridgeport, Lansdowne	Immediate	Exceptional	76
18	Mingo Creek Tidal Area	Philadelphia	Immediate	Notable	94
4	Northeast Philadelphia Airport	Beverly, Frankford	Opportunistic	Local	124
5	Pennypack Park	Frankford	Enhancement	Notable	69
16	Philadelphia Navy Yard	Philadelphia	Near-term	High	98
1	Poquessing Creek Greenway	Beverly, Frankford, Langhorne,	Immediate	Local	70
2	Poquessing Creek Uplands & Benjamin Rush State Park	Beverly, Frankford	Immediate	Local	120
13	Schuylkill River Oil Lands - North	Philadelphia	Opportunistic	None	102
14	Schuylkill River Oil Lands - South	Philadelphia	Opportunistic	None	102
10	Schuylkill River Uplands	Germantown, Norristown	Near-term	Notable	112
8	Tacony Creek Park	Frankford	Enhancement	Local	72
12	Tidal Schuylkill River Corridor	Philadelphia	Immediate	Notable	107
9	Wissahickon Valley	Germantown	Enhancement	Notable	72

*For an explanation of ranking see method section page 47

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Introduction

Although urban landscapes have drastically altered their natural settings, nature and natural processes abound within even highly developed urban areas. Within Philadelphia these processes are exemplified by the bald eagles nesting downtown, the millions of American shad migrating through the Delaware and Schuylkill Rivers each spring northward to their breeding habitat, and the white-tailed deer browsing shrubs in people's backyards. These events, rather than accidents or rare occurrences, are an active part of a functioning landscape where the cityscape and the wildlands not only meet, but integrate.

With actions to reduce pollution and better stewardship of natural resources, these interactions will occur within the city on a more frequent basis, though there are actions that can be taken to encourage them to occur in a regular and sustainable manner and in a pattern compatible with urban life. Through changes in how Philadelphia and its residents perceive development, open space, and greenspace the cycle of re-development within the city can produce areas that meet not only the need for a revitalized cityscape, but the need for integrated wildlands too. GreenPlan Philadelphia (available at www.greenplanphiladelphia.com), through a series of targets and recommendations, will provide the city with the framework to make some of these changes and to help accomplish some of the recommendations provided in this document.

History

Philadelphia occupies land that has hosted European settlements since the early 1600's, and Native American tribes long before then. Starting with small farmsteads along the tidal marshes of the Delaware River, Pennsylvania came into existence with William Penn's charter in 1681. Shortly afterwards, William Penn instructed the formation of the town of Philadelphia with these orders to his commissioners:

"Let every house be placed, if the person pleases, in the middle of its plat, as to the breadthway of it, so that there may be ground on each side for gardens or orchards, or fields, that

it may be a greene country towne, which will never be burnt & always wholesome."

William Penn's Instructions to his Commissioners, September 30th, 1681

This vision was short lived as the reality of economic and social needs superseded Penn's idea of an agrarian utopia. By the time Benjamin Franklin arrived in Philadelphia in 1723, a mere 42 years after Penn's instructions, the town was already a bustling center of trade in the new world and one of the largest cities in North America.

During the past three centuries the natural landscape of Philadelphia has been heavily modified by human use. Starting as a landscape of sweeping tidal marshes along the Schuylkill and Delaware Rivers that marched up to the start of Penn's Woods, early colonists transformed this into an agricultural landscape of small farmsteads and woodlots. As Philadelphia's population and economy grew, factories, warehouses, a port, and the infrastructure to support them (such as roads, dams, and houses) arose around the point of Penn's Landing and the agricultural fields (and forests) were pushed further away. As the population grew and technology progressed, the marshes were filled and the rivers were walled in and straightened.

Today little of this original natural landscape remains within the borders of the City of Philadelphia. As incorporated in the 1854 Act of Consolidation, the City of Philadelphia covers approximately 170 square-miles. Within that area is approximately 13 square-miles of parkland managed by the Fairmount Park System of which 7.5 square-miles is managed as natural area. This park system, while one of the most extensive of any city in the nation, offers challenges to maintaining natural diversity in a highly-developed fully urban setting.

Overview

As part of the Philadelphia City Planning Commission's initiative, *Imagine Philadelphia: Laying the Foundation*, GreenPlan Philadelphia aims to assess the City's needs to establish ecologically sustainable infrastructure in respect to the future vision Philadelphia's residents have of their city. An important aspect of GreenPlan

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Philadelphia is an up-to-date inventory of their existing and *potential* ecological resources.

Because of the degree of development within Philadelphia, the existing natural resources have been well documented. This includes recent work by the Fairmount Park Commission, the Philadelphia Water Department, and the Academy of Natural Sciences to survey the city's parklands. In an effort not to duplicate work already conducted, the Pennsylvania Natural Heritage Program (PNHP) conducted surveys on public and private lands not included in the original Fairmount Park master plan and on lands not currently managed as parks. This generally includes brownfields, lands owned by other city agencies or agents of the city, and private lands where we secured access permission.

Our survey efforts primarily focused on the discovery of new populations of plants and animals considered rare, threatened, or endangered within the Commonwealth. When these species were found we documented the occurrence and noted the conditions they were growing under. Often, we found no species of concern, but did create a description of the current site conditions for use in site descriptions and restoration recommendations sections in the final report.

Overall, twenty-nine sites totaling approximately 3,000 acres of land were identified in 2007; only the most promising areas were surveyed within the sites. For each of these sites we include a general description of the current habitat, any rare species found there, conservation recommendation for the rare species present, and restoration recommendations to increase the natural habitat value.

Methods

Sixty of sixty-seven county inventories have been completed in Pennsylvania to date. The Philadelphia Natural Heritage Inventory followed similar methodologies as previous inventories, which are conducted in the following stages:

Information Gathering

A review of various databases determined where locations for special concern species and important

natural communities were known to exist in Philadelphia. Knowledgeable individuals were consulted concerning the occurrence of rare plants and unique natural communities in the county. Geologic maps, United States Geological Survey (USGS) topographical maps, National Wetlands Inventory maps, recent aerial imagery, and other published materials were also used to identify areas of potential ecological significance.

Field Work

Areas identified as potential inventory sites were scheduled for ground surveys. After obtaining permission from landowners, sites were examined to evaluate the condition and quality of the habitat and to classify the communities present. The flora, fauna, level of disturbance, approximate age of any natural community, and local threats were among the 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 2007 and 2008 field seasons was combined with prior existing data and summarized. All sites with species or communities of statewide concern, as well as sites with a high restoration potential will be mapped and described. The boundaries defining each site will be based on physical and ecological factors, and specifications for species protection provided by government jurisdictional agencies.

Results

During the 2007 and 2008 field seasons PNHP staff and contracted experts conducted surveys around Philadelphia (Fig. 1, pg. v, Table 1, pg. vii). Over this time approximately 52 person days of fieldwork were conducted in Philadelphia at 20 distinct locations. New occurrences of rare, threatened, and endangered species were found during these surveys with these finds concentrated along the tidal areas of the Delaware and Schuylkill Rivers. Among the high points was the confirmation of a species known only from historic records; this species, Needham's skimmer dragonfly (*Libellula needhami*), was found along the Delaware River shoreline.

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Additionally, our surveys indicate that restoration efforts within the tidal area have a high potential for success given the abundant local seed sources in the John Heinz National Wildlife Refuge and along the New Jersey shoreline. This is evident through the tidal wetland restoration project at Pennypack on the Delaware Park where the wetland and upland support several Pennsylvania species of concern.

However, our surveys found that non-native invasive species may be the greatest threat to natural areas within Philadelphia and the greatest impediment to natural-land restoration projects. These species have taken over extensive areas of Philadelphia displacing the native plants and the animals they support, decreasing the overall ecological (native) diversity and values.

Other issues affecting the habitat value of several of the sites we visited are illegal dumping of garbage, construction materials, and abandoned cars, and ATV use within the sites. These actions have caused moderate to extensive damage at several sites and will need to be mitigated through enforcement of existing ordinances.

General Conservation Recommendations

Philadelphia has a number of groups and institutions pursuing the protection and restoration of natural areas within the city. The following are general recommendations for protecting the biological health of the City of Philadelphia.

1. Consider conservation initiatives and tools for natural areas on private land
2. Orient management and restoration plans to address species of special concern and natural communities as targets of conservation (not simply open or multi-use space) through the active maintenance of existing high quality natural area and restoration of more degraded spaces
3. Protect bodies of water with adequate natural buffers
4. Provide for buffers around natural areas
5. Increase the connectivity of the city's green space with surrounding landscapes
6. Encourage and utilize existing grassroots organizations interested in preserving and restoring the city's natural areas

7. Manage for control of known invasive species and early detection of new invasive species in key natural area
8. Promote community education on the importance of ecological health in urban environments
9. Incorporate Natural Heritage Inventory information into city planning efforts

Discussion and County-specific Recommendations

Plan for biodiversity and ecological health:

Provisioning for the future health of ecological resources in Philadelphia will require action on many fronts. Special consideration should be given to steward specific sites that host unique species and communities. Broad-scale planning efforts should endeavor to create contiguity of natural habitats. Restoration efforts to alleviate water pollution and restore ecological function to damaged landscapes and waterways should be undertaken with special attention given to riparian and tidal habitat restoration.

Two problems needing special attention within Philadelphia are the prevalence of non-native invasive species and white-tailed deer. These problems are interrelated in that deer prefer to eat native plants and thus promote the spread of non-native plant species. Without active, coordinated, and targeted control of deer and non-native plant species followed by restoration and maintenance of reestablished native species the existing natural areas within the city will continue to deteriorate. While daunting, this can be achieved by the use of deer fences and control programs and the encouragement and mobilization of private citizens and public groups. Facilitating "weed warriors" groups within the city and providing for the replanting of native species in maintained areas will work towards the goal of preserving the biological health of the landscape.

Wetland/Aquatic Communities: Philadelphia's aquatic systems have undergone substantial modification over the past 300 years. Once supporting extensive lowland and floodplain forests and 10 to 20 square-miles of tidal marsh, today many of the rivers are confined by armored banks,

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have extensively urbanized headwaters, and less than ¼ square-mile of tidal marsh remains within the city proper. To restore water quality within the city these issues need to be addressed through large-scale planning initiatives. This can occur through reconnecting the 100-year floodplain to rivers and creeks throughout the city, actively restoring the tidal marsh on the Delaware and Schuylkill Rivers, and initiating a concerted effort to reduce combined sewage outflows and stormwater discharge.

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

One suggested project to meet these goals would be establishing a public greenway along the Delaware and Schuylkill Rivers that incorporates reconnection of the floodplain and reestablishment of tidal marsh as a component. This would create a green corridor along the city's shore in a flood-prone area and act as a connector between the existing parks along the Pennypack, Wissahickon, and Frankford Creeks with potential connection to Poquessing Creek and eventually Neshaminy State Park.

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

In areas where these connections have been severed “reforestation” activities can help to restore contiguous, usable habitat. In conjunction with the reforestation

of riparian areas within Philadelphia through projects such as Treevitalize, reconnection of upland forests can be achieved. Projects to replant native trees along streets lacking tree cover and in areas of under- and unutilized land can quickly increase tree cover within Philadelphia. Planting projects provide not only the benefits of reducing the urban “heat island” effect, but act as natural habitat stepping stones through the urban environment.

Evaluating proposed activity within sites: A very important part of encouraging conservation of the sites identified within the Philadelphia Natural Heritage Inventory is the careful review of proposed land use changes or development activities that overlap with or abut Natural Heritage Areas. This is especially important when examining the large areas of open land along the Schuylkill and Delaware Rivers. These flood-prone areas are affectively within the river during times of flooding and should be consider unfit for major building projects. Conversion of these areas, especially the portions within the 100-year floodplain, to greenspace should be a priority as the redevelopment of Philadelphia's waterfront is undertaken. The following overview should provide guidance in the review of these projects or activities.

- Always contact the Philadelphia City Planning Commission.

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

- Conduct free online preliminary environmental reviews

Applicants for building permits should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the Pennsylvania Natural Heritage Program's website, at <http://www.naturalheritage.state.pa.us/>. If conflicts

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are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources.

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

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

PNHP and agency biologists can provide more detailed information with regard to the location of natural resources of concern in a project area when this information is available for public distribution, the needs of the particular resources in question, and the potential impacts of the project on those resources.

• Plan ahead

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

butterfly), a survey may need to be scheduled for a particular time of year.

• Work to minimize environmental degradation

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

Conclusion

Philadelphia's natural landscape is fragmented and degraded by three centuries of urban development, but maintains aspects of the original pre-settlement habitats. As the City of Philadelphia moves forward with urban infill plans and redevelopment of abandoned industrial areas, greenspace and natural areas should be a serious consideration. Significant and substantial opportunities exist for the fortification of rare species populations, the restoration of native habitat, and the reconnection of isolated patches of existing native habitat to form contiguous corridors of green space throughout the city. These green spaces can help expand the already impressive public park system into areas underserved by these amenities to help make Philadelphia a more attractive place to live and work. However, these opportunities are transient at best and if they are not utilized now the vision of William Penn for his City of Philadelphia will fade further into the past. GreenPlan Philadelphia offers the opportunity to establish a framework for ecologically sustainable infrastructure development with the Philadelphia Natural Heritage Inventory providing a roadmap to the areas of greatest ecological potential.

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Table 2.

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

Site #	Site Name USGS Quadrangle(s)	Description	Pages
Exceptional Significance Sites			
21	John Heinz National Wildlife Refuge & Little Tinicum Island Bridgeport, Lansdowne	The Tinicum Marsh system hosts a suite of species found only along the tidal Delaware River in Pennsylvania. These species are limited to the marsh and a few nearby locations because this is the limit of tidal influence within the Commonwealth. These species break out into four general groups: plants with fifteen listed species; birds with nine listed species, herptiles with three listed species and two listed communities.	76
High Significance Sites			
19	Fort Mifflin Shoreline Bridgeport, Philadelphia, Woodbury	Fort Mifflin and the surrounding shoreline remain biologically important because they maintain aspects of the original tidal marsh that composed the area. These tidally influenced areas dot the shoreline from the fort downriver to the mouth of Darby Creek and include seven plant, two insect, and one bird species of concern along with one community of concern. Additionally, the Delaware River adjacent to this site hosts extensive beds of floating aquatic vegetation.	86
16	Philadelphia Navy Yard Philadelphia	Large areas of the Navy Yard were reverting to natural cover opening them up to colonization by grassland species with the lower, wetter areas supporting wetland species. The site supports 72 native plant species with an additional 46 non-native plant species recorded at the site. Of these plant species five are listed as species of concern in the Commonwealth. An additional two bird species of concern are found utilizing the Navy Yard.	98
Notable Significance Sites			
17	Army Corps Yard Philadelphia	This site provides excellent hunting habitat for adult dragonflies and damselflies with two species of concern noted at the site feeding on the extensive aggregation of insects over the ponds. One of the local peregrine falcons (<i>Falco peregrinus</i>) has also been observed feeding at this location. It seems likely that these species of concern are reproducing surrounding landscape and simply refueling and maturing here.	90
22	Cobbs Creek Greenway Lansdowne, Philadelphia	This site supports several different populations of a single species of concern, elephant's foot (<i>Elephantopus carolinianus</i>). This plant, typically found much further south in the United States, is found in a few of the southern counties of the Commonwealth.	67
6	Delaware River Shoreline Beverly, Camden, Frankford, Philadelphia	This extensive site along the Delaware River shoreline is tidally influenced along its length and has the ability to support tidal species of concern throughout the site. The species of concern noted within this site are only found in specific areas where tidal habitat remains protected and in a few of the more naturally managed park.	133

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Table 2: continued

Site #	Site Name USGS Quadrangle(s)	Description	Page(s)
Notable Significance Sites cont.			
20	Eastwick Property Lansdowne, Philadelphia	This property has reverted to a wild, if weedy, landscape that is supporting two plant species of concern: field dodder (<i>Cuscuta pentagona</i>) and forked rush (<i>Juncus dichotomus</i>). These are both residents of disturbed areas and do well in this environment and likely originated in the John Heinz National Wildlife Refuge, which the property abuts on both its south and west sides.	82
11	Fairmount Park Germantown, Philadelphia	This park once supported populations of species of concern, but the level of management and development within the park has reduced the amount of natural habitat to a very small area. While these areas have the potential to maintain populations of species of concern, only one is current known. Pied-billed grebes (<i>Podilymbus podiceps</i>) occasionally nest on the East Park Reservoir and fledged young in 2007. This park offers a significant island of green for many native wildlife species in the urban environment.	68
15	Franklin Delano Roosevelt Park Philadelphia	This park, part of the Fairmount Park System, still maintains limited tidal connectivity and some of the tidal species associated with it. Within the site are two plant species of concern associated with tidal areas: multiflowered mud-plantain (<i>Heteranthera multiflora</i>) and Walter's barnyard-grass (<i>Echinochloa walteri</i>). Additionally, the park contains an extensive array of odonates supported by the lagoons.	69
18	Mingo Creek Tidal Area Philadelphia	This area, which has been only partially surveyed, contains habitat that supports Needham's Skimmer (<i>Libellula needhami</i>), a species of dragonfly last recorded in the Commonwealth in 1945 and found again at this site in 2007. The extensive areas of wetland-like habitat on this site are the likely source of this occurrence.	94
5	Pennypack Park Frankford	This park, built around a forested riparian corridor running from the Delaware River up Pennypack Creek into Montgomery County, supports nesting osprey (<i>Pandion haliaetus</i>) in its upper reaches and two wetland species towards its tidal mouth. The small, tidal wetland at the mouth of the creek was created as a mitigation project and maintains two species of concern, the Halloween pennant dragonfly (<i>Celithemis eponina</i>) and the marsh wren (<i>Cistothorus palustris</i>).	69
10	Schuylkill River Uplands Germantown, Norristown	This large, amazingly intact patch of land offers upland forest, meadow, and high-gradient first-order streams that support three plant species of concern and offer habitat to many other species rare in the area. Found in the more open meadow-like areas oblique milkvine (<i>Matelea obliqua</i>) and round-leaved thoroughwort (<i>Eupatorium rotundifolium</i>) are residents of early-successional habitat while reflexed flatsedge (<i>Cyperus refractus</i>) is a species noted on this site only along the floodplain of the Schuylkill River.	112
12	Tidal Schuylkill River Corridor Philadelphia	Acting as a nesting and foraging area for a pair of Peregrine Falcons (<i>Falco peregrinus</i>), the northern portion of this reach of the Schuylkill River is otherwise fully urbanized and not noted for any other species of concern. Further downstream the tidal Schuylkill River helps support three plant species of concern at this site. Two, river bulrush (<i>Schoenoplectus fluviatilis</i>) and salt-marsh water-hemp (<i>Amaranthus cannabinus</i>), are known from a created wetland while the other, annual wild rice (<i>Zizania aquatica</i>), is known from the tidal mudflats found along the river banks. Because of safety concerns, a majority of this area has not been surveyed including the forest and wetland patches that have aerial photography signatures comparable to areas known to harbor species of concern. For this reason we believe this site will be found to host species concern and warrant a higher NHI significance ranking.	107

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Table 2: continued

Site #	Site Name USGS Quadrangle(s)	Description	Page(s)
Notable Significance Sites cont.			
9	Wissahickon Valley Germantown, Norristown	While this park is known for its forested streams and uplands, two of the species of concern noted within the park are plants generally found in open, early-successional habitats. Within the Houston Meadows restoration site are populations of forked rush (<i>Juncus dichotomus</i>) and round-leaved thoroughwort (<i>Eupatorium rotundifolium</i>). Another species, autumn bluegrass (<i>Poa autumnalis</i>), is a plant of moist woods and is found within the park.	72
Locally Significant Sites			
3	Byberry Creek Upland Forest Frankford, Hatboro	While no tracked species have yet been discovered within these woods, they offer an example of some of the forest that once covered this region. Dominated by American beech (<i>Fagus americana</i>), red oak (<i>Quercus rubra</i>), and tulip poplar (<i>Liriodendron tulipifera</i>) this forest also supports 127 native species of plant along with numerous other insects, birds, and mammals.	116
7	Frankford Creek Camden, Frankford	While this site currently offers little possibility of providing habitat for species of concern, if restored and managed it would offer a forested riparian corridor from the Delaware River through urban Philadelphia.	128
4	Northeast Philadelphia Airport Beverly, Frankford	Given the current management of this area as an active airport there is little potential for this site to host species of concern. However, the large grassy open areas within the site offer habitat known to support Lepidoptera species of concern within the city, which PNHP was not able to survey for given safety concerns.	124
1	Poquessing Creek Greenway Beverly, Frankford, Langhorne	Currently, no species of concern are known from this site, but this is possibly due to incomplete survey of the area. Acting as a natural forested riparian corridor from the tidal Delaware River north into both Bucks and Montgomery Counties this site offers the potential to host species of concern.	70
2	Poquessing Creek Uplands and Benjamin Rush State Park Beverly, Frankford	This area of open upland meadow likely hosts plant species of concern that has simply been missed. Additionally, the site hosts species that, while not tracked within the Commonwealth, are uncommon within Philadelphia.	120
8	Tacony Park Frankford	Tacony Park is not known to host any species of concern. Acting as an important wildlife corridor up until the Frankford Creek site border, the wildlife value of this site could be significantly improve with the completion of the corridor to the Delaware River.	72
No Heritage-significance Sites			
14 16	Schuylkill River Oil Lands – North & South Philadelphia	These sites are still actively used for the processing of petroleum products. Additionally, the area has experienced sustained industrial activity for over 150 years and is highly disturbed and degraded with only a few small, highly isolated areas maintaining any natural cover. For this reason these sites warrant no NHI significance rank.	102

EXECUTIVE SUMMARY

Table 3. The sites of significance for the protection of biological diversity in Philadelphia County categorized by their conservation priority. More in-depth information on each site including potential threats to the conservation of the site can be found in the text of the report following the maps for each site.

Site #	Site Name USGS Quadrangle(s)	Description	Pages
Immediate Preservation Need			
6	Delaware River Shoreline Beverly, Camden, Frankford, Philadelphia	This area is positioned for dense urban redevelopment, which if done in the traditional manner, will further degrade the biological value of the small areas of natural habitat that remain within the site. It is very important that any development within this site account for the placement of structures with the 100- and 500-year FEMA floodplains and allow for natural habitat to remain along the tidal Delaware River shoreline.	133
20	Eastwick Property Lansdowne, Philadelphia	Almost entirely within the 100-year FEMA floodplain, this site abuts the John Heinz National Wildlife Refuge along a third of its border. Development of this site into urban hardscape would further degrade the hydrology that supports the refuge. Restoration of this site into a gateway to John Heinz NWR with easy walking and biking trails to the 84 th St. SEPTA rail terminal would ideally position the refuge as a day-trip destination for the east coast. Currently managed by the Philadelphia Redevelopment Authority, this site also has outstanding legal issues.	82
21	John Heinz National Wildlife Refuge & Little Tinicum Island Bridgeport, Lansdowne	Preserving the last large remnant of the 10–20 square miles of freshwater intertidal wetland that once covered this area, the refuge is also dependent upon significant watershed-wide mitigation and restoration. The health of the refuge depends on the health of the land connected to it including appropriate and functional natural buffers around the refuge border, intact greenways for plant and animal migration to and from the refuge, and clean water flowing into and away from the refuge with the tide.	76
18	Mingo Creek Tidal Area Philadelphia	This highly degraded area offers the potential for a stunning expansion of greenspace and tidal wetland within the city proper. Additionally, the area is a key stepping stone along the lower Schuylkill River for the Schuylkill River Trail intended to connect Pottsville (Schuylkill County) through central Philadelphia to the Fort Mifflin Historical Site on the tidal Delaware River.	94
1	Poquessing Creek Greenway Beverly, Frankford, Langhorne	While portions of this area are protected as city and state parkland, a majority of the site's open space is not protected from conversion to a more intensive land use. If this site is to become a contiguous corridor of green from the shore of the Delaware River up to Bucks and Montgomery Counties a significant investment will be needed to prevent the remaining open space from being developed and the corridor from being transformed into a hodgepodge of disparate green islands.	70
2	Poquessing Creek Uplands and Benjamin Rush State Park Beverly, Frankford	Housing the largest community garden in the world, Benjamin Rush State Park offers a large area of protected meadow with some surrounding upland forest. However, the majority of this site is land unprotected from conversion to more intensive land use.	120
15	Tidal Schuylkill River Corridor Philadelphia	While a significant proportion of this site lies within the 100- and 500-year floodplain of the Schuylkill River, it contains infrastructure for activities that are better conducted away from flowing water. The level of development within the floodplain indicates that this is not a significant barrier to continued development within the site. Protection of the riparian and tidal habitat still present within this site is imperative if this site is to eventually become a link for the Schuylkill River Trail. This site is in need of revegetation with native riparian species along most of its length along with the protection of open space and existing riparian habitat. Additionally, restoration projects within this site are threatened by invasion by non-native plant species. Finally, safe access along the whole of this site and safe passage across the Schuylkill River to and from Bartram's Garden is needed.	107

EXECUTIVE SUMMARY

Table 3: continued

Site #	Site Name USGS Quadrangle(s)	Description	Pages
Near-term Preservation Need			
3	Byberry Creek Upland Forest Frankford, Hatboro	This large patch of woods with connecting forest to the headwaters of Poquessing Creek is currently owned by the Philadelphia Industrial Development Corporation. As such it is not in immediate danger of development, but it is effectively slated for eventual conversion to a more intensive land use. As one of the last large forest blocks not protected by public ownership in this area it is very important that this property be protected as a natural area and not reduced to concrete and asphalt.	116
19	Fort Mifflin Shoreline Bridgeport, Philadelphia, Woodbury	Primarily composed of shoreline with direct tidal influence, this site is probably little threatened by development in the near term. Over the long term the site is threatened by the continued expansion of the airport, degradation by the ever-increasing wake size from shipping traffic, and the spraying of existing wetlands with herbicides to prevent their continued expansion.	86
16	Philadelphia Navy Yard Philadelphia	Managed by the Philadelphia Industrial Development Corporation, the remains of the Philadelphia Navy Yard are slated for redevelopment. However, this process has been slowed by the costs associated with the project. As redevelopment plans are created for the currently undeveloped areas it will be important to assess the environmental impacts of developing a site that host numerous species of concern, that used to be an island, and is almost entirely within the 100-year FEMA floodplain.	98
10	Schuylkill River Uplands Germantown, Norristown	While a significant portion of this site is owned, managed, and protected by the Schuylkill Center for Environmental Education, other important parts of this extensive block of open space remain unprotected from development. Additionally, the fate of the retired Roxborough Reservoir, an important area acting as a wetland, remains undecided. Finally, this site acts as a significant greenway along the Schuylkill River.	112
Enhancement Opportunities			
22	Cobbs Creek Park & Greenway Lansdowne, Philadelphia	The Cobbs Creek Greenway offers amazing opportunities for the expansion and improvement of natural habitat along its length from the county line to John Heinz National Wildlife Refuge. There are already efforts to remove non-native invasive species and replant native vegetation along the creek's length with project ongoing throughout the site. An additional goal should be to reestablish Cobbs Creek as a healthy, free-flowing waterway through the removal of fish passage barriers and through active stormwater runoff management.	67
11	Fairmount Park Germantown, Philadelphia	An important example of fully-integrated mixed land use in a highly urbanized setting, Fairmount Park is also one of the older parks in the nation. Because of the park's history it is important to work to maintain the health of the natural systems found within the site including several small watersheds completely contained by the park. These small watersheds support scenic first order streams that have been negatively affected by stormwater runoff, which is entirely within the purview of park management to control.	68
7	Frankford Creek Camden, Frankford	This site abounds with enhancement opportunities. From stormwater runoff control, to riparian habitat protection and restoration, to trash clean-up, to dam removal and full-scale channel reconstruction this reach of Frankford Creek has possible projects to accommodate any budget or number of volunteers.	128

EXECUTIVE SUMMARY

Table 3: continued

Site #	Site Name USGS Quadrangle(s)	Description	Pages
Enhancement Opportunities cont.			
15	Franklin Delano Roosevelt Park Philadelphia	Containing huge swaths of grass, abandoned athletic fields, and an extensive area of land dominated by non-native invasive plant species, this park should be examined for opportunities to expand and restore freshwater intertidal wetland. Additionally, the lagoons in the park appear to be subject to combined sewer overflows (CSO) during rain events leading to their highly eutrophied and biologically degraded states, though no known permitted CSOs exist on the site. Cessation of these inflows along with the removal of accumulated nutrient and increased tidal exchange could lead to a significant increase in the ecological functionality of this park	69
5	Pennypack Park Frankford	Pennypack Creek Park offers an extensive area of greenspace and functions as a contiguous natural corridor from the Delaware River through Philadelphia into Montgomery County. Enhancement of this system is already underway through the replanting of the floodplain with native species and removal of fish passage barriers along the main stem. Continuation of existing project with an expansion into upland forest restoration will increase the natural habitat quality.	69
8	Tacony Creek Park Frankford	Management of stormwater runoff and out-fall areas within this park are of special concern. This small creek is being used to drain an artificially expanded “watershed” composed of an overwhelming quantity of impermeable surface. Additionally, inputs from the numerous golf courses within the watershed need to be examined and, if they are found to be adversely impacting water quality and stream health, addressed.	72
9	Wissahickon Valley Germantown, Norristown	This park contains the largest area of natural habitat within Philadelphia and significant efforts need to be made to ensure that it remains this way. Ongoing restoration needs to be supported and expanded to include the full suite of ecosystems found within the park with the intention of indefinitely sustaining the parks environmental health. Additionally, free-flowing access from the mouth of Wissahickon Creek on the Schuylkill River upstream to the headwaters in Montgomery County should be a stated goal.	72
Opportunistic Acquisition			
17	Army Corps Yard Philadelphia	This site is still used by the Army Corps for maintenance of the Delaware River shipping channel. However, if the site were to become available for other purposes restoration to a freshwater tidal community should be examined.	90
4	Northeast Philadelphia Airport Beverly, Frankford	Still an active airport, this site offers an extensive area of mead and wetland-like habitat with significant habitat improvement opportunities where they do not conflict with the maintenance of airport safety.	124
13 14	Schuylkill River Oil Lands – North & South Philadelphia	This land is still actively used for the refining of oil. Given the over 150 years of industrial activity on the site its conversion to any other use may be costly, but if alternative uses are proposed then conversion to greenspace must be considered.	102

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INTRODUCTION

Philadelphia, founded by William Penn in 1682, began as a pastoral farming village with the vision of religious tolerance. The area supported villages of the Susquehannock people long before initial European settlement in 1644 as part of the colony of New Sweden. Given its strategic position as a protected port in the developing New World, Philadelphia quickly became an economic powerhouse of production and trade. This trend continued through the centuries with the population growing from around 6,000 in the 1720's to over 2,000,000 by the 1950's. However, from 1960 to the present, Philadelphia, along with almost every urban area in the United States, has experienced a significant decline in both economy and population. Over that time the city's population has decreased by over 500,000 individuals, with the majority of these residents moving to the suburbs around the city.

One aspect that has greatly facilitated the movement of people out of the city is the ease of travel around the area. In 1723 Benjamin Franklin traveled from Philadelphia to Boston in a journey that took two weeks by sailing ship. Today, that same journey can be accomplished in only a few hours using modern transportation, joining together the Northeast Corridor's 55,000,000 inhabitants. This same pattern of travel ease exists between the city center and the suburban areas with travel that would have taken two days to a week accomplished in mere minutes today. This ease of travel has allowed Philadelphia's metropolitan area to expand to over 5,800,000 residents over 1,800 square miles.

This level of population and development would be beyond the imagination of William Penn. In his original idea for Philadelphia he envisioned a pastoral town with a single house on each lot surrounded by orchards, pastures, and fields that sustained the resident, with each lot connected by treed lanes to the town center. Economic demands and opportunities quickly superseded Penn's vision and the pattern of development quickly turned the pastoral landscape into that of a growing urban center. This development continued with the conversion of the forested landscape around the town into pastures and fields along with the channelization and damming of the streams and rivers to provide drinking water and power mills. As the easily built-upon lands were used up, more difficult or dangerous areas such as

floodplains, wetlands, and tidal marshes were utilized. The utilization of these spaces was primarily accomplished by infilling with material from other sites, such as dirt, rocks, or garbage, until it was stable enough to build upon. This has resulted in a significant gain of dry land around the city at the expense of the natural systems that the land supported.

At the time of colonization, the Philadelphia area contained between 10 and 20 square miles of tidal marshland. Today, this area, primarily along the Schuylkill and Delaware Rivers, is utilized for industrial purposes, public works, and the Philadelphia International Airport. This transformation has severely affected the aquatic systems that depended on the tidal marsh for containing floodwaters, filtering water, and providing habitat for hundreds of species of birds, mammals, fish, and herptiles along with an untold number of plants, insects, and other invertebrates. What remains of this system is within the John Heinz National Wildlife Refuge, which maintains a 200-acre ($< \frac{1}{3}$ square mile) remnant of tidal marsh.

The riverine systems of Philadelphia have also seen severe impact and modification from urbanization. Many of the city's streams are still impaired by old mill dams. While the oldest of these dams are an important part of the city's history when properly maintained, many are in disrepair and pose a danger to people playing on or around them. These dams also prevent the passage of resident and migratory fish up and down stream from the larger rivers and the Delaware Bay, including many important migratory spawners such as American shad and American eels.

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

Other streams have been locked into underground pipes where they cease to function.

A similar degradation of most other terrestrial systems in the Philadelphia area has occurred over the last three centuries. The forests of the area were very quickly removed to allow for agriculture, with the lumber used as building material and fuel. And while no old-growth forest is known within Philadelphia, some trees may date from just after the first cutover, with an age in excess of 250 years. The “natural” meadows of the area were also quickly converted to agricultural practices. These environments were most likely the result of active management from Native American tribes burning them on a regular basis to prevent succession to a forested environment. A few remnant grasslands remain in the city and plans are being made to actively manage them to restore their characteristic appearance and suite of species.

The process of degradation of the natural systems across the county has been accelerated by the introduction of a large variety of non-native invasive species. These species, native to other parts of the continent or world, were either introduced purposefully or accidentally, often lack resident pests that control them, and are not the preferred choice for native herbivores or predators. This release from normal controls allows them to reproduce and spread at amazingly high rates. The resulting domination of the landscape by non-native invasive species reduces overall biodiversity and the habitat available to native plants and animals. This non-native domination is especially apparent in tracts of unmanaged abandoned lands within the city that are completely dominated by non-native invasive species.

Today, however, the city is presented with unforeseen ecological opportunities. The decrease in population within the city, while causing significant economic hardship, has made available significant areas of land along both the Schuylkill and Delaware Rivers for either redevelopment or retirement to parkland or even native landscapes. This opportunity should not be looked at as an either/or choice. Redevelopment of these areas can be accomplished in an economically advantageous and ecologically informed manner, resulting in benefits to the city, the public, the developer, and the environment all at once. Locally accessible greenspace is well known to increase property values, and by placing greenspace in areas that will be the most difficult to develop, development costs and impediment down-time can be reduced.

Additionally, greenspaces and natural areas provide economic benefits to the community. Tree cover provides shade, cooling the ground during the heat of the summer. This shade reduces the heat island effect caused by city infrastructure and reduces the energy needed to cool buildings and people. Plant respiration (especially from trees) cleans the air of pollution and greenhouse gases, resulting in health benefits for everyone. The reconnection and reforestation of floodplains can mitigate flooding events and the economic costs associated with them, while helping to cool streams and naturally stabilize river banks at the same time.

There are also many social benefits associated with increased urban greenspace and natural areas. Community greenspace can act as a focal point for community involvement and congregation. Greenspace allows for outdoor recreation and exercise, and greenways can act as transportation corridors for walkers, joggers, and bikers.

An especially important benefit of urban natural areas is the exposure of children to nature. Nature deficit disorder is a growing area of concern among educators and results from children growing up without the opportunity to interact with nature and the outdoors. While the extent and consequences of nature deficit disorder is still an area of active discussion, providing urban populations with nearby opportunities to experience nature should be looked at as an important requirement for intellectual development and creative growth.

These opportunities for urban re-greening will be fleeting at best. The trend of urban population decline appears to be reversing as economic pressures and opportunities make urban living more and more attractive. While a population and cultural renaissance in Philadelphia can happen on the existing infrastructure, a green renaissance within Philadelphia will need the creation and restoration of new “green infrastructure” to provide a natural base to build upon.

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

NATURAL HISTORY OVERVIEW OF PHILADELPHIA

Physiography and Geology

Philadelphia lies within three distinct physiographic provinces (Fig. 2). Different provinces generally support different suites of species because of the characteristics of the landscape. These characteristics are based upon the topography and geologic structure and history of the landscape with a province containing a set of characteristics significantly different from the characteristics of adjacent provinces.

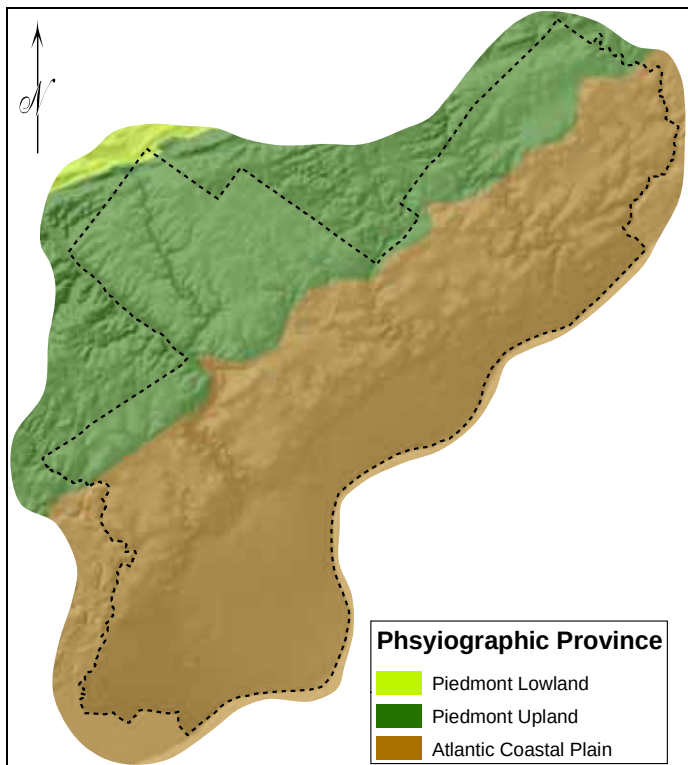


Figure 2. Physiographic provinces of Philadelphia and surrounding area.

Piedmont Lowland

Lying on calcareous bedrock, the Piedmont Lowland is a gently rolling country of low hills and wide valleys that is primarily centered in northern Lancaster County with arms that extend out to York and Montgomery Counties. The streams of the province meander through the broad valleys, but in some areas are completely subterranean because of the very porous bedrock (called karst formation). This province contains rich, deep soils that remain moist throughout most of the year, making it some

of the most productive non-irrigated farmland in the world. The area around the Morris Arboretum on the grounds of the University of Pennsylvania provides good examples of what this area looked like prior to settlement.

Piedmont Upland

The Piedmont Upland province is similar to the Piedmont Lowland in appearance, but very different in origin. The landscape is still composed of rolling hills around wide valleys, but the hills are somewhat taller and steeper with the streams tending to wander less in their valleys, such as the area around Wissahickon Creek. The greatest difference comes in the geologic structure, which is primarily a metamorphic rock called schist that does not have the absorptive properties or mineral content of limestone karst. The lowlands of this area also contain deep soils that provide excellent opportunities for agriculture, though to a lesser degree than the Piedmont Lowlands. This physiographic province stretches from near the Delaware River in Bucks County to the Adams-York Counties line.

Atlantic Coastal Plain

Referred to as the *Lowland and Intermediate Upland Section of the Atlantic Coastal Plain Province*, this area is characterized by two distinct areas: an upper flat terrace composed of sand and gravel derived from weathered metamorphic rocks, and the floodplain of the Delaware River, composed of deep alluvial sediments. The sand and gravel of this area allow for quick drainage to the water table in areas that are not covered with impermeable surfaces, though a large portion of this province has been developed. This province is dissected by numerous short, narrow, steep-walled stream valleys in the terrace area that widen out as they enter the Delaware River floodplain. Pennypack Creek is a good example of this, with a much narrower valley upstream widening out as it approaches the Delaware River. A large portion of this province is near or at sea level.

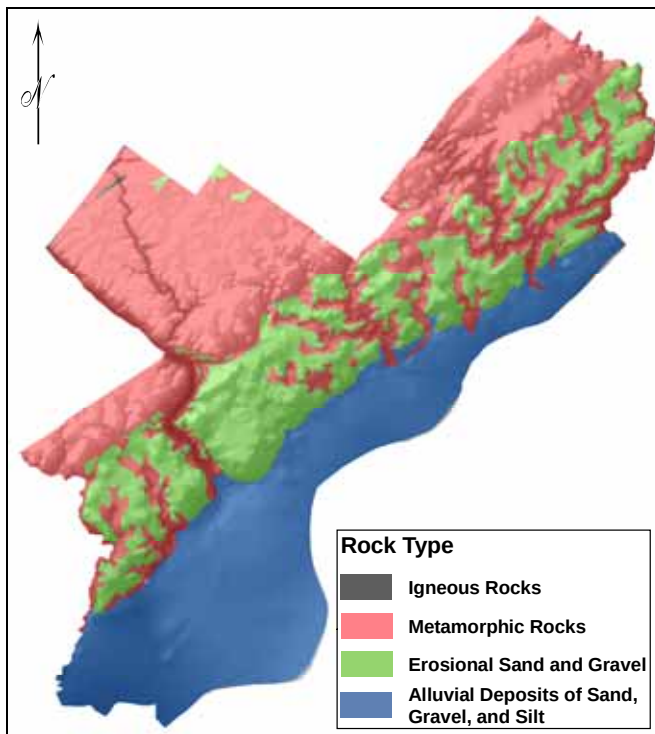


Figure 3. Rock types of Philadelphia.

Bedrock and Soils

The soils of Philadelphia are highly disturbed from the processes that cleared the land, and through farming, infill, excavation, and development. This makes characterizing them in the traditional manner

Table 4. Philadelphia bedrock formations.

Formation	Description
Bryn Mawr	Reddish-brown gravelly sand and some silt deposits on high-level terrace of uncertain age.
Chickies	Thin, interbedded dark slate over a light-gray, hard quartz schist with a conglomerate at base.
Conestoga	Light-gray, limestone with shale partings and a conglomerate base.
Felsic gneiss	Light, medium-grained gneiss with included sedimentary rocks.
Granitic gneiss and granite	Wissahickon Formation that has undergone granitization.
Mafic gneiss	Dark, medium-grained gneiss with included sedimentary rocks.
Ledger	Light-gray, locally mottled coarse dolomite with siliceous parts.
Pensauken and Bridgeton	A dark-reddish-brown quartz sand with some areas of fine gravel and rare areas of clay or silt.
Trenton Gravel	Very gravelly sand with crossbedded sand and clay-silt areas ranging from gray to pale-reddish-brown in color and including areas of alluvium and swamp deposits deposited within the last 12,000 years.
Ultramafic rocks	Igneous rocks with a very low silica content. Generally contains a high concentration of magnesium and iron and often a greenish color.
Wissahickon	A rich mix of metamorphic rocks including oligoclase-mica schist, hornblende gneiss, and augen gneiss, with varying degrees of quartz and feldspar depending on the amount of granitization.

used by the US Department of Agriculture very difficult, but some general observations about their structure and function can be made.

In Philadelphia the soils are very deep and well drained as a result of the parent material they are derived from (Fig. 3). These soils are primarily composed of sand, silt, and gravel resulting from the weathering of very old Paleozoic and Precambrian metamorphic rocks. This rock, originally laid down as sediments 438–1,600 million years ago, was changed by heat and pressure to form various metamorphic rocks, which in turn weather relatively easily. These rocks can be further described by the minerals they are composed of, the specific process that formed them, and their physical characteristics. For example, while the Chickies Formation and Felsic gneiss are both metamorphic rock, their individual descriptions reveal how different they are (Table 4 and Fig. 4).

The area is influenced by the Delaware River and is in a different group. It is composed of sand and gravel laid down by periodic flooding over the last 1.6 million years with additional silt and clay deposits where finer material was able to settle. These are termed alluvial deposits. The specific properties of the mixture are what dictate whether the site is very well drained (primarily gravel) or chronically waterlogged (primarily clay).

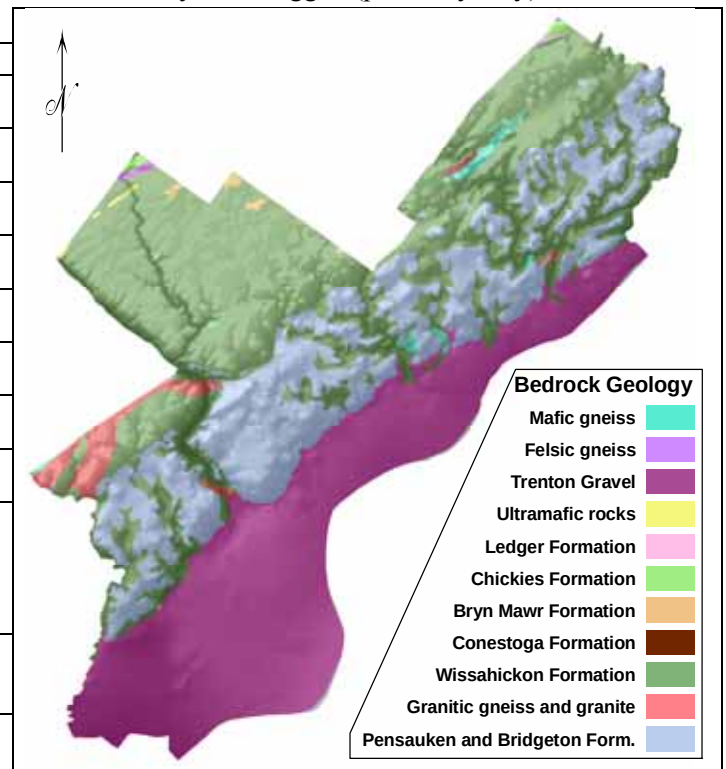


Figure 4. Bedrock geology of Philadelphia.

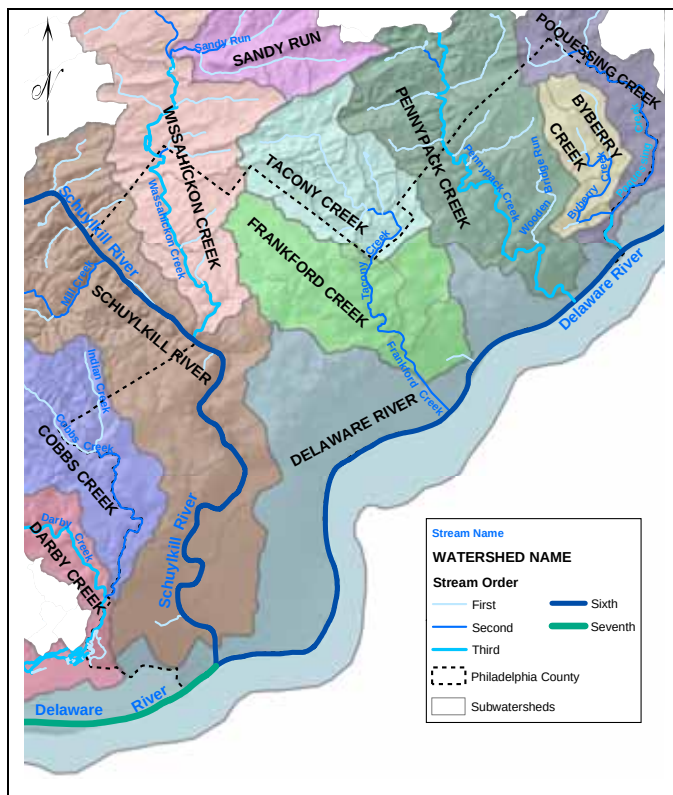


Figure 5. Watersheds of Philadelphia.

Historically, a few areas in the area of these alluvial deposits would have had a thick top-layer of organic matter, sometimes referred to as peat. These areas would have been most prominent in the tidal or continually wet areas where highly productive wetland or aquatic vegetation laid down material faster than it could decompose. The only place likely to still contain this type of soil is within the John Heinz National Wildlife Refuge.

Watersheds

A watershed is defined by the local topography that dictates which way water will flow to the lowest point in an area. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves downstream, eventually reaching an estuary, such as the Delaware Bay, that is connected to a lake, sea, or ocean. Watersheds can be large, like that of the Schuylkill River, which covers 1,100 mi², or small like that of Poquessing Creek, which covers <22 mi², but all land is part of a watershed (Fig. 5). Every stream, tributary, and river has an associated watershed, with

small watersheds merging to become larger watersheds.

In Philadelphia the watersheds have experienced various degrees of disturbance from moderate to very severe. The Wissahickon Creek watershed and associated streams remain relatively intact, with few of the streams lost to development and a large proportion of the watershed remaining in relatively natural cover, though the system is constrained by numerous dams and development around its edges. On the other hand, the Frankford Creek watershed has had almost all its waterways completely removed from the landscape with most of the streams confined to underground pipes covered by impermeable surfaces and the original stream bed to the Delaware River moved and transformed into a straight steel-armored channel.

The process of damming, channelizing, armoring, and burying streams has been occurring since shortly after colonization and has significantly impacted the ecological health of the streams in the area. A stream buried in a pipe loses most or all of its ecological function because of the lost sunlight, sediments, and air circulation among other things. Streams that are armored or channelized lose a

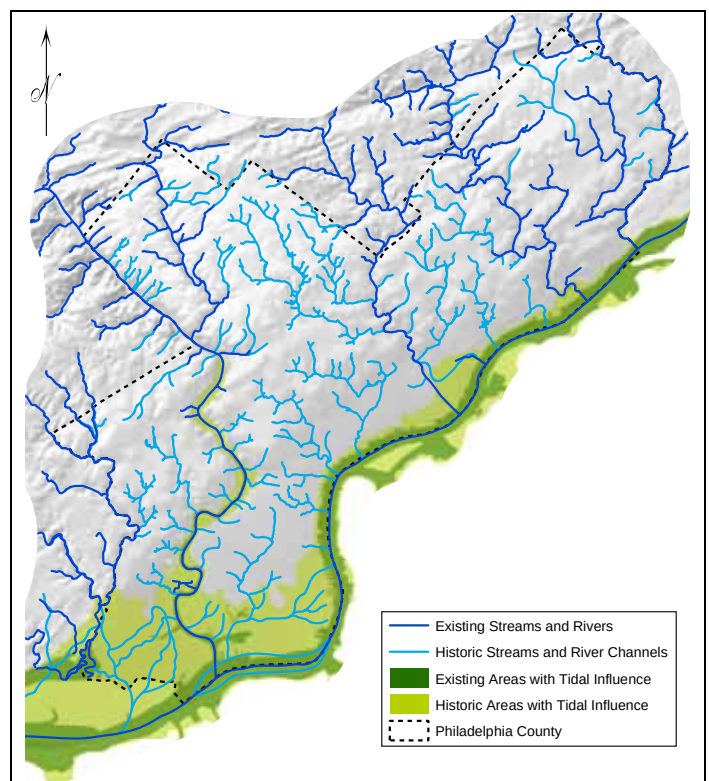


Figure 6. Existing and historic streams of Philadelphia.

significant amount of bank and bottom habitat, reducing their ecological and riparian value. Streams that are dammed have modified habitats because of increased water temperatures and changes in the way sediment moves and is distributed in the river. Dams also act as barriers to fish migration.

Together, these actions have greatly decreased the stream mileage in Philadelphia, severely impacting many of the watersheds (Fig. 6, pg. 5). In some areas of the city an individual can be miles from the nearest above-ground stream even though they may be directly above a stream that has been diverted to an underground pipe. This detachment from moving water, in a city built because of and surrounded by moving water, needs to be remedied to reconnect the city's residents to this critical aspect of the environment.



photo source: PNHP

Looking upstream (left) and downstream (right) on Indian Run, a tributary to Cobbs Creek. Photos taken at the Cobbs Creek Center for Environmental Education.

NATURAL COMMUNITIES OF PHILADELPHIA

Unaltered natural communities are scarce within the borders of Philadelphia. Since the founding of the city, the landscape of southeastern Pennsylvania has experienced severe modification from both intentional land use changes, such as the conversion of forest to farm to village, town, and urban megalopolis, and unintentional impacts, such as the introduction of invasive species, removal of top predators, pollution, and recently global climate change. This does not mean that Philadelphia is devoid of natural communities or lacks the potential for their reestablishment or *re-creation*.

This section short-lists natural communities that were likely common within the Philadelphia area 400 years ago and have the potential to be restored within existing natural areas or re-created anew (a process usually referred to as *reclamation*) in the city. This list should be looked at as the most general of guides, since site-specific conditions will dictate the restoration or reclamation potential of an individual site. Many community descriptions are referenced from *Terrestrial & Palustrine Plant Communities of Pennsylvania*, available at: <http://www.naturalheritage.state.pa.us/fikebook.aspx>.

Terrestrial Communities

The terrestrial landscapes of Philadelphia today are vastly different from the systems that were there prior to colonization (Fig. 7). While the species remain similar, the place of these species in the landscape and their stature has been greatly modified. The pre-colonization forest was a mixed-aged forest with trees ranging in size from inch-tall seedlings to centuries-old behemoths six or more feet in diameter (Latham 2008). This provided a wide range of habitats that supported many species of plants and animals no longer found in the southeastern corner of the Commonwealth. The various tree species were also found in predictable locations on the landscape based on soil, aspect, and hydrology.

While restoring the massive trees that dominated the landscape can only be accomplished with time, restoring the species composition of the forest is already ongoing. Active management by municipal and volunteer organizations is underway, with plans

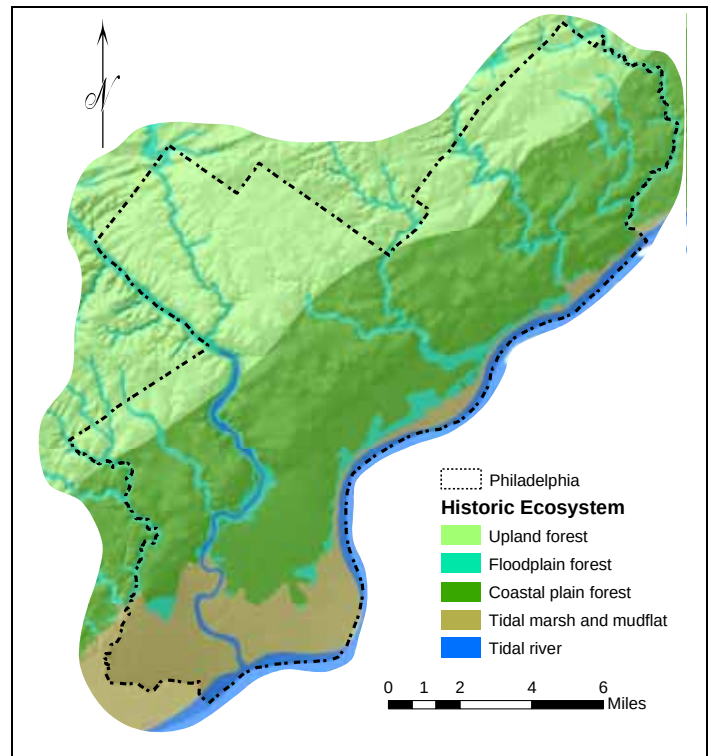


Figure 7. Historical ecosystems of Philadelphia.

to restore the terrestrial landscape through the replanting of native species and the control and removal of invasive non-native species. Through relatively simple and inexpensive actions a great deal of forest restoration can be accomplished. This reforestation will contribute to the greening, cooling,



Upland forest above Karakung Golf Course with well-developed overstory, midstory, shrub layer, and spring ephemeral herbaceous layer.

photo source: PNHP

and refreshing of Philadelphia along with increasing water recharge and habitat availability.

Restoring terrestrial communities will be relatively inexpensive, but restoration efforts will need to be managed to prevent invasive species from taking over. Once forests become reestablished they should become self-maintaining and self-perpetuating with monitoring and only the occasional removal of invasive species. Below are descriptions of forest types known in the area or believed to have historically occurred in the area that could be restored.

Upland Forest

The upland forest communities of the Philadelphia area were and still are composed of a varied group of species. The species present reflect the combined influences of land use history, soil characteristics, and location within the greater landscape (Latham 2008). Today, many upland sites are dominated by tuliptree (*Liriodendron tulipifera*). Over successive cycles of timber harvest and forest regrowth this fast-growing, deer-resistant species with low timber value came to dominate the area. In general, upland sites in Philadelphia should be dominated by a mix of oaks (*Quercus* spp.) and hickories (*Carya* spp.), with individual species suited to different soil-moisture regimes from the wettest to the driest sites, in a wide range of soil types. However, because of heavy deer browsing and successive cycles of timber harvest these species are absent from many areas. Additionally, many upland sites are pervaded by non-native invasive species that limit or prevent the regrowth of native tree species. Regeneration of the oak-hickory forest will take active management over a period of centuries, with replanting of trees from local seed sources, active management of invasive species, and reduction of deer herd size below carrying capacity to allow for natural recruitment and regrowth on the landscape.

Historic coastal plain forest community species	
Common Name	Scientific Name
American beech	<i>Fagus grandifolia</i>
American holly	<i>Ilex opaca</i>
Fetter-bush	<i>Leucothoe racemosa</i>
Southern red oak	<i>Quercus falcata</i>
Sweetbay magnolia	<i>Magnolia virginiana</i>
Sweet-gum	<i>Liquidambar styraciflua</i>
White oak	<i>Quercus alba</i>
Willow oak	<i>Quercus phellos</i>

Historic oak-hickory forest community species		
Common Name	Scientific Name	Position
Scarlet oak	<i>Quercus coccinea</i>	Dry, poor soils
Chestnut oak	<i>Quercus prinus</i>	Dry, thin soils
Sassafras	<i>Sassafras albidum</i>	Dry and disturbed soils
Pignut hickory	<i>Carya glabra</i>	Dry soils
American chestnut	<i>Castanea dentata</i>	Dry to dry-mesic soils
Shagbark hickory	<i>Carya ovata</i>	Dry to moist soils
Southern red oak	<i>Quercus falcata</i>	Dry, sandy soils
Hop-hornbeam	<i>Ostrya virginiana</i>	Dry-mesic, well-drained
American beech	<i>Fagus grandifolia</i>	Dry to moist soils
Mockernut hickory	<i>Carya tomentosa</i>	Moist well-drained soils
Black oak	<i>Quercus velutina</i>	Well-drained, rich soils
Northern red oak	<i>Quercus rubra</i>	Moist, rich soils
White oak	<i>Quercus alba</i>	Moist, rich soils
Bitternut hickory	<i>Carya cordiformis</i>	Moist, rich soils
Shellbark hickory	<i>Carya laciniosa</i>	Moist to wet, rich soils
Willow oak	<i>Quercus phellos</i>	Wet, rich soils
Pin oak	<i>Quercus palustris</i>	Seasonally flooded soils
Swamp-white oak	<i>Quercus bicolor</i>	Wet, rich soils

Coastal Plain Forest

The Atlantic coastal plain in Pennsylvania is a strip only 1 to 5 miles wide along the lower 50 miles of the state's Delaware River frontage. Nonetheless, the coastal plain forest type covered a significant portion of Philadelphia, supporting a suite of species common further south, partly due to the sandy soils and partly because of the warm coastal air that blows up from the bay. This forest was dominated by sweet-gum and oaks intermixed with species such as American beech. The understory included many broadleaved evergreen small trees and shrubs such as American holly and fetter-bush, giving this community a distinctive shiny-green look throughout the year.



A well developed floodplain forest with buttressed trees, active regeneration, and an extensive native shrub layer.

photo source: PNHP

Historic floodplain forest community species		
Common Name	Scientific Name	Position
Blackgum	<i>Nyssa sylvatica</i>	Permanently wet
Red maple	<i>Acer rubrum</i>	Permanently wet
Pin oak	<i>Quercus palustris</i>	Backwaters
Swamp white oak	<i>Quercus bicolor</i>	Backwaters
Black walnut	<i>Juglans nigra</i>	Intermixed
Butternut	<i>Juglans cinerea</i>	Intermixed
Common hackberry	<i>Celtis occidentalis</i>	Intermixed
Eastern cottonwood	<i>Populus deltoides</i>	Intermixed
Box-elder	<i>Acer negundo</i>	Intermixed
Green ash	<i>Fraxinus pennsylvanica</i>	Yearly flooding
American elm	<i>Ulmus americana</i>	Yearly flooding
Silver maple	<i>Acer saccharinum</i>	Yearly flooding
Slippery elm	<i>Ulmus rubra</i>	Yearly flooding
Sycamore	<i>Platanus occidentalis</i>	Yearly flooding
Black willow	<i>Salix nigra</i>	River scours
River birch	<i>Betula nigra</i>	River scours
Smooth alder	<i>Alnus serrulata</i>	River scours
Box elder	<i>Acer negundo</i>	River edge

Small depauperate areas of this forest type remain in and around Philadelphia and correspond with the sweet gum–oak coastal plain forest community type (Fike 1999). In areas where this forest type has been restored within the city it has done very well.

Floodplain Forest

Extensive developed areas of Philadelphia lie within the 100- and 500-year floodplains of the Schuylkill and Delaware Rivers and the floodplains of their many small tributaries. Historically, parts of these areas would have been flooded on a yearly basis

Historic Atlantic white-cedar community species	
Common Name	Scientific Name
Atlantic white-cedar	<i>Chamaecyparis thyoides</i>
Bayberry	<i>Myrica pensylvanica</i>
Black chokeberry	<i>Photinia melanocarpa</i>
Blackgum	<i>Nyssa sylvatica</i>
Bog sedge	<i>Carex atlantica</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>
Collins's sedge	<i>Carex collinsii</i>
Dangleberry	<i>Gaylussacia frondosa</i>
Fetter-bush	<i>Leucothoe racemosa</i>
Highbush blueberry	<i>Vaccinium corymbosum</i>
Inkberry	<i>Ilex glabra</i>
Marsh fern	<i>Thelypteris palustris</i>
Pitch pine	<i>Pinus rigida</i>
Purple pitcher-plant	<i>Sarracenia purpurea</i>
Rose pogonia	<i>Pogonia ophioglossoides</i>
Sphagnum mosses	<i>Sphagnum</i> spp.
Swamp azalea	<i>Rhododendron viscosum</i>
Sweet pepperbush	<i>Clethra alnifolia</i>
Virginia chain fern	<i>Woodwardia virginica</i>
Winterberry	<i>Ilex verticillata</i>

with higher areas flooded on a correspondingly less frequent basis. The frequency and duration of flooding strongly influenced the tree species that dominated the area. In the most frequently flooded areas, sycamore, silver maple, and American and slippery elm would dominate with eastern cottonwood, common hackberry, black walnut, butternut, green ash, and box-elder interspersed among them. More permanently wet areas, such as backwaters and stranded oxbows, would have supported swamp white oak, pin oak, and red maple. Areas where the river was actively scouring and rebuilding the bank would host fast-growing black willow, river birch, and smooth alder. Today very little floodplain forest remains along the Schuylkill and Delaware Rivers in Philadelphia; small corridors remain along the smaller tributaries. These few remaining floodplain forests are generally dominated by non-native invasive species and are in need of immediate attention to prevent further degradation. Floodplain restoration efforts are underway in the city, but they have met with mixed success. In areas where the plantings are tended and non-native invasive species are removed at least semi-annually, planted native species have quickly become reestablished. In areas where plantings are installed and left alone, there is moderate to complete failure of the plants through deer browsing and smothering by invasive species.

Atlantic White-cedar Forest

It is likely that areas of Atlantic white-cedar forest were present in the Philadelphia area at the time of colonization (Smith 1886, Rhoads and Block 2005, Latham 2008). These forests, still present along the Atlantic coast from Florida to Maine, are a unique mix of evergreen and deciduous plant species that live in permanently saturated soils primarily composed of organic matter.

These forests were likely harvested quickly after colonization due to the properties of Atlantic white-cedar wood. Rot and insect resistant, easy to work, and fragrant, the lumber of Atlantic white-cedar is still prized for these qualities and used in a wide range of applications. An additional characteristic that likely contributed to the demise of Atlantic white-cedar forests around Philadelphia is their susceptibility to fire and grazing. During the colonization period uncontrolled fires were set to maintain forest openings for livestock and after only a few repeated burns with no reforestation the

seedbed in any remnant Atlantic white-cedar forest would have been exhausted, effectively extirpating the species from the Commonwealth (Latham 2008).

Restoration of this forest type and its associated species poses a significant challenge, but the rewards will be substantial. The soil type this species prefers is no longer accessible within Philadelphia and there is no local seed source for the primary members of this natural community, though there are seed sources in surrounding states. These are not insurmountable obstacles to a restoration project, but will necessitate proper planning to allow any restoration project to progress.

Grasslands, Meadows, and Old Fields

Grasslands and native meadows covered a substantial proportion of the Philadelphia area prior to colonization. However, it is unlikely that these were self-maintaining systems. There is extensive evidence that these meadows were managed by resident Native Americans who burned them on a periodic basis to prevent their succession back to forest and provide foraging areas for game species such as grouse, turkey, deer, and elk (Latham 2008). These systems supported species generally common to the extensive grasslands much further west despite their diminutive size. Today there are several remnant native meadows within Philadelphia with restoration plans underway. Active management that includes the removal of non-native invasive species, replanting of lost native species, and control of woody species through periodic

Historic freshwater tidal wetland community plant species	
Common Name	Scientific Name
Annual wild rice	<i>Zizania aquatica</i>
Beggar-ticks	<i>Bidens</i> spp.
Broadleaf arrowhead	<i>Sagittaria latifolia</i>
Crimson-eyed rosemallow	<i>Hibiscus moscheutos</i>
Dotted smartweed	<i>Polygonum punctatum</i>
Green arrow-arum	<i>Peltandra virginica</i>
Halberdleaf tearthumb	<i>Polygonum arifolium</i>
Hemlock waterparsnip	<i>Sium suave</i>
Jewelweed	<i>Impatiens capensis</i>
Pickeringweed	<i>Pontederia cordata</i>
Primrose-willow	<i>Ludwigia peploides</i>
Rice cutgrass	<i>Leersia oryzoides</i>
River bulrush	<i>Schoenoplectus fluviatilis</i>
Salt-marsh water-hemp	<i>Amaranthus cannabinus</i>
Spatterdock	<i>Nuphar lutea</i>

burning or mechanical removal will need to be a part of these plans for them to succeed.

Wetland Communities

Historically, the Philadelphia area supported wetlands unique to the state in both their species makeup and their vastness. The combination of the large low-elevation outwash plain of the Schuylkill River and the tidal flow of the Atlantic Ocean up the Delaware River allowed the formation of a vast tidal marsh that covered 15 to 20 square miles in southern Philadelphia. Around the edges of this marsh were likely enclaves of Atlantic white-cedar swamp, which is still found up and down the mid-Atlantic coast with the exception of Pennsylvania. Further inland along the river banks were backwater wetlands in old oxbows and dry channels and on the



photo source: PNHP

A very successful grassland restoration project at Pennypack on the Delaware Park that supports several species of concern.

Historic spring seep community species	
Common Name	Scientific Name
Bristlystalked sedge	<i>Carex leptalea</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>
Clearweed	<i>Pilea pumila</i>
Golden saxifrage	<i>Chrysosplenium americanum</i>
Goldenthrum	<i>Coptis trifolia</i>
Jewelweed	<i>Impatiens capensis</i>
Northern long sedge	<i>Carex folliculata</i>
Rough aster	<i>Eurybia radula</i>
Sensitive fern	<i>Onoclea sensibilis</i>
Skunk cabbage	<i>Symplocarpus foetidus</i>
Slender mannagrass	<i>Glyceria melicaria</i>
Spicebush	<i>Lindera benzoin</i>
Spinulose wood fern	<i>Dryopteris carthusiana</i>
Sweet-scented bedstraw	<i>Galium triflorum</i>
Weak stellate sedge	<i>Carex seorsa</i>

hill slopes were spring seeps and headwater stream wetlands.

Today, with the exception of small patches of tidal mudflat, a smattering of ponds, and a few hidden spring seeps, these systems have been removed from the landscape. The removal of these wetlands has

had a negative affect not only on the species that depended on these communities for their existence, but also on the regional economy. Wetlands work to purify water and facilitate ground-water recharge, they act as nurseries for many fish of economic importance, and they create a buffer against floods and tidal storm surges. The removal of these systems has shifted their formerly free ecological services into higher water bills, more expensive seafood, and increasingly damaging flooding.

Restoring wetlands is likely to take longer and be more expensive than restoring upland habitat, but it is vitally needed. Below are some communities known or believed to have been in the Philadelphia area that have restoration potential.

Freshwater Tidal Wetland

Philadelphia once harbored an extensive area of freshwater tidal marsh. Covering between 10 and 20 square miles (6,400–12,800 acres), this area resembled a large flooded grassland full of wild rice interspersed with emergent and floating aquatic vegetation. This area would have been an important breeding spot for many bird, mammal, fish, and insect species as well as a critical stopover site for migratory waterfowl and shorebirds during the spring and fall. Smaller area of tidal marsh would have been found all along the Delaware River shoreline and the Schuylkill River up to the Fall Line (at Trenton on the Delaware and around the Fairmount Water Works Dam on the Schuylkill).

Today, around 1/3 square-mile of tidal marsh remains. A remnant of Tinicum Marsh persists in the John Heinz National Wildlife Refuge, straddling the Philadelphia-Delaware County line. Even with its greatly reduced size it still acts as critical habitat for many species. Efforts are underway to restore parts of Tinicum Marsh and expand it as possible, but development pressure in the area has continued to nibble away at the edges and further degrade the system. There are also concerns for Tinicum Marsh from the continued expansion of the Philadelphia International Airport. This pattern of development, nearly a complete concrete ring around the Refuge, is severely degrading the marsh through air and water pollution and uncontrolled stormwater runoff.

Other remnant tidal marshes still exist in and around Philadelphia County and may be used as reference sites for restoration or, with permission, seed banks.



A remnant tidal marsh outside of Tinicum Marsh along the Delaware River shoreline with blooming annual wild-rice, pickerelweed, and salt-marsh water-hemp. Annual wild rice and salt-marsh water-hemp are species of concern.

These sites can be found in Neshaminy State Park, Quaker Penn Park, Bristol Marsh at the mouth of Otter Creek along the Delaware River, and along the Pennsylvania side of Little Tinicum Island (Latham 2008).

One positive aspect is that tidal marsh restoration projects in and around Philadelphia have been generally successful. This success provides evidence that freshwater tidal marsh restoration projects in urban Philadelphia have a good possibility of success and should be pursued at every opportunity.

Spring Seeps

The spring seep community is common but almost always is very small in size and vulnerable to changes in local hydrology. Forming where ground water seeps to the surface and creates permanently saturated soils, these micro-wetlands are important landscape features for water recharge. During the spring they can also function as vernal pools, which are an essential component for reproduction in several species of reptiles and amphibians.

The dominant vegetation in spring seeps is usually skunk cabbage intermixed with a diverse range of herbs, ferns, sedges, and grasses. The exact mix of species present in the seep is highly variable but predictable, influenced by the pH and mineral content of the water feeding the seep.

Thus, these systems are very sensitive to disturbances that change the chemical composition, pH, or rate of flow to water feeding the seep. During times of low water, spring seeps will dry out and the plants will go dormant or die back until the water begins to flow again. However, springs can literally be sucked dry by excessive water withdrawal from the aquifer or inadequate water recharge due to too much impermeable surface in the watershed. If these seeps are left dry over successive seasons, the plants in them will eventually die and the micro-wetland and its ecological function will be lost.



A small, isolated spring seep in the Cobbs Creek watershed. Many hidden, relatively undisturbed and non-native invasive-free example of this community exist within the city.

photo source: PNHP

DISTURBANCES IN PHILADELPHIA

Overview

Disturbances, whether natural or man-made, have played a key role in shaping many of the county's natural communities and their associated species. The frequency and scale of these disturbances is formative in the appearance of natural communities today.

Natural disturbances such as fire and flooding can actually benefit certain natural communities and species. Periodic fires are needed to maintain grassland openings, allow new growth of the characteristic species, and keep out other successional species. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same time, streamside wetland communities retain excess water, thus reducing the scale of downstream flooding.

Another natural disturbance (exacerbated by human mismanagement), over-browsing by deer can have detrimental effects on natural communities and species (Rhoads and Klein 1993; Latham et al. 2005). Excessive deer browse can remove the understory of some forests and halt regeneration of new growth of the canopy and understory by preferential feeding. Deer feeding preferences can have a direct effect on rare plants and severely decrease essential habitat for other animal species. Current deer density in the Fairmount Park System is as high as 90 deer per mi^2 ; density of 8 to 10 deer per mi^2 will be needed to restore native vegetation (Fairmount Park Commission, pers. comm.).

Historically, beavers occupied the streams in Philadelphia. Disturbances caused by beaver can be both beneficial and detrimental to wetland habitats within the state. On one hand, thinning the canopy and flooding by beavers eventually creates open wetland meadows upon which many unique species rely. On the other hand, damming by beavers alters habitats to a degree that renders the sites no longer suitable for some species. For example, peatlands support an array of rare plants and animals, but flooding by beaver can degrade these communities until they no longer support the uniquely adapted species. Beaver activity in the long term is critical to the cyclic pattern of wetland disturbance, but in



photo source: PNHP

This photograph, from Wissahickon Park, showcases the destruction possible from an overpopulation of deer. While many people are attracted to the park-like atmosphere in this forest, there is very limited habitat due to the absence of a mid-story or shrub layer and it is representative of a degraded ecosystem. Decreasing deer population on lands could eventually allow this forest to recover, but this particular stand may require hands-on management to restore.

the short term, beaver activity can threaten the integrity of now rare wetland habitats and jeopardize many of the unique species that inhabit these natural communities. This creates difficulty in assessing how beavers should be managed. The long-term benefit of habitat creation must be weighed against the potential short-term threat to the existing plants and animals. In certain situations, beaver removal is preferred and implementation of management practices with regard to beaver must be considered on a case-by-case basis. In Philadelphia it may be necessary to consider how the absence of beavers is affecting wetland succession across the landscape.

Human and natural disturbances create different habitats in different scenarios, but human disturbances often leave the most lasting effect on the environment. Many human disturbances can be beneficial to a specific suite of species that require an early successional habitat. However, what is beneficial to one species is often detrimental to many other species. Many once common species have become rare because they are unable to adapt to disturbance of their small, specialized part of the environment. Consequently, many species have



Millbourne Dam, a run-of-the-river dam, across Cobbs Creek in Philadelphia.

declined due to human alteration of the landscape. Human disturbances are semi-permanent parts of landscape, but decisions about the type, timing, location, and extent of future disturbances are important to the natural ecological diversity that remains.

From a historical perspective, human disturbance to the natural communities of the county has been occurring for hundreds, if not thousands, of years. Because of Pennsylvania's central location in the original colonies and the abundant natural resources present, the state was a hub of human settlement and subsequently served as a "keystone" in the developing economies of the emerging country. Housing the first European settlement in the state, Philadelphia may have one of the most human-modified landscapes in the state. Additionally, because Philadelphia has been inhabited for such an extended period it has been extensively colonized by non-native species.

In many cases, human disturbances have directly affected natural communities and animal and plant species of the area. In Philadelphia, development has created biological "islands" where small natural areas are surrounded by development. These islands contain isolated populations of plant and animal species where gene flow between populations is inhibited. This loss of gene flow reduces the health of the population as individuals within an isolated group become more and more related.

Additionally, the many wetlands of Philadelphia were intentionally flooded or drained, resulting in the loss of biodiversity at a given site. In fact, in less than 25 years Pennsylvania lost 50% of its natural wetlands through draining and filling. Though increased efforts have been made to protect our remaining wetlands, these often rely on wetland mitigation, where artificial wetlands are created to replace those that are destroyed. From a biological standpoint, mitigated wetlands are of a poorer quality than natural wetlands and do not provide the diversity of species and functioning food webs that natural wetlands can provide (Ashworth et al. 2006; Balcombe et al. 2005; Fennessy et al. 2008; Hartzell et al. 2007; Snell-rood and Cristol 2003; Stanczak and Keiper 2004). It is important to protect existing wetlands first, even if they are degraded and resort to mitigation only as a last resort.

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

<http://www.emappa.dep.state.pa.us/emappa/viewer.htm>

Dams

Pennsylvania has thousands of dams on its rivers, streams, and creeks. Some of these dams currently serve important purposes, but many of these dams no longer serve their intended uses and have fallen into a state of disrepair. Philadelphia, being a very old city, still has numerous dams. These unnecessary structures can be a liability to their owners, as many run-of-the-river dams* create dangerous hydraulic conditions at their base, making them a threat to river users in the area. Due to this public safety threat, owners of existing run-of-the-river dams and permittees for the construction of new run-of-the-river dams are required to mark the areas above and below the dam to warn river users

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

of the dangerous conditions around the dam structure. This requirement went into effect on January 1, 1999 through an amendment to the Fish and Boat Code known as Act 91 of 1998 (P.L. 702, No. 91). Failure to comply with the responsibilities of Act 91 can lead to a civil penalty between \$500 and \$5,000 annually for each calendar year of noncompliance.

Besides acting as liabilities and maintenance headaches, dams cause numerous environmental impacts including reduced water quality, thermal pollution, disrupted sediment transport processes that increase sedimentation in impounded areas and increase streambed and streambank erosion in downstream areas, altered flow regimes, and habitat destruction and fragmentation. By removing the unused, unnecessary dams from waterways, natural free-flowing dynamics which support diverse ecosystems, reduce localized flooding and erosion, improve water quality, and restore habitat and access to upstream habitat for aquatic organisms can be

re-established. To address the impacts to resources under their management, the Pennsylvania Fish and Boat Commission has authority (PA Code Chapter 57, Section 22) to request that dam owners install fish passage structures on dams to benefit migratory or resident fish species.

Pennsylvania currently leads the nation in dam removal. Numerous agencies, non-profit organizations, and engineering firms have experience with dam removal in Pennsylvania. For more information on dam safety, dam owner requirements, and dam removal, please contact the Department of Environmental Protection Division of Dam Safety, at 717-787-8568 or at <http://www.dep.state.pa.us/dep/deputate/watermgt/we/damprogram/main.htm>.

Invasive Species

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

Invasive Plants

Invasive plants reproduce rapidly, spread quickly over the landscape, and have few, if any, natural controls such as herbivores and diseases to keep them in check (Table 5, pg. 16). Invasive plants share a number of characteristics that allow them to spread rapidly and make them difficult to remove or control:

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



photo source: PNHP

Mile-a-minute (*Polygonum perfoliatum*) smothering native vegetation.

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

Aggressive invasive plants can also transform a diverse small-scale ecosystem, such as a wetland or meadow, into a monoculture of a single species,

drastically reducing the overall plant richness of an area and limiting its ecological value. The decrease in plant biodiversity can, in turn, impact the mammals, birds, and insects in an area, as the invasive plants do not provide the same food and cover value as the natural native plant species did (Swearingen et al., 2002).

Control methods for these invasive species can range from hand pulling to mechanical methods (e.g., mowing) to herbicides. A variety of tools have been developed for control of several of these species (e.g., the WeedWrench and the Honeysuckle Popper). Control with herbicide should *only be performed by individuals with proper training and licensing* by the Pennsylvania Department of Agriculture. When working in sensitive habitats

Table 5.

Abridged list of significant invasive plant species found or with colonization potential in Philadelphia County.

Species	Description and Threat
Bamboo (<i>Bambusa</i> spp.)	This very large grass spreads through runners and wind-blown seeds. It is highly invasive and quickly forms large monocultures that offer little habitat to native species.
Burning bush (<i>Euonymus alatus</i>)	A shrub that can form dense thickets that displace native woody and herbaceous plants.
European alder (<i>Alnus glutinosa</i>)	A highly invasive tree species that forms smothering thickets along rivers and in wetlands
Garlic mustard (<i>Alliaria petiolata</i>), pachysandra (<i>Pachysandra terminalis</i>)	These increasingly common invasive herbs are spreading through natural areas throughout the region. Garlic mustard is known to disrupt mycorrhizal relationships that trees depend on for growth and pachysandra forms large mats of vegetation that can prevent forest regeneration.
Japanese and giant knotweed (<i>Polygonum cuspidatum</i> and <i>P. sachalinense</i>)	These large fast-growing exotics displace natural vegetation, greatly alter natural ecosystems, and degrade riparian systems through Philadelphia. Typically found along stream banks and other low-lying areas, as well as old home sites and waste areas.
Japanese honeysuckle (<i>Lonicera japonica</i>), Japanese hops (<i>Humulus japonicus</i>), Oriental bittersweet (<i>Celastrus orbiculatus</i>), porcelain berry (<i>Ampelopsis brevipedunculata</i>), English ivy (<i>Hedera helix</i>)	These species of vines cover and out-compete native vegetation as well as girdle trees by twining up them. They are noted for devastating unmanaged tree and shrub planting by smothering the plants and often form an impenetrable barrier along forest and stream edges. Additionally, Japanese hops and English ivy are noted for causing skin rashes.
Japanese stiltgrass (<i>Microstegium vimineum</i>)	A fast-spreading grass that is typically found in cool, shaded areas. Out-competes native vegetation and may have an effect on animal species that use streamside microhabitats.
Mile-a-minute (<i>Polygonum perfoliatum</i>)	A vine that invades open and disturbed areas and scrambles over native vegetation, smothering them. This species is listed as a noxious weed in Pennsylvania.
Multiflora rose (<i>Rosa multiflora</i>)	Widely planted shrub that invades many habitats; excludes most native shrubs and herbs.
Non-native bush honeysuckles (<i>Lonicera tatarica</i> , <i>L. morrowii</i> , <i>L. maackii</i> , and <i>L. xylosteum</i>)	Found in a variety of environments from wetlands to uplands. These compete with native plants for moisture, nutrients, and pollinators. Fruits do not provide high-energy food for migrating birds.
Non-native viburnums (<i>Viburnum plicatum</i> , <i>V. sieboldii</i> , <i>V. dilatatum</i>)	Shrubs or small trees that supplant native viburnum species. Commonly used in landscaping, the berries of viburnums attract birds allowing quick and widespread invasion.
Norway maple (<i>Acer platanoides</i>), sycamore maple (<i>A. pseudoplatanus</i>)	Introduced and still sold as ornamental trees, they have spread throughout Pennsylvania invading many rich upland woodlands and are commonly found along roadsides.
Princess tree (<i>Paulownia tomentosa</i>)	A fast growing tree commonly planted in landscaping. Competes with native forest species.
Privet (<i>Ligustrum</i> spp.)	A shrub that forms dense thickets in floodplains, forests, wetlands, and fields.
Purple loosestrife (<i>Lythrum salicaria</i>)	An herbaceous wetland invasive that is present at scattered sites throughout the county. Once established in a wetland this species is difficult to eradicate and will displace native species.
Tree-of-heaven (<i>Ailanthus altissima</i>)	Introduced to Philadelphia from China in the early 1800s, it is present throughout the state. This fast growing tree is a prolific seeder and can also proliferate through vegetative means.
White mulberry (<i>Morus alba</i>), paper mulberry (<i>Broussonetia papyrifera</i>)	These two species, introduced from east Asia, are common invasive species along riparian corridors and in disturbed lands where they form large monocultures.

such as wetlands, a “wetland-safe” herbicide should be used to avoid indirect effects on other organisms. It should be noted that several popular herbicides have severe adverse affects on amphibians and reptiles and should not be used in or around wetlands under any circumstances. Also, different invasive species present on a site may require a different technique or suite of techniques for effective control. Generally speaking, control efforts should be concentrated before these species disperse their seed for the year. Specific control methods for many invasive species can be found at:

<http://www.invasive.org/eastern/>. Other invasive plants that pose fewer, but still significant, threats to native flora and fauna have been observed in the county. For example, zebra grass or Chinese silvergrass (*Miscanthus sinensis*), a widely planted ornamental grass, has been observed spreading along roadsides into natural areas in Philadelphia.

Invasive Animal Species

In addition to invasive plants, Pennsylvania is now home to several exotic species of animals including

Table 6.
Abridged list of significant invasive animal species found or with colonization potential in Philadelphia County.

Species	Description and Threat
Asian clam (<i>Corbicula fluminea</i>)	Found in extremely high densities along major tributaries and rivers, this species is directly competing with native mussels for food and habitat.
Red-eared slider (<i>Trachemys scripta</i>)	This species of turtle, native much further south in the United States, competes directly with native turtles for basking and nesting sites.
Common carp (<i>Cyprinus carpio</i>)	Introduced as a food fish, this species is now found anywhere with warm, slow-moving water. As a bottom feeder it greatly increases turbidity and mobilizes large amounts of sediment.
European starling (<i>Sturnus vulgaris</i>)	Competing directly with native cavity-nesting birds, this species also cause severe crop damage.
Grass carp (<i>Ctenopharyngodon idella</i>)	A voracious herbivore, this species was introduced to control weeds in eutrophied lakes. However, it now causes significant damage to native wetland vegetation that is important for reducing nutrients in water-bodies.
Gypsy moth (<i>Lymantria dispar</i>)	Feeding preferentially on oak trees (<i>Quercus</i> spp.) and their relatives, this species will eat almost any plant when forced and can cause severe environmental and economic damage.
Hemlock woolly adelgid (<i>Adelges tsugae</i>)	Often called simply HWA, this species is causing severe damage to eastern hemlock (<i>Tsuga canadensis</i>) killing up to 90% of infected trees, thus greatly modifying ecosystems.
House cat (<i>Felis silvestris</i>)	House cats, both domestic and feral, can individually kill several small animals each day. Summed among the great number of house cats out-of-doors this adds up to <i>billions</i> of small amphibians, reptiles, birds, and mammals each year in the United States.
House mouse (<i>Mus musculus</i>)	Ubiquitous throughout the world, this species carries many diseases, competes directly with many native species, and can cause significant damage to crops and structures.
House sparrow (<i>Passer domesticus</i>)	Generally found any place humans are, this species can cause crop damage, but mainly competes with small, native cavity nesting birds.
Multicolored Asian ladybird beetle (<i>Harmonia axyridis</i>)	Preying on native insects and invading houses each winter, this species was likely introduced in an attempt to control non-native aphids.
Mute swan (<i>Cygnus olor</i>)	While considered pretty by some, this European invader causes significant damage to wetland vegetation that it “grubs” out during feeding. Additionally, it is fiercely competitive and will exclude all other native waterfowl from its nesting territory to the point of killing intruders.
Norway rat (<i>Rattus norvegicus</i>)	Generally a pest of human infrastructure, the Norway rat is also found around rivers and other water systems. Known as a carrier for many diseases, this species is a threat anywhere it occurs.
Rock dove / European pigeon (<i>Columba livia</i>)	Generally found around human structures, this species can cause crop damage, is a known carrier for several serious human diseases, and causes a general mess where it nests and roosts.
Rusty crayfish (<i>Orconectes rusticus</i>)	Found in many of our streams, this recent invader is displacing native crayfish, reducing fish populations by feeding on young fish, and generally disrupting aquatic systems.
Flathead catfish (<i>Pylodictis olivaris</i>)	Native to the Mississippi watershed, this species was introduced to the Delaware River watershed for sport fishing. An efficient and voracious predator, flathead catfish are known to reach over 100 lbs allowing them to prey upon almost any native species of fish.
Snakehead (<i>Channa</i> spp.)	Prized as a food species in Asia, this species was recently introduced to the East Coast and has quickly taken root. It is currently found in several ponds in the Philadelphia area.
Zebra mussel (<i>Dreissena polymorpha</i>)	Introduced from dumped ballast water, this species must be watched for given its disastrous effects on ecosystems and economies.

mammals, birds, fish, and reptiles along with a suite of invertebrates, fungi, and bacteria (Table 6, pg. 17). These species can directly threaten populations of native animals through direct competition or predation. Other invasive exotic animals can alter habitats and ecosystems by changing plant cover or diversity. Some of these invasive animals, such as the Norway rat (*Rattus norvegicus*), are all too common pests of our homes and developed areas.

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

Another introduced tree-killing species is the hemlock woolly adelgid (*Adelges tsugae*). This is a small aphid-like insect that feeds on the leaves of eastern hemlock trees (*Tsuga canadensis*). Infestations of the woolly adelgid appear as whitish fluffy clumps of feeding adults and eggs along the underside of the branch tips of the hemlock. Hemlock decline and mortality typically occurs within four to ten years of initial infestation. The adelgid can cause up to 90% mortality in eastern hemlocks, which are important for shading trout streams, and provide habitat for about 90 species of



photo source: Connecticut Agricultural Experiment Station Archive

Hemlock woolly adelgid infestation along a hemlock branch.

birds and mammals, some exclusively. Several control options are currently being tested, but these have met with very limited success. This species was originally found in Japan and China and was introduced accidentally to North America around 1924 (McClure 2001). It is currently distributed from Maine to Georgia and can be found in most of the counties in Pennsylvania (PA DCNR 2007).

The gypsy moth (*Lymantria dispar* L.) has caused extensive defoliation of forests in the northeast. This European moth was intentionally introduced to the U.S. in 1869 as part of a failed commercial silk production venture. Its main impact is that it defoliates trees, concentrating on oak species, but opportunistically eating almost any type of plant. This defoliation can result in a reduction in the growth rate and eventual death of afflicted trees.

The European starling (*Sturnus vulgaris*) is an exotic bird species established to North America in the late 1890s and it has since spread throughout the US. In addition to competing with native bird species for food and space, large flocks of this species destroy fields of crops. The house sparrow (*Passer domesticus*) was introduced to several places in the United States in the late 1800's and has since become ubiquitous with human settlement. In addition to causing crop damage, house sparrows will kill native adult cavity nesting birds and their young and smash unattended eggs. The house sparrow is partially responsible for a decline of eastern bluebirds (*Sialia sialis*) in the United States.

Several invasive animal species are spreading throughout the streams, rivers, and lakes of Pennsylvania, but in many cases the impact of these

photo source: M. C. Barnhart
<http://unimind.missouristate.edu/>



Fatmucket (*Lampsilis siliquoidea*) covered in zebra mussels (*Dreissena polymorpha*)

species remains unknown. The zebra mussel (*Dreissena polymorpha*) was accidentally introduced to the Great Lakes in the 1980's and has been spreading in Pennsylvania's waters. This mussel poses a great threat to industry, recreation, and native fish and mussel species and should be controlled wherever it occurs. Another non-native bivalve, the Asian clam (*Corbicula fluminea*), has spread throughout most of Pennsylvania's waterways including the Schuylkill, Delaware and their tributaries. Of greatest concern to biodiversity is the capacity of the clam to alter the ecology of aquatic systems, making it less hospitable to the native assemblage of freshwater mussels, fish, invertebrates, and plants. Another aquatic species found in the county, the rusty crayfish (*Orconectes rusticus*), has been transplanted from its native range in the Midwestern United States to many of Pennsylvania's watersheds in the form of live fishing bait even though it is prohibited from transport by the state. Potentially, rusty crayfish can reproduce in large numbers and reduce lake and stream vegetation, depriving native fish and their prey of cover and food. Their size and aggressive nature keep many fish species from feeding on them. Rusty crayfish may also reduce native crayfish, freshwater mussels, and reptile and amphibian populations by out-competing them for food and habitat or by preying directly on young individuals.

An additional threat in urban areas is large flocks of resident Canada goose (*Branta canadensis*). These flocks have lost the incentive to migrate due to human modification to the environment that have suppressed the number of predators, create open water year round, and provide a constant supply of food. These large flocks can do significant damage to native vegetation (both aquatic and terrestrial) and contribute to nutrient loading of lake, rivers, and lawns. Large resident populations of waterfowl may also become repositories for pathogens, which they continually reintroduce into the environment.

Overall Invasive Recommendations

The prevalence of invasive species within Philadelphia presents a significant hurdle to the reestablishment of native plants and animals. Additionally, new invasive species continue to be introduced, further degrading natural habitat and displacing native species. This continuous disturbance from invasive species mandates their

Table 7.
Noxious Species List for Pennsylvania. Possession, propagation, transport, barter, and/or sale of these species is prohibited in Pennsylvania.

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

active management for any native vegetation restoration plan to be successful.

Philadelphia has many areas managed for native vegetation, but these sites are threatened by invasive species. Successful control of invasive species is a time-, labor-, and resource-intensive process, but it is also necessary for native areas to survive. Prevention or control during the early stages of an infestation is the best strategy. In areas where invasive plants are well established, multiple control strategies and follow-up treatments may be necessary. After the infestation has been eliminated, regular "maintenance" of the site to prevent a new infestation may also be needed. Specific treatment depends on the target species' biological characteristics and population size. Invasive plants can be controlled using biological, mechanical, or chemical methods.

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

- Natural Heritage sites in this report can serve as useful high conservation value “focus areas” for the control of invasive species.
- Many education resources exist regarding invasive exotic species. Regional groups such as the Mid-Atlantic Exotic Pest Plant Council (<http://www.ma-eppc.org/>) can help with funding opportunities and educational outreach on invasive species.
- Weed warrior programs can be used to educate the public on the identity and consequences of invasive species and involve them in the removal of invasive species. Urban Weed Warrior programs have been initiated in large cities around the world as partnerships between private non-profit organization, city governments, and the people.
- Pennsylvania has a Noxious Weed law that prevents the propagation, sale, or transport of several weed species within the Commonwealth (<http://www.agriculture.state.pa.us/agriculture/lib/agriculture/plantindustryfiles/NoxiousWeedLawSummary.pdf>). Most of the 13 species that are currently listed are agricultural weeds that rarely threaten natural areas; however several are invasive in non-agricultural settings. The Pennsylvania Fish and Boat Commission maintains a list of aquatic nuisance species that are prohibited from possession, sale, barter, or distribution within the Commonwealth (<http://www.fish.state.pa.us/ais.htm>). This list includes the zebra mussel and the rusty crayfish among others. See table 7 (pg. 19) for the complete list of prohibited species.

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

species. An excellent resource for information on Pennsylvania's native horticulture-friendly plants can be found at:

<http://www.dcnr.state.pa.us/forestry/wildplant/native.aspx>.

ECOLOGICAL REHABILITATION, RESTORATION, AND RE-CREATION IN PHILADELPHIA

Overview

As the benefits of a healthy natural environment has become increasingly apparent, information on ecological restoration and re-creation has become more available and accessible. This ease of information access has promoted the growth of organizations and business devoted to ecological restoration that can be hired to create and implement restoration plans.

However, restoration plans need to be realistic in their scope and expectations. Every site is unique. The site's surface geology and ecologic history, position in the landscape, land use history, surrounding land use, and a myriad of other factors will dictate not only the ecologic potential of the site, but the economic cost of restoring or re-creating a natural community on it. In general, it is easier and cheaper to maintain high-quality existing natural areas than it is to restore degraded system, much less re-create ecological systems anew. For restoration efforts to be successful, a suite of factors affecting the site needs to be considered. While assessing every aspect that affects a site is daunting, the expanding body of restoration resources available can assist in this task.

Tenets of Ecological Restoration

- *Do no harm*

The first thing to consider is whether restoration is necessary or possible. If the existing ecological system is functioning and providing environmental value, this needs to be weighed against the impact restoration will have to that system and the organisms currently using it.

- *Have clearly outlined and realistic goals, methods, means, and benchmarks of success*

Simply planting native species and expecting them to thrive and maintain themselves in an already modified system is a path to failure, just as attempting a system-wide environmental re-creation on a shoe-string budget is. The project's restoration goals, the methods and means needed to achieve these goals, and the

benchmarks to determine whether you have succeeded or *failed* need to be laid out in a manner that accounts for the resources and expertise allocated to the project before work begins.

- *Use ecologically appropriate native species from local seed sources*

The species and ecosystems that can survive on a site will be dictated by site conditions, but a species survival is related to the local genetics and species adaptations. A single species will be adapted to different climates and site conditions across its range. This means that while a species from a local seed source can thrive on a site, the same species from a different part of the range may fail or even act as an invasive.

- *Approach from the standpoint of long-term management and stewardship*

A successful restoration may take years to decades to accomplish, with active management required throughout the establishment period. A failure to plan for the long-term monitoring and management of a restoration site will invite its regression to the pre-restoration condition. Additionally, without long-term monitoring there is no way to assess whether the project succeeded or not and insight to better restoration methods will be lost.

Planning Aspects

- *Objectives, goals, and timeline*

Outlining a project's minimum objectives, ultimate goals, and expected timeline will need to be the first step in any restoration project. These will determine the projects cost, dictate the methods necessary to meet objectives, and inform the choice of what to monitor to assess progress towards the projects goals.

- *Budget*

Restoration projects can be very expensive depending on site size, the level of site

preparation needed before restoration can begin, the species and number of individuals required, the labor for planting and maintaining the site, and management needed during site establishment. It is important to secure the needed funding before the project commences to increase the likelihood of the project succeeding, or reduce the scale and scope of the project to fit with the available budget.

- *Management methods and contingency plans*

Ecosystems are dynamic and can respond to restoration activities in unpredictable manners. Having pre-defined methods for land management can direct these responses, but ongoing monitoring of the site will be necessary to determine whether the effort is creating the expected outcome. It is important to have contingency plans ready if restoration goals are not being met within the project timeframe or budget.

- *Site assessment*

The degree of detail necessary in a site workup will depend on the site's history and the type of restoration planned. A restoration involving only the removal of invasive species may necessitate little more than a list of the species needing to be removed or protected during removal activities. As the complexity of the restoration project increases so will the detail, breadth, and cost of the information needed.

- *Long-term management strategy*

Ecological systems tend to resist change even if that change is attempting to restore the system to a prior, more ecologically healthy state. To assess whether the ecological path of a system has been sufficiently changed to meet restoration goals, long-term monitoring will be needed. Setting up a long-term monitoring and management structure can help protect the investment made in the restoration project.

Integration of restoration projects into the larger landscape

An ecosystem cannot survive in isolation. Connections to and through other ecosystems are needed to keep these complex and dynamic

assemblages healthy. These connections need to allow for the safe movement of not only animals, but also plants, fungus, insects, and the entire suite of species present within the system.

In the absence of these connections, isolated ecosystems tend to lose species over time. As a species is lost the function it provides to the ecosystem is also lost. If enough of an ecosystem's species and their functions are lost the ecosystem can collapse.

With the goal of ecological restoration being to restore ecosystem function to a self-sustaining level, creating and maintaining these connections becomes a necessary and vital part of any planning effort.

Conclusion

Ecological rehabilitation, restoration, and re-creation will be necessary aspects of the re-greening of Philadelphia. For them to succeed over the long-term they must be undertaken in a concise and preplanned manner. A lack of planning, monitoring, *and* managing these projects with a long-term outlook invites their failure and the loss of the time and resources invested into them.

MAMMALS OF PHILADELPHIA

Philadelphia County lies within the Piedmont Upland Section of the Piedmont Province as well as along the Atlantic Coastal Plain Province. Because of the level of development in the area, many of the mammal species generally common throughout the more forested and rural portions of the state are either extremely rare or nonexistent. With more than 80% of the county comprising either urban or highly developed suburban environment, there are not many opportunities for the public to observe the state's mammals except by visiting institutions such as the Philadelphia Academy of Natural Sciences or by hiking through the parks and preserves that dot the landscape.

It is interesting to note that, in some ways, the state's studies of mammals began in Philadelphia with the many scientists and naturalists that frequented the Philadelphia Academy of Natural Sciences and conducted many of their mammal studies in and around the area. One of the earliest texts in the Americas describing the mammalian fauna of the region surrounding Philadelphia, "The Mammals of Pennsylvania and New Jersey", was written by Samuel N. Rhoads in 1903 and published in Philadelphia. The first line of the text is a testament to the importance of wildlife to this day: "Job, the ancient divine and naturalist, asks, 'who teacheth us more than the beasts of the earth or maketh us wiser than the fowls of the heavens?'" Species that existed around Philadelphia prior to and during the early mammalian studies, such as the eastern cougar, grey wolf, harp and harbor seals, and several whale

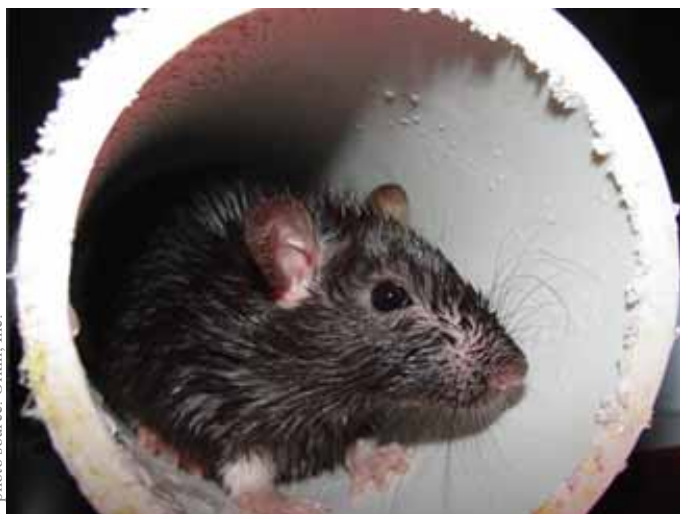


Grey squirrels (*Sciurus carolinensis*)

and dolphin species, are either gone from the state entirely or are extremely rare in the waters along the Delaware Estuary. Other species such as elk have seen their populations grow throughout Pennsylvania, but remain absent within the county. This being said, there are still opportunities for the patient hiker or biker to become aware of the many species of mammal still occurring in Philadelphia County.

The mammals of Philadelphia fall into three distinct categories: those species that are common within the urban environment, those species that occur within the parks and other undeveloped areas, and those occurring in the marshes and wetlands along the coastal plain and within the Delaware Estuary.

The first category contains many of the species that humans could likely live without, including the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*), two species not native to the North American continent, and feral cats and dogs, which, when they begin to revert to their historically wild nature, may become dangerous to people and native wildlife. Several other species, such as the gray squirrel (*Sciurus carolinensis*) and chipmunk (*Tamias striatus*), have become well established within urban environments where tree-lined landscapes provide the habitat necessary for their success.



Norway rat (*Rattus norvegicus*)

photo source: Tanya Dewey, Animal Diversity Web

photo source: Orkin, Inc.



White-footed mouse (*Peromyscus leucopus*)

The Norway rat is a species that is commonly associated with diseases such as bubonic plague, rat bite fever, typhus, and even rabies, and has proved to be a challenge in terms of control. The house mouse, a very common species that is best described as a “nuisance,” can be found throughout urban areas as well as in rural areas around farms and outbuildings. Both of these species, however, are very beneficial to the scientific community for many different research purposes ranging from medical to behavioral.

Feral cats and dogs pose problems because of their danger to humans as well as their destructive impact on native wildlife, since cats and dogs are carnivores and effective predators of native mammals, birds, reptiles, and amphibians. While they can serve as rodent control in a very limited manner (such as in agricultural settings), they can carry diseases dangerous to humans and other wildlife and have been the documented cause for native species extinctions.

Squirrels and chipmunks, denizens of many habitats throughout Pennsylvania, are likely the most visible mammal species in the urban environs. These two species are common in the neighborhoods of Philadelphia and are found nesting and traveling through the backyards, trees, and power lines and found digging in the many gardens of the city. Squirrels can, however, become a nuisance when they begin to chew through insulation of electrical wires or buildings or get into homes and set up nests in attics. Chipmunks can be a problem for gardeners as they burrow into the soil and eat bulbs and plants. Species such as the gray squirrel, however, serve as educators of wildlife to urban children and adults

alike as they go about their daily routines even in highly developed and “unnatural” environments. Additionally, squirrels and chipmunks serve as important seed dispersers and as a food source for many birds of prey.

The second group of mammals occurring in Philadelphia County is those that are common in the various parks and open lands and include species that are widespread throughout Pennsylvania and are also generalists in their use of habitats. Many of these species are quite unremarkable in that they possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout both the county and the state. These species include the northern short-tailed shrew (*Blarina brevicauda*) and several other shrew and mole species, white-footed mouse (*Peromyscus leucopus*) and several other rodent species, as well as northern raccoons (*Procyon lotor*), skunks (*Mephitis mephitis*), and opossums (*Didelphis virginiana*).

Open land in the form of meadows and grasslands are habitat types commonly found in the parks of the county. The most well known mammal occurring in these open lands is the meadow vole (*Microtus pennsylvanicus*). The runways formed by this medium-sized rodent can be seen under dense vegetation during the summer months and under the icy crust forming on snow during the winter months. Meadow voles are very successful at dispersing and can be found using gardens, hedgerows, and culverts in housing developments. Several other species of mammal are common in parks and include the eastern cottontail rabbit (*Sylvilagus floridanus*) and groundhog or woodchuck (*Marmota monax*). It is even possible to see red foxes (*Vulpes vulpes*)



Red bat (*Lasiurus borealis*)

hunting along the river and within the woodlands of the city's parks.

Bats are somewhat more common within the county than most people would expect, with bats most often encountered during summer evenings along the streams and open bodies of water in the county, especially foraging over the Schuylkill River and the various forested creeks in the parks. The silver-haired bat (*Lasionycteris noctivagans*), a rarely encountered bat species in Pennsylvania, was first captured within Philadelphia County and nearby Berks County during the early part of the last century. It is unknown whether it still frequents the area, although it has been found to be a resident of other regions of the state. During the winter months most bat species, such as the little brown bat (*Myotis lucifugus*) and eastern pipistrelle (*Pipistrellus subflavus*), disappear into caves and mines common within the central and southwestern portions of Pennsylvania and surrounding states. Bats from Philadelphia County may overwinter in Bucks County at the Durham Mine, returning when the weather permits foraging on the many insects available throughout the parks and along the watercourses. Several species such as the hoary bat (*Lasiurus cinereus*) and red bat (*Lasiurus borealis*), which have been found nearby in the Valley Forge area, do not overwinter in the state at all: they migrate further south to states like the North and South Carolina and Florida and are thought to spend their winter months in hibernation under deep patches of leaves and forest floor litter. Although the bat fauna of Philadelphia County may not be as diverse as that found in other portions of the state, bats can still be seen foraging at streetlights and over the waters in the county and sometimes form large



Marsh rice rat (*Oryzomys palustris*)



Raccoons (*Procyon lotor*) and skunks (*Mephitis mephitis*) have adapted easily to human-modified environments.

colonies in buildings such as found at the John James Audubon Center at Mill Grove.

The third category of mammals includes wetland species and marine mammals, all of which are believed to be either extremely rare or have disappeared altogether from the county.

There are several records for porpoises and even small whales occurring in the Delaware Estuary. These records are from the early to mid-1900's and are very infrequent. It is likely that pollution of the estuary has caused these marine species to avoid the area although they are still somewhat common in New Jersey along the Atlantic coastline and in the harbors of New York City.

Another species that could possibly occur along the marshes and wetlands of Philadelphia County is the marsh rice rat (*Oryzomys palustris*), although it remains unknown whether any Philadelphia records exist for this species. The rice rat is a native of North America and differs from Norway rat in both the habitat in which it occurs as well as its size and pelage (fur) characteristics. It is generally smaller than the Norway rat and has softer, more colorful fur and a more mouse-like face. It has been found in New Jersey but, if it ever occurred in Pennsylvania, may now be extirpated.

A species that occurs along the marshes is the muskrat (*Ondatra zibethicus*). This rodent burrows in stream banks and in areas above the waterline where streams flow into the estuary, feeding on the various wetland plants including the cattails

common to marsh. It is quite likely that as marshland was either reclaimed for development or drained during the previous century and its habitat became restricted, it came into contact with the marsh rice rat and out-competed it for the remaining habitat. In other areas where muskrat populations have increased along marshes, the rice rat has become less common. Recently, northern river otter (*Lontra canadensis*) have been photographed using the fish ladder at the Fairmount Dam confirming their presence in the City's waterways.

Habitat availability and food resources are extremely important factors in the success of mammals as reproductive females and dispersing individuals require consistent and substantial amounts of both in order to bear young, nurse, and travel between nesting and foraging areas or find new nest sites. Within Philadelphia County, a lack of contiguous habitat has created population "islands" that may not be able to disperse over the landscape and may be in jeopardy of disappearing in the future. Development of land, splitting of habitats by uncrossable barriers such as major highways, drainage of wetland areas, and environmental degradation have all served to confine many mammal species to small, localized populations. These populations may lack the ability to survive any major change in food resources, availability of nesting habitat, or increased predation. These populations may be doomed to what is termed "localized extinction." If enough of these populations disappear from the landscape, these species' existence in Philadelphia County may be in jeopardy. Efforts to conserve valuable open space and parklands in the county, as well as planning that creates possible dispersal corridors between existing greenspace, should be undertaken.

Important Mammal Areas

One Important Mammal Area (IMA) has been designated in

Philadelphia County. The John Heinz National Wildlife Refuge is listed as an area important to the conservation and protection of the states mammal populations under the IMA program developed by the Pennsylvania Biological Survey. The area is noted as supporting northern river otter use on occasion and being the last potential location for the marsh rice rat in the Commonwealth.

Conservation

Conservation of this IMA should be focused on improving the water quality of the area. Continued control of non-native invasive species on the refuge will be needed to maintain the habitat, along with restoration of native vegetation in the managed areas. Management of the local deer herd, non-migratory Canada goose, and carp populations will be needed to maintain and restore the vegetation in the respective habitats.

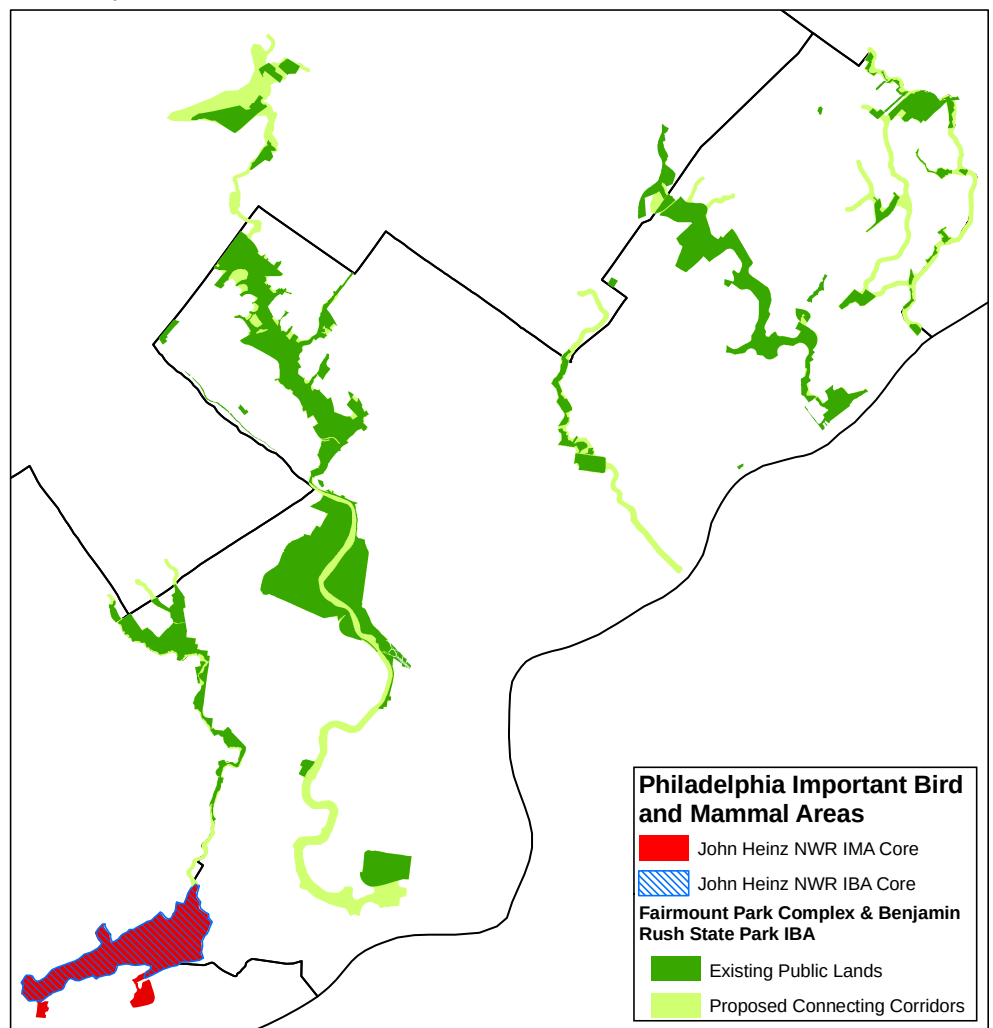


Figure 8. Important Bird Areas and Important Mammal Areas in and around Philadelphia County.

BIRDS OF PHILADELPHIA

Pennsylvania is an important state for breeding, migrating, and wintering birds (Brauning 1992). Philadelphia County, with its proximity to Tinicum Marsh, the Delaware Bay, and the confluence of the Delaware and Schuylkill Rivers, presents a wide range of habitats for birds. The habitat types include the remnant tidal marsh of Tinicum, upland woods and grasslands, riparian corridors and expansive riverine areas, and the urban environment. Several of these important habitats are being negatively affected by land use choices both within and beyond the city. The protection and responsible management of these ecosystems is necessary for the maintenance of healthy bird populations.

Additionally, because of Philadelphia's proximity to many important migratory areas, it serves as a major resting stop for migratory birds traveling along the Atlantic Flyway. It is not uncommon for several hundred different species of birds to pass through the Philadelphia area over the course of the year.

Urban Species

The urban landscape that covers much of the Philadelphia area offers habitat for many common bird species. These are species that can not only find habitat for feeding, nesting, and hiding in an urban setting, but can also adapt to the pressures of continued close encounters with humans. In densely populated areas the species that are able to adapt to these conditions are limited. In more suburban areas or neighborhoods with greater tree cover this list can rapidly increase as more habitat niches become available.

Common Native Urban Bird Species of Pennsylvania

American Crow	<i>Corvus brachyrhynchos</i>
American Robin	<i>Turdus migratorius</i>
Common Grackle	<i>Quiscalus quiscula</i>
House Finch	<i>Carpodacus mexicanus</i>
Mourning Dove	<i>Zenaida macroura</i>

Common Suburban Bird Species of Pennsylvania

American Goldfinch	<i>Carduelis tristis</i>
Carolina Chickadee	<i>Poecile carolinensis</i>
Baltimore Oriole	<i>Icterus galbula</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Northern Mockingbird	<i>Mimus polyglottos</i>
Song Sparrow	<i>Melospiza melodia</i>



photo source: Joe Kosack/PGC Photo

Peregrine Falcon (*Falco peregrinus*)

The urban environment has even become as a refuge for rare species in some instances. The Peregrine Falcon (*Falco peregrinus*) nearly went extinct due to the effects of DDT and other organochlorine pesticides. These chemicals cause the bird eggshells to become so thin that the nesting parent would crack the eggs at the slightest bump and kill the chick inside. This eggshell thinning affected many species and nearly drove some to extinction and extirpated others from much of their range. However, the Peregrine Falcon, historically nesting on steep rock cliffs, readily took to nesting on top of tall buildings in urban areas. This allowed resource conservation specialists easy access to the nests, (via the elevator!) where they collected the eggs, carefully hatched them in a controlled environment, and then returned the chicks to the parents without the parents ever knowing. Today the affects of DDT have subsided enough that Peregrine Falcons are

now able to raise their chicks without human assistance and may be seen chasing the Pigeons around City Hall in downtown Philadelphia on any average summer day.

Forest Species and Edge Habitat

Large contiguous tracts of forests, necessary for forest interior species, are declining in most regions. This is true in Philadelphia where even the large forested blocks within the Fairmount Park System are bisected by roads, paths, and trails. Fragmentation and smaller interior area negatively affects the nesting success of forest interior bird species (Whitcomb et al. 1981). Increased forest edges exposes nesting birds to greater dangers such as brood parasitism and nest predation (Robinson 1994). For example, interior birds nesting near edges are more often parasitized by Brown-headed Cowbirds (*Molothrus ater*), which lay their eggs in other bird nests where they are raised at the resident bird's expense.

Common Edge Species in Southeastern Pennsylvania

Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>
Eastern Bluebird	<i>Sialia sialis</i>
Eastern Towhee	<i>Pipilo erythrophthalmus</i>
Gray Catbird	<i>Dumetella carolinensis</i>
Orchard Oriole	<i>Icterus spurius</i>
Prairie Warbler	<i>Dendroica discolor</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
Yellow-breasted Chat	<i>Icteria virens</i>

Common Forest Species in Southeastern Pennsylvania

Cooper's Hawk	<i>Accipiter cooperii</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Eastern Phoebe	<i>Sayornis phoebe</i>
Great-horned Owl	<i>Bubo virginianus</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
White-breasted nuthatch	<i>Sitta carolinensis</i>

Common Grassland Species in Philadelphia

American Kestrel	<i>Falco sparverius</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Eastern Meadowlark	<i>Sturnella magna</i>
Field Sparrow	<i>Spizella pusilla</i>
Grasshopper Sparrow	<i>Ammodramus savannarum</i>
Killdeer	<i>Charadrius vociferous</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
swallows	<i>Hirundinidae</i>

However, several bird species are specially adapted to the forest edge and "old field" habitat types and are found within Philadelphia. Good examples of this habitat type can be found in and around Benjamin Rush State Park. This successional habitat is generally short lived and acts as suitable habitat for these species for only 10 to 30 years. After that, the vegetation age and structure becomes too forest-like and these species move away.



photo source: Ron Austing

Eastern Meadowlark (*Sturnella magna*)

Additionally, this habitat type is very susceptible to invasion by non-native plant species that decrease the value for nesting birds. Maintaining this habitat type through periodic management and control of invasive plant species can help preserve these species within the Philadelphia area.

Grassland Birds

Grasslands and open fields create a unique habitat for a variety of bird species. Historically, grasslands were not a dominant part of the northeastern United States landscape, but were present and extensive in some areas. Philadelphia would have had extensive grassland-like areas within the tidal marshes found in the area. Although more grassland has been created in this historically forested state, a large number of grassland birds appear to be declining throughout the eastern US as documented in the American Breeding Bird Survey (BBS). Most grassland birds, including common species, show a decline of around 40 to 60 percent (Sauer et al. 2000). Their decline has resulted from increasingly intensive agricultural practices, habitat fragmentation, increased pesticide and herbicide application, natural fire suppression, and human development of the landscape.

Within Philadelphia several meadows are maintained by the Fairmount Park Commission and these can serve as grassland bird habitat. Additionally, both of the airports within Philadelphia can offer grassland bird habitat in areas where there is not direct conflict with plane operation.



Sora (*Porzana carolina*)

Marsh, Wetland, and Riparian Dependent Birds

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

Wetlands are transitional lands between terrestrial and aquatic systems and have high species diversity and exceptional environmental value. Saturation by water determines the soil development, which in turn influences the type of plants and animals using that habitat. Wetlands range in size from very small vernal pools to massive complexes; the associated plants and animals are just as varied. Common wetland birds include waterfowl, shorebirds, herons, rails, bitterns, swallows, and sparrows to name a few. Many wetland-dependent birds are of special concern to the Pennsylvania Natural Heritage Program (PNHP) because of habitat loss across their range. Many of these birds are also secretive, cryptic, and hard to flush, making marshes difficult areas to survey. These species are also very habitat specific and unknown from other habitats.

Wetlands and riparian zones also provide breeding and foraging habitat for various raptors and wading birds. Raptors, such as the Osprey and Bald Eagle, prefer nesting on top of tall trees with a good view of the surrounding land. Wading birds, such as herons and egrets, prefer clumps of dead trees surrounded by water for their rookeries. Trees around wetlands often provide the nesting habitat these species require with all of these species often

found around rivers and wetlands at the same time. Species, such as the Double-crested Cormorant (*Phalacrocorax auritus*), are very common around the City and are regularly seen on the buoys in the rivers.

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

Philadelphia abuts the largest tidal marsh remaining in Pennsylvania. Tinicum Marsh, residing within the John Heinz National Wildlife Refuge, contains around 200 acres of remnant tidal wetland. Originally covering between 10 and 20 square miles (6,400-12,800 acres), this wetland has been severely modified by human activity through diking, dredging, and filling. Despite these activities the wetland still supports populations of several Pennsylvania rare, threatened, and endangered species. In addition, Tinicum Marsh is a feeding and nesting location for many wetland and upland species and a migratory stopover point for hundreds of thousands of birds each spring and fall.

Open-water Dependent Birds

Several species generally found over the open waters of the Delaware Bay and Atlantic Ocean wander to

Common Wetland Bird Species in Philadelphia	
Great Blue Heron	<i>Ardea herodias</i>
Great Egret	<i>Ardea alba</i>
Green Heron	<i>Butorides virescens</i>
Mallard	<i>Anas platyrhynchos</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Swamp Sparrow	<i>Melospiza georgiana</i>
Wetland bird species of special concern in PA	
American Bittern	<i>Botaurus lentiginosus</i>
American Coot	<i>Fulica americana</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Common Moorhen	<i>Gallinula chloropus</i>
King Rail	<i>Rallus elegans</i>
Least Bittern	<i>Ixobrychus exilis</i>
Marsh Wren	<i>Cistothorus palustris</i>
Osprey	<i>Pandion haliaetus</i>
Sedge Wren	<i>Cistothorus platensis</i>
Sora	<i>Porzana carolina</i>
Virginia Rail	<i>Rallus limicola</i>



Great Black-backed Gull (*Larus marinus*)

the shoreline of Philadelphia on a regular basis. These species, sometimes termed pelagic species, generally do not nest in the area, but are in search of areas to feed, rest, and mature before they return to their nesting grounds or the open ocean. Species like the Great Black-backed Gull (*Larus marinus*) are uncommon residents of the area, while species like the Iceland Gull (*Larus glaucoideus*) appear rarely, but regularly, during the deep of winter. Others, like Leach's Storm-petrel (*Oceanodroma leucorhoa*), visit the area on occasion as they travel up and down the coast in search of food.

The needs of all of these species are similar. They need safe places to roost either on shore or on open water and quality water to feed in. Pollution in the form of chemicals (oil, industrial effluent, agricultural runoff, etc.) garbage (plastic bags, tires, foam cups, golf balls, etc.), sewage, and noise and light pollution all have a direct negative effect on these species. These environmental degradations reduce the benefit birds receive from staying around the City and forces them to other location.

Migratory Birds in Philadelphia County

The City of Philadelphia is located within the Atlantic Flyway, which stretches from the shores of Greenland south along the Atlantic seaboard of North America to the tip of Florida. This flyway

opens the area up to Arctic species in the winter, tropical species in the summer, and a wide range of boreal, temperate, and coastal species during migration. Additionally, the city's location within the landscape helps to funnel birds through the area; spring migrants follow the shoreline of Delaware Bay to the city while fall migrants follow the river-course of the Delaware back south. This density and diversity of migratory birds makes Philadelphia a preeminent city for birding. It also increases the importance of maintaining adequate habitat within the city to give migratory birds the opportunity to rest and "refuel".

Because migratory birds have not adapted as quickly as humans have modified the landscape around Philadelphia, it is not uncommon to see migratory birds from a diverse suite of ecosystems gathered in the available natural habitat within the area. The parks of the Fairmount system and John Heinz NWR are well known as regional birding hotspots, but it is not uncommon to see a diverse group of migratory birds in small neighborhood parks or even along tree-lined streets. Furthermore, Philadelphia regularly sees unfamiliar birds in Center City during the migratory season along with numerous injured and dead birds around the taller buildings.

This concentration of birds makes the protection and preservation of a matrix of natural areas within the city vital for migratory birds. Areas such as Benjamin Rush State Park regularly host large aggregations of birds during migration. These natural areas, as higher-quality habitat, attract birds away from otherwise sub-standard or dangerous areas. In the absence of this habitat these individuals would be forced to use whatever habitat is available, whether it is suitable, such as a neighborhood park, or disastrous, such as a roadway.

Fall migrants at Benjamin Rush State Park

Chipping Sparrow	<i>Spizella passerina</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
Eastern Meadowlark	<i>Sturnella magna</i>
Field Sparrow	<i>Spizella pusilla</i>
Horned Lark	<i>Eremophila alpestris</i>
Lincoln's Sparrow	<i>Melospiza lincolni</i>
Marsh Wren	<i>Cistothorus palustris</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Song Sparrow	<i>Melospiza melodia</i>
Swamp Sparrow	<i>Melospiza georgiana</i>
Tree Sparrow	<i>Spizella arborea</i>
Vesper Sparrow	<i>Poocetes gramineus</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
White-throated Sparrow	<i>Zonotrichia albicollis</i>

Important Bird Areas in Philadelphia County

In an effort to conserve the Commonwealth's avifauna, the Pennsylvania chapter of the National Audubon Society, along with the Pennsylvania Ornithological Technical Committee of the Pennsylvania Biological Survey, has identified 85 areas within the state that it considers to be a part of a global network of places recognized for their outstanding value to bird conservation. Termed Important Bird Areas, or IBAs, two of these areas occur within Philadelphia. Philadelphia's IBAs highlight what is considered to be critical bird habitat for both common and rare birds. More information about the IBA Program can be found at Audubon PA's website (<http://pa.audubon.org/>).

Philadelphia's IBAs are the John Heinz NWR at Tinicum and Mud Island, and the Fairmount Park Complex & Benjamin Rush State (Fig. 8, pg. 26). The IBAs extend beyond Philadelphia's border; therefore, features described below pertain to the entire IBA and are not necessarily confined to the county.



Migratory Swainson's Thrush (*Catharus ustulatus*) in Pennypack Park

John Heinz NWR at Tinicum and Mud Island

This IBA is composed of the John Heinz NWR (Tinicum Marsh), Little Tinicum Island, and the connecting waters and surrounding land. This area is a critically important wildlife oasis in urbanized southern Philadelphia. Its neighbors include the Philadelphia International Airport, several major thoroughfares, and extensive urban development and infrastructure.

This IBA is a critical migratory stopover for birds using the Atlantic Flyway in spring and fall. It also supports breeding for many state threatened and endangered species during the summer, as well as many neotropical migrants that are of increasing conservation concern.

Tinicum Marsh is the largest freshwater tidal marsh remaining in the Commonwealth, and it is only a vestige of the marsh that once covered the site. This small remnant now comprises approximately 80% of the state's coastal wetland habitat.

This area satisfies the following IBA criteria:

- Hosts thousands of migratory waterfowl and tens of thousands of migratory shorebirds during the spring and fall migration.
- Supports breeding populations of several state species of concern including American and Least Bittern, various rails, and Marsh Wrens.
- Provides foraging habitat for several Pennsylvania species of concern including Bald Eagle, Osprey, Peregrine Falcon, Great Blue Heron, and Great Egret.

Conservation

Conservation of this IBA should be focused on mitigating the water quality of inflow from Darby Creek and contamination from the Lower Darby Creek Superfund Site. Continued control of non-native invasive species on the refuge will be needed to maintain the habitat, along with restoration of native vegetation in the managed areas. Management of the local deer herd, non-migratory Canada Goose, and carp populations will be needed to maintain and restore the vegetation in the respective habitats.

Fairmount Park Complex & Benjamin Rush State Park

This IBA is composed of the Fairmount Park System in Philadelphia (9,200 acres) and several other public and privately owned lands in Philadelphia and Montgomery Counties. These include Benjamin Rush State Park, Lorimer Park, Fort Washington State Park, and the Wissahickon Waterfowl Preserve.

This area satisfies the following IBA criteria:

- Hosts over 200 species of birds known to occur within the Fairmount Park IBA each year. Of these 80-100 are breeding species, while 90-100 are wintering species.
- Comprises the last remaining large forest blocks in the area. Some of these forests are among the oldest and largest remaining in the heavily populated greater Philadelphia region, which also includes Bucks, Delaware and Montgomery Counties.
- This IBA hosts extensive research on the effect of urbanization on bird populations and several long-term monitoring projects, and offers innumerable opportunities for community bird-watching and education.

Conservation

This site is recognized as an IBA primarily because it attracts an unexpectedly large diversity and concentration of birds, especially during migration. While this recognition is based in part on the fact that large numbers of migratory birds naturally occur in Philadelphia, the fact remains that if the IBA's lands are not managed properly they will eventually become less beneficial to the many birds that depend on them. There are currently a number of issues that could reduce the IBA's value to birds that need to be addressed, including park management goals, continued development, and the loss of native diversity through invasive species colonization.

REPTILES AND AMPHIBIANS OF PHILADELPHIA

Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptiles and amphibians. Known as the herpetofauna, the diversity of reptiles and amphibians in the Commonwealth is quite unique, a testament to the varied habitats within Penn's Woods. Today, Pennsylvania is home to 72 native herptile species, including those common in the glaciated regions of the Canadian Shield, many of the southern species from the lower regions of the Appalachians, several associated with western prairies, and a few species associated with the coastal plain, the ecoregion in which Philadelphia County is primarily encompassed.

At one time, Philadelphia County likely supported more than 45 species of reptiles and amphibians. As one of the oldest metropolitan centers in the United States, the county has succumbed to a large amount of habitat degradation, destruction, and fragmentation due to the conversion of land to agriculture, followed by urban and suburban development. As Philadelphia County was developed, the extensive marshes were drained and filled, destroying much of the habitat for a number species that thrived in the coastal plain. Pennsylvania contains only a modest amount of the coastal plain ecoregion; the majority of Pennsylvania's has been developed. As a result, some species inhabiting the coastal plain are considered rare, and habitat destruction has dramatically decreased the overall diversity of reptile and amphibian species.

Ironically, Philadelphia's contribution to the field of herpetology has been remarkable over the years. As the birthplace of the new world natural sciences, Philadelphia was home to a number of famous students of herpetology, including Edward Cope and Henry Fowler.

A small number of forested tracts remain in Philadelphia County, particularly in the Fairmount Park systems. Cobbs Creek, Wissahickon, Tacony, and Pennypack Parks, as well as Benjamin Rush State Park, follow the most natural drainages in the county, and consequently host much of the herpetological diversity in the county. These areas, while small when compared to other portions of the



Green frog (*Lithobates clamitans*)

state, provide the most contiguous habitat for Philadelphia County's herptiles.

Philadelphia County is home to a number of common, generalist species, such as the eastern garter snake (*Thamnophis sirtalis*), the bullfrog and green frog (*Lithobates catesbeianus* and *L. clamitans*), and the painted and snapping turtles (*Chrysemys picta* and *Chelydra serpentina*). These species occur in many different habitats, exist throughout the entire state, and are the most commonly encountered reptiles and amphibians in the Commonwealth. Along with these common species, Philadelphia County is home to several less common species of herptiles. Many of these species have restricted ranges or are considered specialists,



Long-tailed salamander (*Eurycea longicauda*)

photo source: Charlie Eichelberger, PNHP

photo source: Charlie Eichelberger, PNHP



Spring peeper (*Pseudacris crucifer*)

meaning that their life histories have more specific habitat requirements.

Salamanders

The terrestrial woodland salamanders depend on canopied forests with adequate amounts of leaf litter. Despite their small size, these salamanders are voracious predators of forest floor invertebrates. Their role in limiting the numbers of leaf-decomposing invertebrates has been shown to be significant in maintaining a rich layer of organic matter on the forest floor, often an indicator of forest health. The red-backed salamander (*Plethodon cinereus*) is the most common woodland salamander species in Philadelphia County's forests.

The numerous waterways and streams of Philadelphia County provide habitat for the brook salamanders, including the northern dusky salamander (*Desmognathus fuscus*), the northern two-lined salamander (*Eurycea bislineata*) and the long-tailed salamander (*E. longicauda*). The northern red salamander (*Pseudotriton ruber*) is an infrequent but persistent resident along the high-quality drainages of the county. All of the streamside salamanders require high water quality. Amphibians as a whole are particularly sensitive to pollution. Consequently, pollutants can be detrimental to the amphibians inhabiting affected streams.

Temporary wetlands are critical to a group of amphibians that rely on the wet/dry annual cycle that prevents the local establishment of fish populations. Historically, temporary wetlands were found in Philadelphia County and were known to support

spotted salamanders (*Ambystoma maculatum*) and marbled salamanders (*Ambystoma opacum*). Suitable shallow, temporary wetlands used by these species for breeding are rare in the county, and therefore Philadelphia may no longer support these species of salamanders.

Frogs and Toads

The American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*), and grey tree frog (*Hyla versicolor*) are regular visitors to many different types of wetlands, where they breed and forage. Shallow wetlands, or shallow margins to deeper wetlands with emergent vegetation, are important for these species for cover, food, and for development of eggs and young.

The Fowler's toad (*Anaxyrus fowleri*) is generally less common than the related American toad, and prefers the sandier soils frequently found in the coastal plain. The pickerel frog (*Lithobates palustris*) requires heavily vegetated streams and creeks and can still be found along Philadelphia County's waterways.

The New Jersey chorus frog (*Pseudacris kalmi*) can be found in herbaceous marshes, riparian backwaters, and ephemeral wetlands where there is plenty of cover among the grasses and sedges. This species has declined precipitously in the past few decades because of habitat loss. This species is currently listed as an endangered species in Pennsylvania.

The southern leopard frog (*Lithobates sphenoccephalus*) can be found breeding in shallow open pools. Known for its characteristic call,



Stinkpot turtle (*Sternotherus odoratus*)



Northern brown snake (*Storeria dekayi*)

sounding like muffled laughing, this species is listed as endangered in Pennsylvania. Though they are certainly rare, little is known about the status of the populations of these species in the state, and dedicated searches should be conducted to establish where the species and habitat for the species still exist.

Turtles

The stinkpot turtle (*Sternotherus odoratus*) inhabits most moderate to large wetlands, though it is infrequently encountered because of its secretive nature. Though commonly known from the Delaware River drainage, the map turtle (*Graptemys geographica*) was just recently located in Philadelphia County. The semi-aquatic wood turtle (*Glyptemys insculpta*) relies on wooded creeks and rivers, and while it can be locally common in areas, the species is becoming increasingly rare across its range. The eastern box turtle (*Terrapene carolina*) is an easily recognized species still found in pockets of woodlands in Philadelphia. While this species is still considered common, with a lifespan that may reach beyond a century, many biologists believe that box turtle populations have been in a steady decline due to road mortality and predation on nests and juveniles. Turtle nests are laid in suitable substrates with sun exposure, frequently along waterways. These sites are used by many nesting females and are easily targeted by overpopulations of raccoons, skunks, and opossums, which can thrive in urban areas. There is growing concern for many of Pennsylvania's turtles because numerous populations are nearly devoid of juvenile turtles, indicating that there is little successful reproduction occurring.

One of Pennsylvania's rarest turtles is found in Philadelphia County. The red-bellied turtle (*Pseudemys rubriventris*) is listed as a Pennsylvania threatened species. The restricted range of this species is confined to the southeastern counties of Pennsylvania. One of the concerns for this species is the introduction of the invasive sliders (*Trachemys scripta*). Sliders are native to the southeastern US, and are now widely distributed outside of their native range, a result of pet owners releasing their turtles (a practice that is illegal in the Commonwealth). There is concern that the sliders may be displacing the red-bellied turtle. Red-bellied turtles are also known to travel considerable distances from their aquatic habitats in order to lay their eggs. As these females move across land in search of suitable nesting habitats, they face an onslaught of threats, including predation, collection, and road mortality.

The eastern mud turtle (*Kinosternon subrubrum*), a very secretive species, still exists in Philadelphia County. Small pockets of habitat in the county may provide refugia for small colonies of these turtles, and dedicated search efforts should be conducted to establish the remaining distribution of this turtle in the Commonwealth.

The eastern spiny softshell (*Apalone spinifera*) is native to the Ohio River drainage; however, a population was established in New Jersey decades ago and has been spreading steadily ever since. More recently, spiny softshells have been showing up in the Delaware River drainage, and if the species has not been seen in Philadelphia County yet, it will likely show up soon.



Northern black racer (*Coluber constrictor*)

Lizards and Snakes

The northern fence lizard (*Sceloporus undulatus*) and the five-lined skink (*Plestiodon fasciatus*) were once known from Philadelphia County. These species occur in relatively small, isolated populations in dry habitats with an abundance of cover objects and basking areas, and are particularly susceptible to localized extinction because of their populations' small sizes and isolation from other lizard populations. These two species have likely been lost from Philadelphia County.

Interestingly, Philadelphia was once home to a reproducing population of the exotic Italian wall lizard (*Podarcis sicula*), a species native to the Mediterranean. These lizards were thought to have been an accidental release by a pet owner that became established along a railroad right of way. The wall lizards were known from the location for a number of years, and while they have not been officially documented from this area for a many years, rumors persist that the species may still exist in the county. This species is of increasing concern as other established populations along the east coast are rapidly spreading.

Pennsylvania Fish and Boat Commission Regulations

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

Pennsylvania Herpetological Atlas

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

The northern black racer (*Coluber constrictor*), despite being one of the larger snakes in the Commonwealth, can still be found within the borders of Philadelphia County. These large predators feast on small mammals including mice and rats, and as their name suggests, they are quickly able to flee from danger. For this reason, black racers can survive in urban areas if enough cover is available. The brilliantly patterned eastern milk snake (*Lampropeltis triangulum*) can be found in a variety of habitats and though it is common, this species is rather secretive and is rarely seen. A more frequently observed snake, the northern water snake (*Nerodia sipedon*) is a widespread resident of Philadelphia County. This species hunts along open waterways, searching for amphibians and small fish.

The northern brown snake (*Storeria dekayi*), a small and secretive snake, is a common resident of Philadelphia County and can be found beneath rocks and decaying wood and bark. Unlike most snake species, which do not tolerate urban environments well, the brown snake can actually thrive in vacant lots in urban settings. Worm snakes (*Carphophis amoenus*) and smooth earth snakes (*Virginia valeriae*) are exclusively fossorial, meaning that they spend their lives underground. Little is known about these species in the state, and although their ranges include Philadelphia County, they have not been recorded from the county yet. More survey work needs to be conducted to update the status of worm snakes and to determine if the smooth earth snake still exists in Pennsylvania.



Northern fence lizard (*Sceloporus undulatus*)

photo source: John Kunsman, PNHP

Historically known from Philadelphia County is the northern copperhead (*Agkistrodon contortrix*), the only venomous snake species known to have inhabited the county. This species was persecuted due to its venomous nature and although it may deliver a serious bite if threatened, the danger this species poses has been drastically exaggerated. Many residents still believe they see copperheads in Philadelphia, but are most likely misidentifying the common, harmless, northern water snake

Although relatively little habitat exists within Philadelphia County, it remains a significant spot in the state for the Commonwealth's reptiles and amphibians due to its unique geographic location. The forested tracts, though small, and numerous waterways and wetlands provide critical habitat for reptiles and amphibians, both common and rare. Of utmost importance to the conservation of the county's herpetofauna is the protection of the remaining forests, streams, marshes, and wet meadows. Several species should be considered a priority for conservation in Philadelphia County, including the New Jersey chorus frog, the southern leopard frog, the red-bellied turtle, and the eastern mud turtle.

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

FISHERIES OF PHILADELPHIA

Rivers have provided humans with places to gather and live for thousands of years since the birthplace of civilization between the shores of the Euphrates and Tigris Rivers. Rivers provide fresh water, food, and easy travel, and in the past were used to take away waste and garbage. These services were especially useful in Philadelphia where the Schuylkill and Delaware Rivers provided easy access to the fisheries of the tidal Delaware Bay and the annual migration of fishes to New York and central Pennsylvania.

The Delaware River holds a unique distinction of being one of North America's great rivers without a dam on the main channel, allowing for the continued passage of fish and a free-flowing river ecosystem. In past years, however, the fisheries in and around Philadelphia were degraded by human mismanagement. Channelization and damming of headwater streams, modification to the original river channels through dredging and filling, increased sediment loads and alteration to flow rates and patterns, and the removal of tidal marsh habitat have combined to put the future of this resource in jeopardy.

In recent years an effort has been made to redress these impacts on rivers and restore the native and migratory fish communities. The installation of sewage treatment plants and prohibition of dumping of waste into rivers, creation of fish "ladders" around dams, and the restoration of riparian and marshland habitat have moderated water pollution and reopened migratory passages.

Migratory Species

One of the largest remaining migrations of anadromous fish along the east coast of the United States passes almost unnoticed along the shoreline of Philadelphia every year. Every spring, generally from April to June, tens of thousands of shad, herring, and alewife, all members of the *Culpeidae* family, migrate from the Atlantic Ocean up the Delaware River to spawning grounds in the vast network of headwater tributaries.

Since humans first settled in the Delaware Basin, this migration has signaled the return of spring food



Shad fishing around 1905

and represents an important cultural event. During this migration, the shores were lined with fishermen working to bring in nets that were bursting with shad. In the late 1800's, the peak of the shad take, estimates of the catch along the Delaware River reach four million fish, weighing a total of 16 million pounds. By the early 1900's the catch was declining quickly because of the decline in reproduction from damming headwater spawning grounds and severe pollution; 1916 saw the last one-million pound catch. Shortly thereafter, the fishery collapsed catastrophically and has not yet recovered. Though today's migration is just a reflection of the vast number of fish that once moved up the Delaware River each spring, it is showing signs of a slow recovery.

Efforts to reduce the level of pollution in the Delaware River Drainage have reopened this migratory pathway and an intensive stocking program is working to restore the population to a self-sustaining and growing level. Work still needs to be done on restoring access to headwater spawning habitat through the removal of dams or the installation of fish ladders where removal is not an option. Additionally, continued restoration of riparian forests and wetlands in the watershed is critical to the continued improvement of water quality.

One species of migratory fish often forgotten, but of both ecological and economic importance, is the American eel (*Anguilla rostrata*). This species,

photo source: Lib. of Congress.

found on both sides of the Atlantic Ocean, is one of only two catadromous species known in North America; the other, *Agonostomus monticola*, is believed to also be catadromous (Orr 2008). American eels begin life as eggs laid in the vast Sargasso Sea, elvers (young eels) embark on a long migration back towards the freshwater estuaries of the coast. This process, potentially lasting years, is completed by only a small fraction of the elvers. Once the elvers have made it to the freshwater mouths of the North American coast most remain in the brackish waters of the lower estuaries, but some move much further inland. Because they have the unique ability to crawl up and over stream barriers, such as waterfalls and dams, eels can move upstream into even the smallest, most isolated tributaries. The eels reach maturity after 3–40 years (depending on sex and habitat quality) at a length of 3 to 5 feet. At this point the large “silver eels” begin the process of migration back to the Sargasso Sea where they will breed and die.

Unfortunately, every year numerous adult eels are killed at hydroelectric dams during their seaward migration; the adult are too large to pass through the turbines without fatal injury. This mortality, combined with habitat loss and fishing pressure, has greatly reduced the population of the American eel. In 2007 the US Fish and Wildlife Service considered granting the species a federally endangered status. However, it concluded that the listing is not warranted at this time, despite current declines in the population.



Juvenile American eel (*Anguilla rostrata*) found along the Delaware River shoreline in Philadelphia



Large striped bass (*Morone saxatilis*) caught and released by the Philadelphia Water Department

Historically, American eels were considered a significant part of the fishery along the Delaware River and its tributaries. Eel weirs, v-shaped rock structures used to channel eels into collecting baskets, were once a common sight throughout the area. However, over the past century the eel fishery has also collapsed, potentially due to parasite introduced by fish-farming operations. Today, the American eel is relatively common in the Delaware River basin and appears to have a stronghold in the watershed compared to other coastal river watersheds in the region. The Delaware River and its tributaries may be supporting a large proportion of the global population of eels.

Resident Species

Because of its location between the Atlantic Ocean and Delaware Bay and the headwaters of the Schuylkill and Delaware Rivers, Philadelphia exhibits a wealth of resident fish species. Today, 80 species are known to inhabit the rivers, streams, and creeks of the Delaware River watershed, though 12 of these species were probably not present in the watershed 300 years ago.

Of particular importance are the species of game fish found in the area, including smallmouth bass (*Micropterus dolomieu*), striped bass (*Morone saxatilis*), and several different native and introduced catfish (Family Ictaluridae). Found in varied habitats from backwaters to deep river bottoms throughout Philadelphia’s watersheds, these species

offer an important source of recreation and economic opportunity.

Of lesser direct economic importance, though significantly greater ecological importance, are the dozens of species of minnow, darter, and sunfish that compose the remainder of the native fishes in the Delaware River watershed. These species are generally not sought out by anglers because of their small size, but provide a vital food source for the larger game fish inhabiting this region.

Of the fishes found in the Delaware watershed in Pennsylvania, 11 are listed as endangered or threatened species, or are candidates for listing. The decline leading to the listing of these species is primarily related to habitat loss, but some species have also been harmed by past overfishing. Species such as the shortnose and Atlantic sturgeons (*Acipenser brevirostrum* and *A. oxyrinchus*) have been directly impacted by reduced water quality, decreased spawning habitat, and overharvesting for their roe (eggs that were sold as caviar).

The decline of resident species, both common and rare, is an indication of watershed-wide problems resulting from the reduced health of the entire ecosystem. State and federal agencies are working to maintain some populations of rare species and restore others. Restoring fish communities of the Delaware River basin to a state of thriving populations of native fish species is a goal for which watershed managers should aim. Unfortunately, some invasive species are gaining footholds in the watershed.

Aquatic Invasive Species

The Port of Philadelphia has been a vital gateway into the country for both goods and people since colonization. A less savory aspect of this gateway is that ports are a significant source of invasive species introductions. To date, dozens of invasive aquatic species have been introduced into the Delaware River watershed.

Aquatic invasives species include species not only from far away locations, such as the Asiatic clam (*Corbicula fluminea*), but also species from other, sometimes adjacent watersheds, such as the flathead catfish (*Pylodictis olivaris*). Watershed divides separate aquatic fauna, and adjacent watersheds often have distinct species compositions until

humans transport or stock non-native species. The impacts can be devastating on aquatic ecosystems. Invasive species may thrive in their new locations, displacing or preying on native species, or altering native species' habitats.

This pattern of invasive species altering the ecosystem has occurred in the Delaware River watershed where species like the flathead catfish, native to the Ohio River basin in Western Pennsylvania, have been introduced. Predation on native catfish and other species has altered the fish community in the watershed. Others species such as the zebra mussel (*Dreissena polymorpha*) stand to do significant economic harm in addition to the ecological disturbance they will cause by covering boat hulls, pipelines, drinking water inlets, and all other surfaces in the river system.

Some species, such as the common carp (*Cyprinus carpio*) and the snakehead (*Channa* spp.), have been intentionally introduced into the watershed as food and sport fish. The common carp already does



Large flathead catfish (*Pylodictis olivaris*) captured by the Philadelphia Water Department. This non-native species is highly predacious.

photo source: Philadelphia Water Department

Table 8.

Species of fishes and count of number of fish that passed through the Fairmount Dam, Philadelphia, in 2006. The data were provided by the Philadelphia Water Department.

Common Name	Scientific Name	# Passed
American eel	<i>Anguilla rostrata</i>	34
American shad	<i>Alosa sapidissima</i>	345
Bluegill sunfish	<i>Lepomis macrochirus</i>	276
Brown trout	<i>Salmo trutta</i>	5
Bullhead catfish	<i>Ameiurus spp.</i>	2
Channel catfish	<i>Ictalurus punctatus</i>	3,421
Common carp	<i>Cyprinus carpio</i>	2,215
Flathead catfish	<i>Pylodictis olivaris</i>	466
Gizzard shad	<i>Dorosoma cepedianum</i>	2,899
Grass carp	<i>Ctenopharyngodon idella</i>	1
Hickory shad	<i>Alosa mediocris</i>	9
Hybrid striped bass	<i>Morone saxatilis</i> x <i>M. chrysops</i>	48
Hybrid trout	<i>hybrid trout</i>	40
Largemouth bass	<i>Micropterus salmoides</i>	42
Pumpkinseed sunfish	<i>Lepomis gibbosus</i>	1
Quillback	<i>Carpionodes cyprinus</i>	2,631
Rainbow trout	<i>Oncorhynchus mykiss</i>	16
Redbreast sunfish	<i>Lepomis auritus</i>	4
River herring	<i>Alosa aestivalis</i> or <i>pseudoharengus</i>	7
Smallmouth bass	<i>Micropterus dolomieu</i>	1,225
Striped bass	<i>Morone saxatilis</i>	61
Unknown sunfish	<i>Lepomis species</i>	2
Walleye	<i>Sander vitreus</i>	84
White catfish	<i>Ameiurus catus</i>	6
White perch	<i>Morone americana</i>	112
White sucker	<i>Catostomus commersoni</i>	2,887
Unknown		11
TOTAL		16,850

significant damage throughout North America by rooting around on the bottom of water bodies, destroying vegetation, and mobilizing large amounts of sediment. The snakehead is a voracious predator that has the amazing ability to “walk” on land. This gives it the ability to move between ponds and even watersheds, opening up large areas to its potential invasion.

Watershed Conservation and Restoration

Because of Philadelphia’s position in the Delaware and Schuylkill River watersheds, very little of the watershed is within its political boundaries (Fig. 5, pg. 5). This does not mean that the opportunities for meaningful watershed improvements within THE Philadelphia area limited. Within Philadelphia there are extensive opportunities for the preservation and restoration of shoreline habitat. Along the banks of the lower Schuylkill River shoreline, as outlined in several site descriptions (pgs. 107, 102, 94, 90), are extensive areas of shoreline that could be returned to

a natural state. With restoration, the floodplain and the river would be reconnected. This would allow for the re-creation of highly-valuable ephemeral and tidal wetlands along the riparian corridor, contributing wildlife habitat and improving water quality. Similarly, four sites along the Delaware River shoreline (pgs. 86, 90, 98, 133) offer an extensive opportunity to re-connect Philadelphia with the river through the restoration of natural habitat. Removal of hard-edged riprap and steel piling along river banks and restoration of native vegetation would greatly improve not only the ecological value of riparian zones, but also their appearance. Tree-lined river banks would make the river fronts of Philadelphia more inviting locations to visit.

Beyond habitat restoration within the watershed, management of stormwater within the city is vital. Because the vast majority of land in the city is closely associated with impermeable surfaces (roads, buildings, etc.), the water from rainstorms is not absorbed into the ground, but runs off into streams and sewers. Even small rains (<¼ inch) can cause dramatic and artificially high flows that erode stream banks, mobilize sediment, cause overflows of nutrient- and bacteria-laden sewage, and flush aquatic species from the watershed. Management of these storm flows is necessary for a healthy watershed and their management begins with individual landowners. Proper retention of rainwater through the use of rain gardens, permeable pavement, and green roofs can greatly reduce storm flow, decreasing watershed damage and sewage treatment costs at the same time. Continued efforts



The Fairmount Dam under construction in 1904. This dam, and dozens more along the Schuylkill River and its tributaries, severely impacted the fishery and water quality in Philadelphia.

photo source: Philadelphia Water Department

to reduce the number of combined sewer overflows through infrastructure improvements are necessary to improve water quality by preventing untreated sewage from reaching waterways.

As mentioned in the disturbances section on page 14, dams also play a significant role in the disturbance of the Delaware River watershed. Where dams are no longer wanted or pose a safety risk, their removal should be investigated. Where removal is not an option, the installation of a fish ladder should be considered. In 1979 a fish passage structure was installed on the Fairmount Dam which now allows thousands of fish, both resident and migratory, to pass this otherwise insurmountable barrier (Table 8, pg. 41).

Dredging, filling, and channel modification have also caused significant damage to the aquatic habitat around Philadelphia. At the time of European colonization, the Delaware River was much wider and shallower and had numerous islands (see pg. 86). This habitat allowed the river to support extensive areas of shallow, freshwater, tidal habitat that is now only found in a very limited area around Philadelphia.

Examples of what this shallow-water habitat was like can still be found along the Philadelphia shoreline. These areas support beds of American eelgrass (*Vallisneria americana*) and other emergent aquatic plants that act as nurseries for young fish. They also provide habitat for mussels, aquatic insects, and wetland and riverine species of birds.

Protection and expansion of these emergent beds will be a vital part of restoring the fish assemblages that once thrived in Philadelphia.

The protection and restoration of riparian, floodplain, wetland, and aquatic habitats within and upstream of Philadelphia will be necessary for the fishery to return to its historic standards. While restoration opportunities appear expensive, the social, economic, and environmental benefits from healthy rivers and fisheries in Philadelphia are well documented.

photo source: PNHP



Extensive bed of American eelgrass (*Vallisneria americana*) along the Delaware River shoreline at the Fort Mifflin historical site

INSECTS OF PHILADELPHIA

Butterflies and Moths

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

Life history and habitats

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



Clouded sulphur (*Colias philodice*)



Zabulon skipper (*Poanes zabulon*)

caterpillar to adult takes place. After a period of time that varies from species to species, the adult emerges with a plump abdomen and withered wings and immediately begins pumping fluids from the abdomen into the wing veins until they are fully expanded. Then the fluids are withdrawn from the wing veins, the wings harden, and the moth or butterfly takes off on its maiden flight.

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

Many Lepidoptera depend not only on a specific habitat, but also a specific plant within that habitat. The larvae of many species will often use only a single host plant. The Monarch (*Danaus plexippus*) uses only milkweed (*Asclepias* spp.) or closely related plants. The Spicebush Swallowtail caterpillar (*Papilio troilus*) prefers to feed on

spicebush (*Lindera benzoin*). The same type of relationship exists with many moths.

Species diversity in Pennsylvania

In North America north of the Mexican border, there are an estimated 13,000 butterfly and moth species (Wagner 2005). Pennsylvania's varied habitats support a large range of butterflies. Altogether, the state has about 156 species of butterflies and the closely related skippers, and probably a minimum of 1,200 species of moths (Wright 2007; PNHP 2006). However, no state agency is directly responsible for managing Lepidoptera, and scientists suspect that the populations of many species are declining. For a list of butterfly species known to occur in Philadelphia County, see Appendix VI (pg 171).

Dragonflies and Damselflies

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



Ebony jewelwing (*Calopteryx maculata*)



Meadowhawk (*Sympetrum* sp.)

Life history and habitat

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

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

When a larva is fully developed, it undergoes metamorphosis inside its larval skin. Then it crawls out of the water for its final molt. This movement of the larva out of the aquatic habitat to shed its larval skin is called emergence. Once properly positioned, the larval skin is shed one last time and a winged adult emerges.

Odonates emerge from the water, transforming from camouflaged stalkers into jeweled fighter planes.

Adult odonates continue to feed on the community of insects with whom they shared an underwater life. They also add to their diet additional insects they encounter for the first time as adults, such as butterflies.

roadsides, in wooded glades, in open meadows, and in other upland and aquatic habitats. Some males and females disperse long distances from their natal aquatic habitat to find new breeding areas, an important process that strengthens populations by diversifying the gene pool.

Species in Pennsylvania

In North America, there are an estimated 350 species of dragonflies (Needham et al. 2000) and 161 species of damselflies (Westfall and May 1996). In Pennsylvania, 121 species of dragonflies and 55 species of damselflies are currently known (PNHP 2006). For a list of odonate species known to occur in Philadelphia County see Appendix VII (pg. 173).

Conservation Recommendations for Insects

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

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

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

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

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

Larval and adult odonates feed on the other insects that share their environment, such as mosquitoes,



A tidal wetland at Fort Mifflin, which supports a diverse group of odonates and lepidopteron.

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



Swarthy Skipper (*Nastra lherminier*) found on the meadow restoration at Pennypack on the Delaware Park

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

Indirect effects of pest control can also severely reduce populations of butterflies and moths. These species are vulnerable to changes in the distribution and abundance of the food plants. Applications of herbicides or vegetation removal (e.g., mowing) while the eggs or larvae are on the plants can cause declines in Lepidoptera and interrupt stages of the life cycle of these animals. In an effort to slow the spread of gypsy moth and to protect timber resources, various insecticides including lead arsenate, DDT, and carbaryl (Sevin), have been

sprayed over the years. Presently, the biological insecticide *Bacillus thuringiensis* (*Bt*) and the insect growth regulator diflubenzuron (Dimilin) are considered more environmentally safe than other sprays and are the primary means of gypsy moth control. However, both chemicals affect species of insects beyond the target gypsy moth. The *Bt* variety used against gypsy moth (*Bt kurstaki*) is toxic primarily to caterpillars, or larvae of Lepidoptera. Species with 1st and 2nd instars at the time of spraying and that feed on foliage are most at risk. Butterflies seem to be particularly susceptible to *Bt*, though there have not been studies to evaluate the effect on all butterflies. In order to protect rare or small populations of non-target organisms, the size of the spray blocks and the timing of spraying for gypsy moths can be adjusted on a site-by-site basis.

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

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

METHODS

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

PNHP Data System

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

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

The database has recorded over 19,000 detailed occurrences of species and communities of special concern as of July 2008, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps and geographic information system (GIS) files. Additional data are stored in extensive manual and digital files set up for the over 230 natural community types, 600 animals, and 650 plant species currently tracked. These files are organized by each of Pennsylvania's 881 7½-minute USGS topographic quadrangle maps using GIS.

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

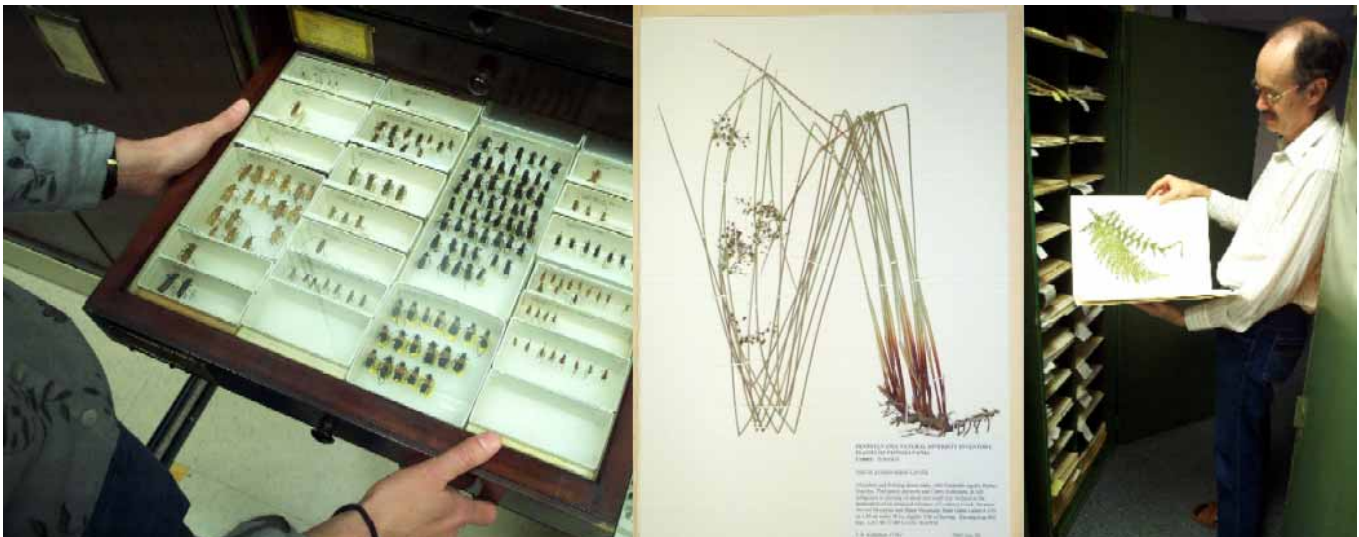


photo source: PNHP

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

communities, and viable populations of sensitive plant and animal species can help to ensure that a full range of biological diversity is preserved with the county for the future.

Information Gathering

A list of natural features found in the county was prepared from the database and supplemented with information volunteered by local individuals (see Site Survey Forms in Appendix I, pg. 162) and organizations familiar with Philadelphia County. PNHP staff solicited information about potential natural communities, plant species of special concern and important wildlife breeding areas from knowledgeable individuals and local conservation groups within the City in addition to information from the Fairmount Park Commission and the Philadelphia Water Department. This information was used to schedule sites for field surveys.

Map and Air Photo Interpretation

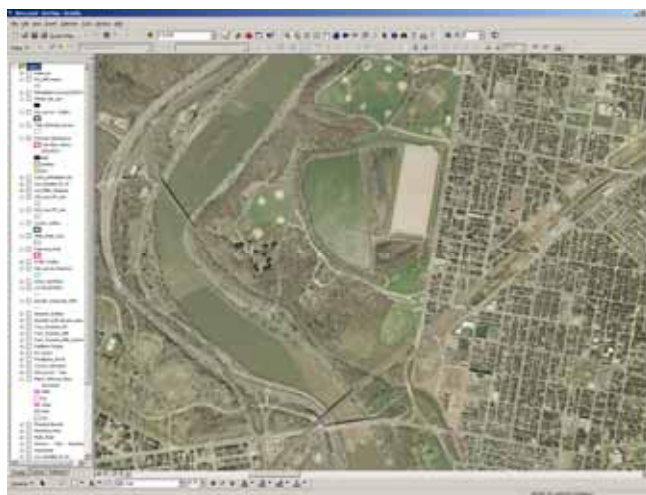
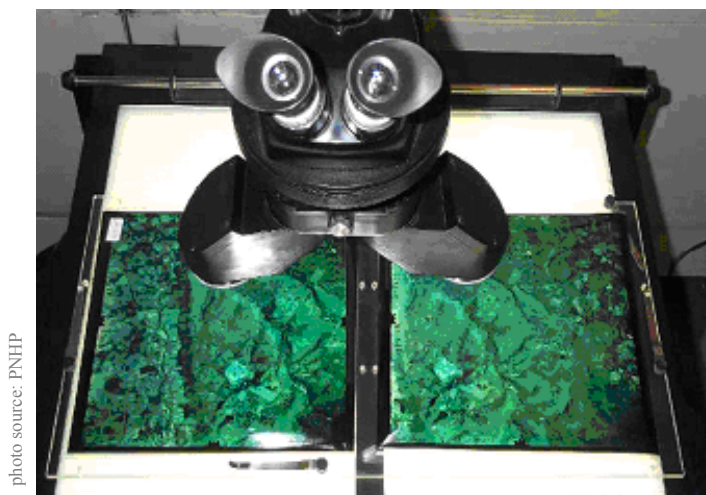
PNHP ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented (Appendix II, pg. 162). Additional data from vegetation maps, soil survey maps, field survey records, and other sources were consulted to gain familiarity with Philadelphia County's natural systems. This information, along with references on physiography, geology, and soils, was used to interpret photos and designate probable vegetation types and potential locations for exemplary communities and rare species. In many instances, vegetation was classified at an ecosystem

level, and it was therefore critical that an ecologist or person with similar training interpret the maps and aerial photos.

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

An additional level of analysis was conducted to assess the restoration potential of open space throughout the city. As airphotos were examined the general cover type was noted along with the total area covered. These two characteristics were used to give each mapped parcel of undeveloped land a quality rank and help prioritize survey efforts.

After an initial round of photo interpretation, field surveys were conducted to evaluate the potential natural areas. Locations with minimally disturbed natural communities or with species of special concern were outlined on topographic quadrangle maps. The photo signatures (characteristic patterns, texture, tone of vegetation, and other features on the



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

photos) of these sites were then used as a guide for continued photo interpretation and future field surveys. Photo signatures with poor quality sites led to the elimination of further fieldwork on other sites with similar signatures.

Field Work

Experienced PNHP biologists and contractors conducted numerous field surveys throughout Philadelphia County during 2007 and 2008. Biologists evaluated the degree of naturalness of habitats (including assessment of percent of native vs. non-native plant species, degree of human disturbance, age of trees, etc.) and searched for plant and animal species of special concern. Workers also categorized the vegetation of each potential natural area visited. An evaluation of quality was made for each potential natural community element, with care being taken to give reasons for the quality rank. Boundaries of the community types were redrawn, if needed, based on new field information. Community information recorded included the dominant, common, and other species, as well as disturbances to the community. Field forms were completed for all occurrences of plant and animal species of special concern and natural communities, the quality of each population or community was assessed, and locations were marked on USGS topographic quadrangle maps.

Data Analysis

To organize the natural features data and set conservation priorities, each natural community or species of concern (element) is ranked using factors of rarity and threat on a state-wide (state element

ranking) and range-wide (global element ranking) basis (see Appendix III, pg. 166). Each location of a species (an element occurrence) is ranked according to naturalness, its potential for future survival or recovery, its extent or population size, and any threats to it. An explanation of the five element occurrence quality ranks is given in Appendix IV (pg. 169). The element-ranking and element occurrence-ranking systems help PNHP personnel to simultaneously gauge the singular importance of each occurrence of, for example, a freshwater intertidal marsh community or oblique milkvine occurrence in Philadelphia County, as well as the statewide or world-wide importance of these natural features. Obviously, sites with a greater number of highly ranked elements merit more immediate attention than sites with a smaller number of lower ranked elements.

Field data for natural communities (S3 and C-rank or better), and for all plant and animal species of concern found, were combined with existing data and summarized on PNHP Element Occurrence Records for mapping and computerization. Mapped locations of natural features, including approximate watershed or subwatershed boundaries, were then created and added electronically to PNHP's GIS layer.

Information on the needs of the rare species in this report has come from a variety of sources, including field guides and research publications. For reptiles and amphibians, the major sources are Hulse et al. (2001); for birds, Brauning (1992) and McWilliams and Brauning (2000); for butterflies, Opler and Krizek (1984) and Opler and Malikul (1992) with Schweitzer (1981) provided much of the information on rare moth and butterfly species in Pennsylvania;

photo source: PNHP



Small mammal surveys



Invertebrate surveys



photo source: Andrew Strassman, PNHP

Experienced PNHP staff conducts botanical surveys and habitat assessments for species of special concern, here along the tidal Delaware River shoreline. All sites are evaluated for their natural condition. Associated disturbances and threats are noted and recommendations are made to minimize negative impacts.

for mussels, Strayer and Jirka (1997) was the primary source. A list of Plant and Animals of Special Concern currently known in Philadelphia County is provided in Appendix V (pg. 170).

Landscape Analysis

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

These smaller forest fragments will have significantly more edge habitat and less forest interior than the original forest block. Furthermore, fragmentation of large forest blocks decreases the ability of many species to migrate across manmade barriers such as roads. Migration corridors, once severed, isolate populations of species one from another, limit the gene flow between populations, and create islands of suitable habitat surrounded by human activity.

Much of the native biological diversity of an area can be preserved by avoiding further fragmentation of large areas of natural habitat. Historically, edge habitat was created to provide habitat for organisms, namely game species, which often thrive in disturbed areas. Today, we realize that by fragmenting forests we are eliminating habitats for the forest interior species. Those species that utilize edge habitats are typically considered generalists, capable of utilizing many different habitats and are usually not of immediate conservation concern.

The larger blocks of undeveloped habitat within the County have been highlighted in an effort to draw attention to the significance of large blocks of undeveloped land within the County. Besides being habitat suitable for many native species, large blocks in close proximity to each other become natural corridors for species movement within and through the county. In many cases, by highlighting the larger blocks, the most natural landscape corridors become evident and the areas in greatest need of protection from development can be quickly perceived on the landscape. A review of this map and the results are presented in figure 9 (pg. 55).

Species Ranking

Each year biologists representing various taxonomic groups of the Pennsylvania Biological Survey (PABS) meet to discuss and prioritize the most important species for the protection of biodiversity in Pennsylvania. There are various Biological Technical Committees for each of these groups: Bryophytes and Lichens, Vascular Plants, Fungi, Invertebrates (with subcommittees of aquatic, terrestrial, arachnid, and mollusc), Fishes, Herptiles, Birds, and Mammals. These meetings consist of a review and ranking of species of concern within the state, in terms of the rarity and quality of the species or habitats of concern, potential threats, and protection needs. The results of these meetings provide a baseline for evaluating the statewide significance of the species recognized in the Natural Heritage Inventory.

Site Mapping and Ranking

Boundaries defining each site were delineated based upon PNHP observation of continuity of habitat, existing greenspace, and similar ecology. Included within some of these sites are recommendations based on scientific literature and professional judgment for individual species or animal assemblages and may incorporate physical factors (e.g., slope, aspect, hydrology), ecological factors (e.g., species composition, disturbance regime), and input provided by jurisdictional government agencies.

Sites were then assigned two ranks to help prioritize conservation efforts: a conservation priority rank and a natural heritage significance rank.

For the conservation priority rank the PNHP considered aspects based on local characteristics including habitat quality and restoration potential, connection to existing open space, and level of existing protection from conversion to a more intense land use. Sites with high habitat quality or restoration potential, close to existing open space, *without* existing protection from conversion rank highest. This allows for a comparison of sites across the county with the opportunity to quickly assess the areas most in need of immediate protection, preservation, and restoration.

The four conservation priority ranks are:

Immediate, Near-term, Enhancement, and Opportunistic. These ranks have been used to prioritize all identified sites and suggest the relative attention that sites should receive for protection.

Immediate: Sites that are of immediate importance for the preservation of open space within the county. Sites in this category are generally larger, are important links for greenways and potential dispersal corridors for species, abut existing greenspace, and are lacking effective protection from conversion to a more intensive land use. Property ownership may also be a component of this rank. Sites of immediate conservation priority rank merit quick, strong, and complete protection.

Near-term: Sites that are of near-term importance for the future completion of a connected and integrated network of open space in the county or region. These sites are medium in size, are important links for greenways and potential dispersal corridors for species, may abut existing greenspace, and have varying levels of protection from conversion to a more intensive land use. Property ownership may also be a component of this rank. Sites of near-term conservation priority rank merit strong protection in the future.

Enhancement: These are sites that are generally extensive in size and are mostly protected from conversion to more intensive land use, but have substantial impacts caused by past land use choices and ongoing non-native species invasion. This offers the potential for extensive increases in biological value through active management. Sites with an enhancement conservation priority rank merit study to determine the course of action necessary to protect or increase their existing biological value.

Opportunistic: Sites classified as opportunistic are currently used or retained for other purposes, but may become available for retirement to open space or green space in the foreseeable future. If these spaces become available for other uses they should be examined for their open space and greenspace potential. Integration of these areas into the existing network of greenspace in the county could greatly enhance public access to open areas, facilitate species dispersal through the city, and increase the amount of natural space available.

For the natural heritage significance rank the PNHP considers several criteria when ranking NHI sites to ensure that all sites, regardless of ecological differences, are evaluated systematically. Each criterion is considered independently and then all are examined collectively to ensure that no one criterion receives more emphasis than another. First, the commonness/rareness of the species at a site, defined by the global and state ranks (G & S ranks Appendix III, pg. 166), is considered in the site ranking process. Those sites which include rarer species with higher ranks (i.e. G3 or S1) are given precedence over sites with more common, lower ranked species (i.e. G5 or S3). Next, the number of different species occurring at a site is also considered in the ranking process. Sites with multiple tracked species are considered to be higher conservation priorities than sites with fewer tracked species. The ecological characteristics of the species at each site are also considered in the ranking process. For example, species that have highly specialized habitat requirements and are not known to readily disperse during periods of disturbance are under greater ecological pressure than species that have more general habitat requirements and have a greater capacity for dispersion. Finally, the site ranking process examines the landscape context of each site. For example, a site that is entirely isolated due to fragmentation, with little chance of restoration of connectedness, is a lower conservation priority than a site that remains connected to other suitable patches of habitat. Site connectedness is critical because the potential for connected populations to remain viable is far greater than small isolated populations.

The four natural heritage significance ranks are: **Exceptional, High, Notable, and Local significance.** These ranks have been used to prioritize all identified sites and suggest the relative attention that sites should receive for protection.

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

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

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

Local significance: Sites that have great potential for protecting biodiversity in the county but are not, as yet, known to contain species of special concern or state significant natural communities. Often recognized because of their size, undisturbed character, or proximity to areas of known significance, these sites invite further survey and investigation. In some cases, these sites could be revealed as high or exceptional sites.

RESULTS

Priorities for Protection

Twenty-four Natural Heritage Sites were identified in the Philadelphia County Natural Heritage Inventory. Detailed maps and description of each follows, organized northeast to southwest through the county; for convenience the parks under jurisdiction by the Fairmount Park Commission are grouped. For each site, a map, summary table, and full report are provided. Site sections include:

- A categorical designation of a site's conservation priority and significance rank is listed after the site name. Tables 2 and 3 (pgs. xiv and xvii, respectively) have summaries of sites by significance category and by conservation priority. Definitions of the significance categories are outlined in Methods (pg. 47).
- Listed under each site name are any state-significant natural communities and species of special concern that have been documented within the area.
 - See Appendix II (pg. 162) for a list of Natural Communities recognized in Pennsylvania.
 - Some species perceived to be highly vulnerable to intentional disturbance are referred to as “species of special concern” rather than by their species name, and no ranks are revealed.
 - The PNHP rarity ranks and current legal status are listed for each community and species (explained in Appendix III, pg. 166).
- The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for conservation.

Conservation Priority and Site Ranking

Table 2, presented in the Executive Summary, prioritizes sites with by conservation priority and significance ranks documented in Philadelphia County. This table ranks sites from the most important and threatened to the least, with **Exceptional/Immediate** representing the higher priority sites, **High/Near-term** representing the medium priority sites, and **Notable/Enhancement** representing the lower priority sites for the conservation of biodiversity and greenspace in the county. Sites of **Local significance** or **Opportunistic** priority sites at which species of special concern or high-quality natural communities could not be documented during the survey period.

These areas are not exemplary at the state level, but are considered to be important at the county level.

Table 2 lists the site name, rank, and pertinent information about the site. A more detailed description for each site follows.

Potential Greenspace Quality Ranking

In an effort to facilitate and focus survey efforts PNHP conducted an aerial photography analysis of the landscape in and directly connected to Philadelphia County. This survey revealed the remaining areas of greenspace in the county and by using associated imagery and maps revealing other biologically important information PNHP was able to assign a cursory rank to the largest parcels. These rank are presented in figure 9 (pg. 55) with reference to the associated natural heritage sites (fig 1, pg. v).

Grouped into simple categories of high, medium, and low quality, these ranks are PNHP's opinion of the potential for the parcel to maintain species of concern, provide meaningful environmental services, or offer opportunities to expand the existing greenspace within and around the county. These ranked areas are presented in every site map to help facilitate preservation and restoration efforts by illuminating the areas with the greatest preservation need along with those in need of the most restoration. A detailed analysis of these areas is presented within each site description.

Areas given a **high** greenspace quality rank are generally large patches of natural habitat that offer significant existing greenspace, the potential to increase existing adjacent habitat through restoration, or are acting as natural corridors for plant and animal dispersal. High-quality greenspace areas deserve the most attention in terms of ecological preservation and restoration.

Areas given a **medium** greenspace quality rank are generally large in size, but environmentally degraded or smaller isolated patches of quality habitat. These sites are often adjacent to or near high-quality greenspace and can be converted into high-quality greenspace through connection to larger areas of adjacent greenspace and ecological restoration projects.

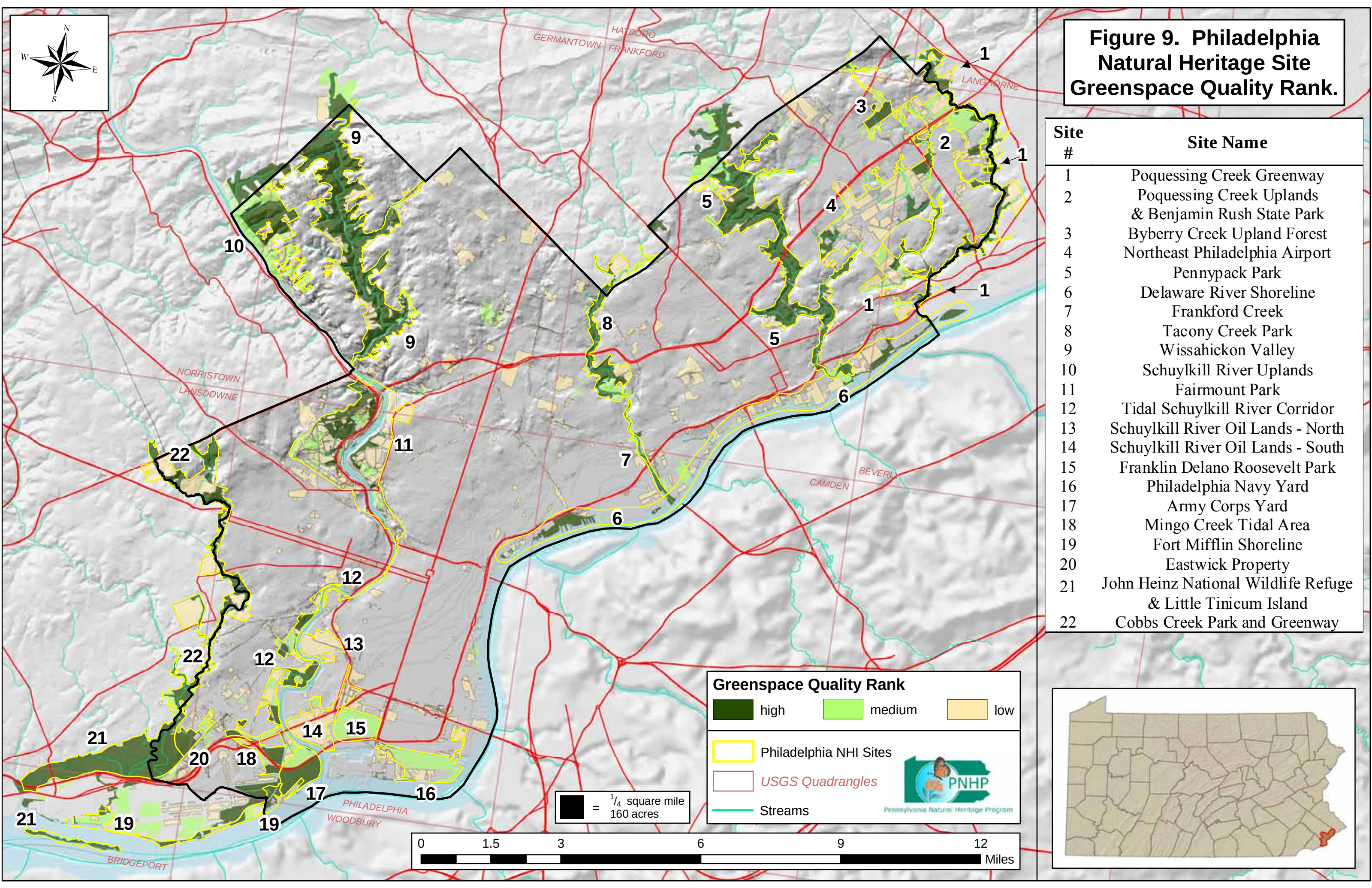
Areas given a **low** greenspace quality rank are of various sizes and show various levels of connectivity with the surrounding greenspace, but all are highly degraded through current and past land use choices. These parcels are noted for their potential to act as connectors between existing greenspace and as areas where green infrastructure could be installed.

Overall, the largest areas of high-quality greenspace within the city are within the Fairmount Park System. These areas are protected from development, offer a full suite of environmental services needed to maintain the environmental quality of the areas, and maintain small populations of species of special concern.

Large areas of high-quality greenspace were found outside of the park system too. Centered along the lower Schuylkill River, the Delaware River on the east side of the county, and along Poquessing Creek, these areas are significantly more degraded, but provide the same services as other high-quality areas found in the park system. These areas are also all threatened by conversion to more intensive land use practices and are will be lost to development in the near future without protection.

In the southwest corner of the county are several extensive areas of potential greenspace of various quality centered around the Philadelphia International Airport. These areas were all historically tidal marshland once connected together in a massive complex that covered 10 to 20 square miles. Today there is only a small remnant of this marsh remaining within the John Heinz National Wildlife Refuge. These areas need to be examined in light of their potential restoration to tidal marshlands.

Several areas of the county are noted for their lack of existing greenspace or the potential to create greenspace from large patches of open space. These areas should be reexamined as possible to assess how greenspace can be incorporated into the existing urban matrix.



SITE DESCRIPTIONS

Fairmount Park System

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Cobbs Creek Park and Greenway		Enhancement Conservation Priority and Notable Significance				
Eastern mudminnow (<i>Umbra pygmaea</i>)	F	G5	S3	CP	-	E
Elephant's foot (<i>Elephantopus carolinianus</i>)	P	G5	S1	PE	2002	BC
Fairmount Park		Enhancement Conservation Priority and Notable Significance				
Pied-billed grebe (<i>Podilymbus podiceps</i>)	B	G5	S3B, S4N	CR	2007	E
Franklin Delano Roosevelt Park		Enhancement Conservation Priority and Notable Significance				
Halloween pennant (<i>Celithemis eponina</i>)	O	G5	S2S3	N	2007	E
Multiflowered mud-plantain (<i>Heteranthera multiflora</i>)	P	G4	S1	PE	1998	E
Sensitive species of concern 5	-	-	-	-	-	-
Walter's barnyard-grass (<i>Echinochloa walteri</i>)	P	G5	S1	PE	2007	B
Pennypack Park		Enhancement Conservation Priority and Notable Significance				
Annual wild rice (<i>Zizania aquatica</i>)	P	G5	S3	PR	2008	E
Field dodder (<i>Cuscuta pentagona</i>)	P	G5	S3	TU	2008	E
Halloween pennant (<i>Celithemis eponina</i>)	O	G5	S2S3	N	2007	E
Marsh wren (<i>Cistothorus palustris</i>)	B	G5	S2S3B	CR	2007	E
Multiflowered mud-plantain (<i>Heteranthera multiflora</i>)	P	G4	S1	PE	2008	AB
Osprey (<i>Pandion haliaetus</i>)	B	G5	S2B	PT	2003	E
River bulrush (<i>Schoenoplectus fluviatilis</i>)	P	G5	S3	PR	2008	E
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	E
Showy bur-marigold (<i>Bidens laevis</i>)	P	G5	S3	TU	2008	E
Subulate arrowhead (<i>Sagittaria subulata</i>),	P	G4	S3	PR	2008	E
Swamp beggar-ticks (<i>Bidens bidentoides</i>)	P	G3G4	S1	PE	2008	E
Poquessing Creek Greenway		Immediate Conservation Priority and Local Significance				
None currently known						
Tacony Creek Park		Enhancement Conservation Priority and Local Significance				
None currently known						
Wissahickon Valley		Enhancement Conservation Priority and Notable Significance				
Autumn bluegrass (<i>Poa autumnnalis</i>)	P	G5	S1	PE	1990	CD
Forked rush (<i>Juncus dichotomus</i>)	P	G5	S1	PE	1997	CD
Round-leaved thoroughwort (<i>Eupatorium rotundifolium</i>)	P	G5	S3	UTF	1997	B

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

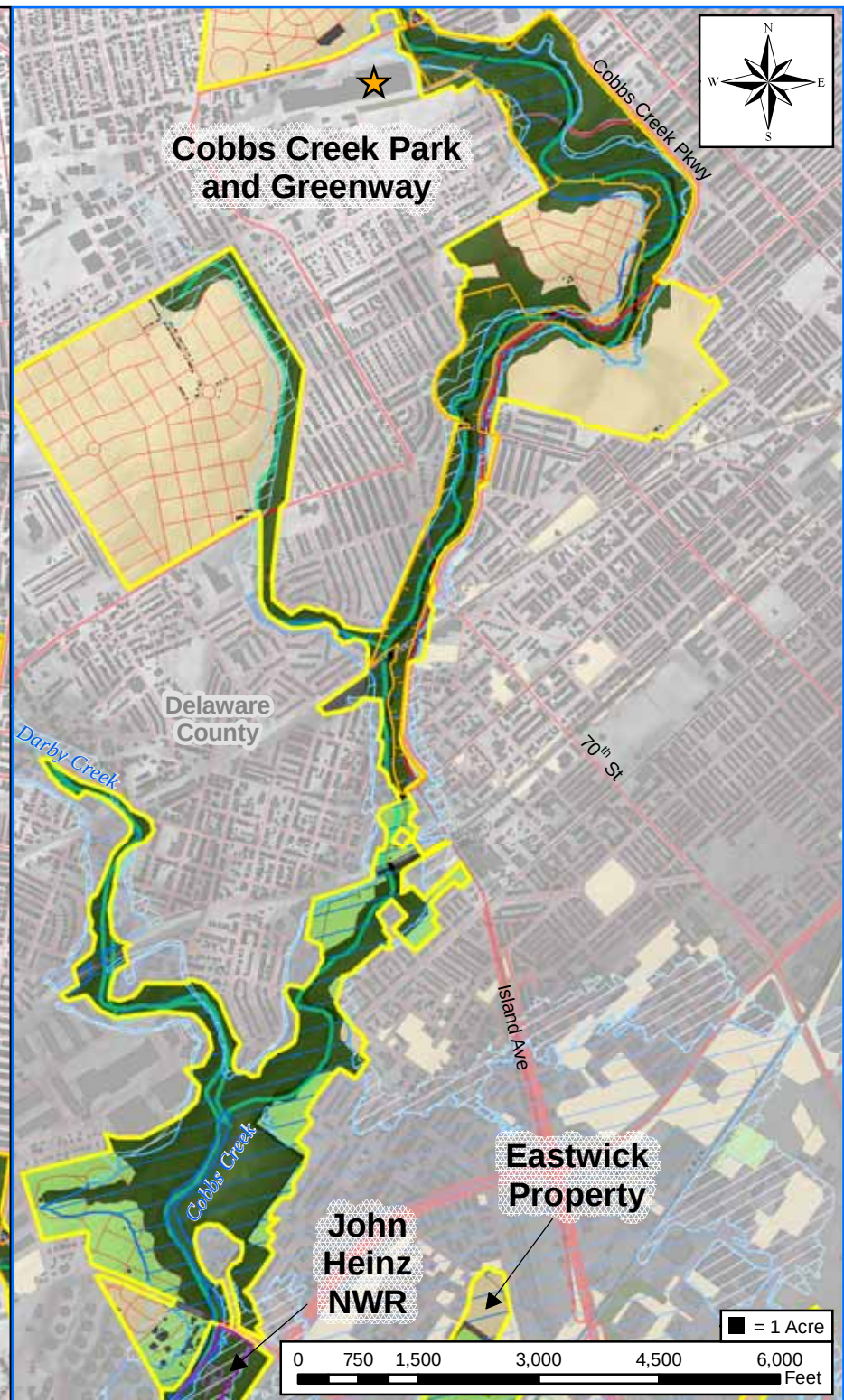
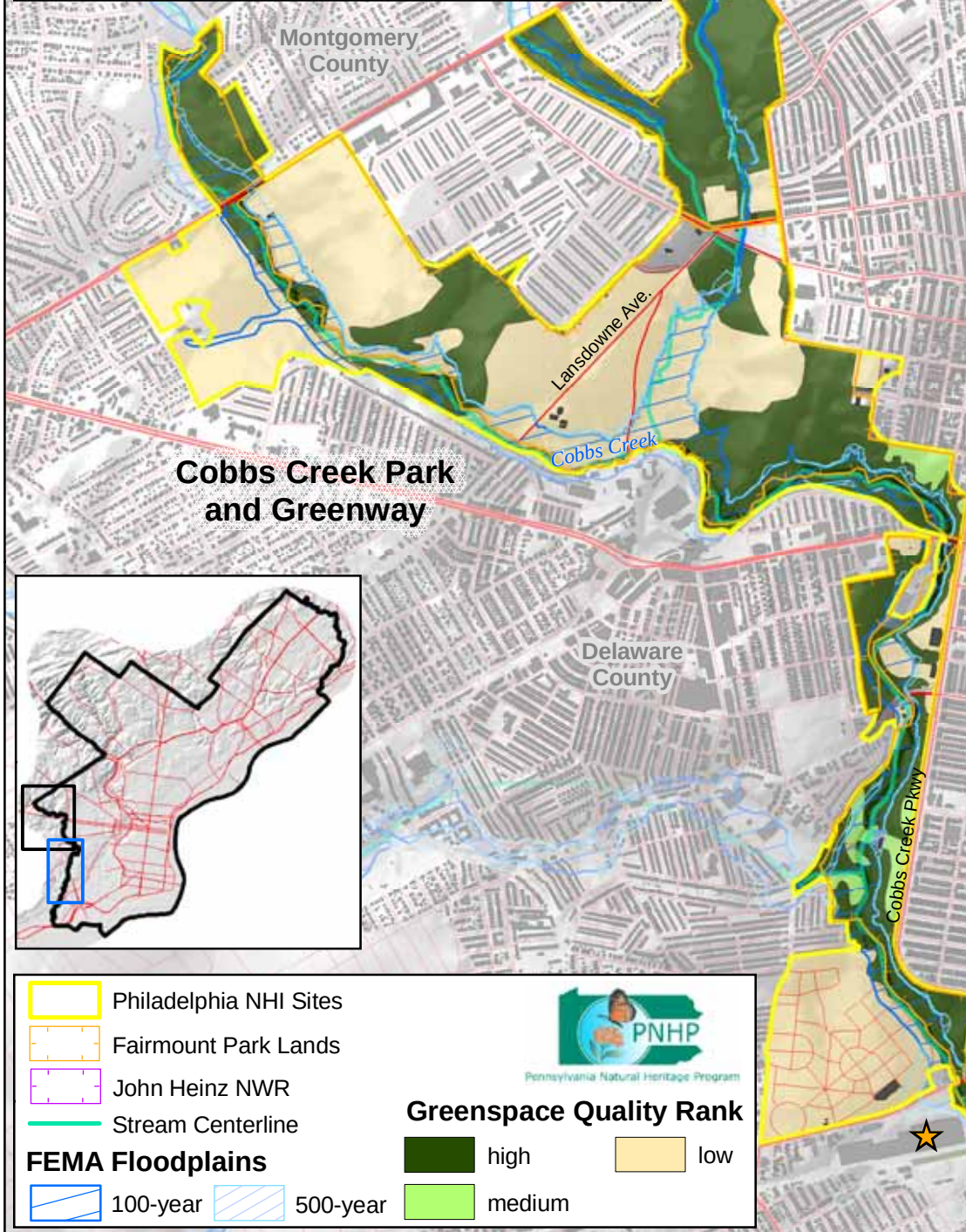
² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

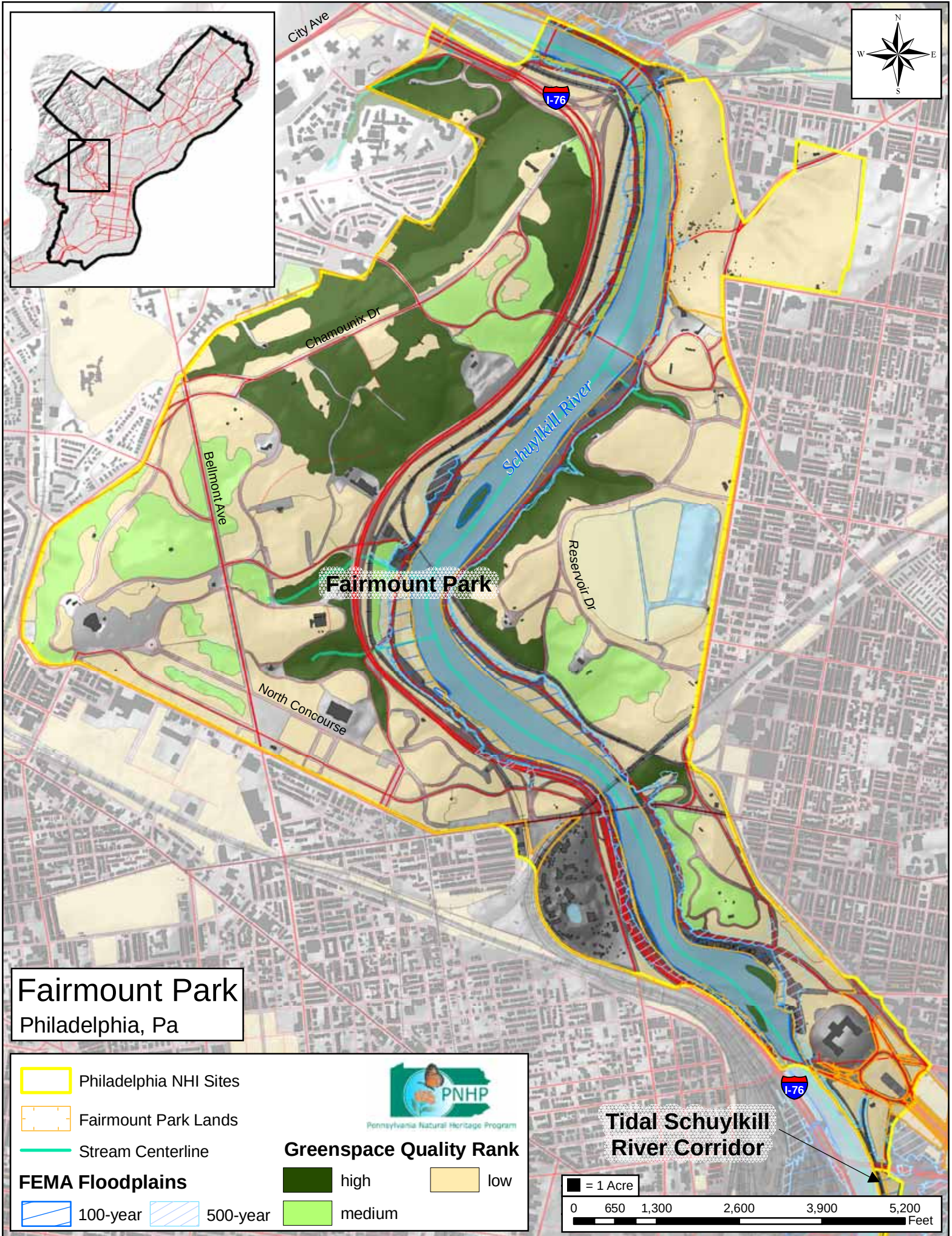
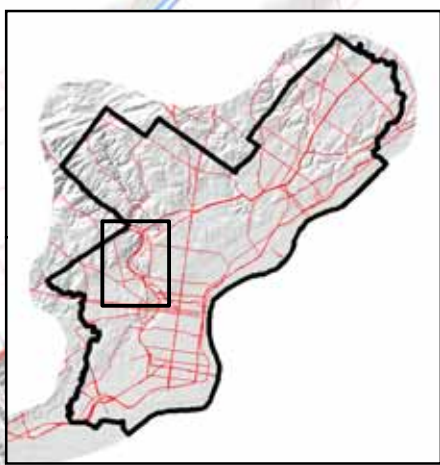
³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Cobbs Creek Park & Greenway

Philadelphia, Pa





Philadelphia NHI Sites

Fairmount Park Lands

Stream Centerline

FEMA Floodplains

100-year 500-year

Greenspace Quality Rank

high

low

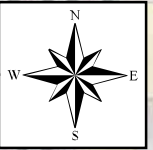
medium



Pennsylvania Natural Heritage Program

Franklin Delano Roosevelt Park

Philadelphia, Pa



Schuylkill River
Oil Lands - South

FDR Park

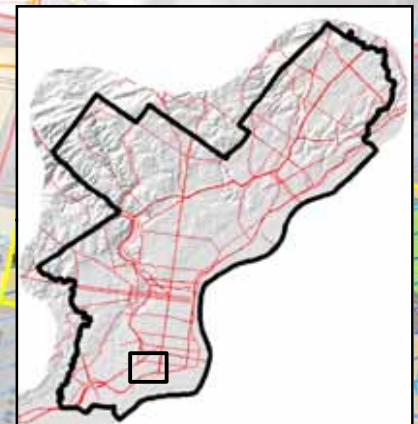
Pattison Ave.

Broad St

I-95

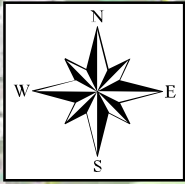
= 1 Acre

0 300 600 1,200 1,800 2,400 Feet



Pennypack Park

Philadelphia, Pa



Mont.
Co.

Rockledge Branch

Pennypack Creek

Pennypack
Park

Rhawn St

Busleton Ave

■ = 1 Acre

0 750 1,500 3,000 4,500 6,000 Feet

- Philadelphia NHI Sites
- Surrounding CNHI Sites
- Fairmount Park Lands
- Streams

FEMA Floodplains

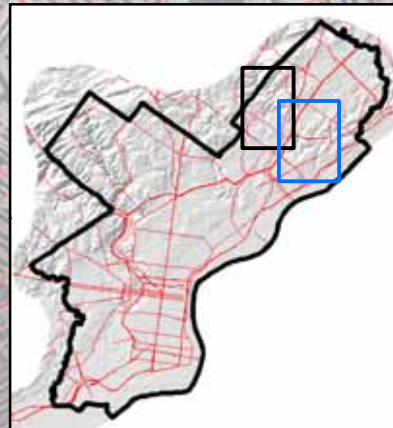
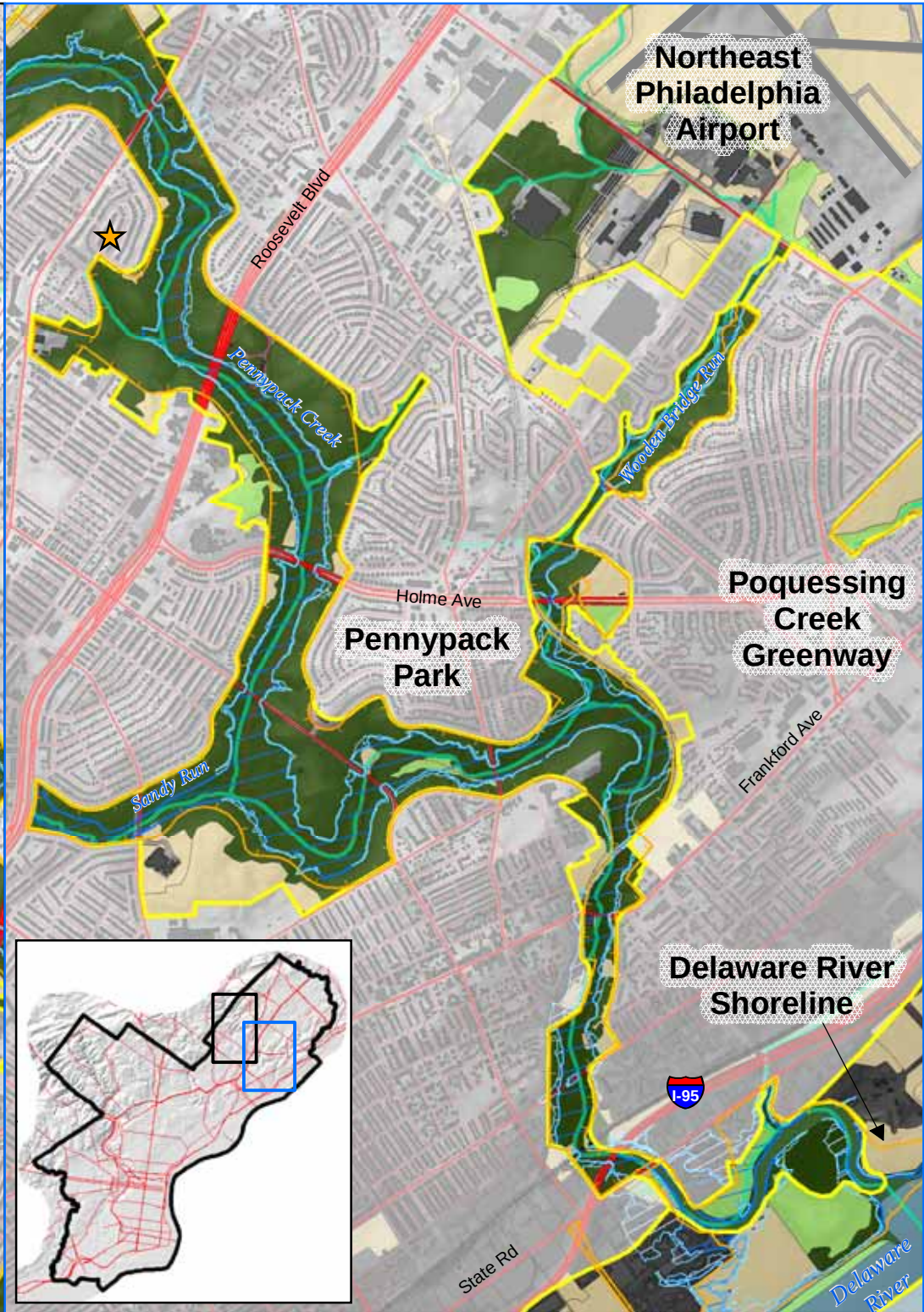
100-year 500-year

Greenspace Quality Rank

high medium low



Pennsylvania Natural Heritage Program



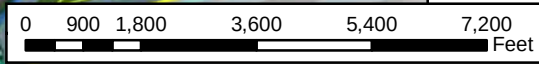
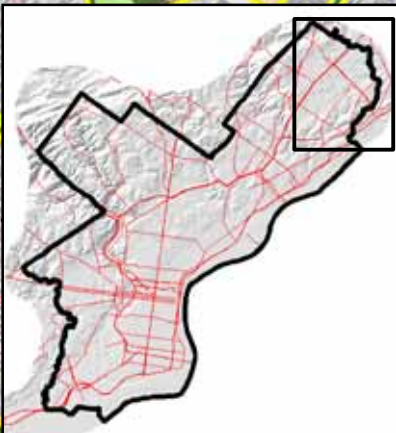
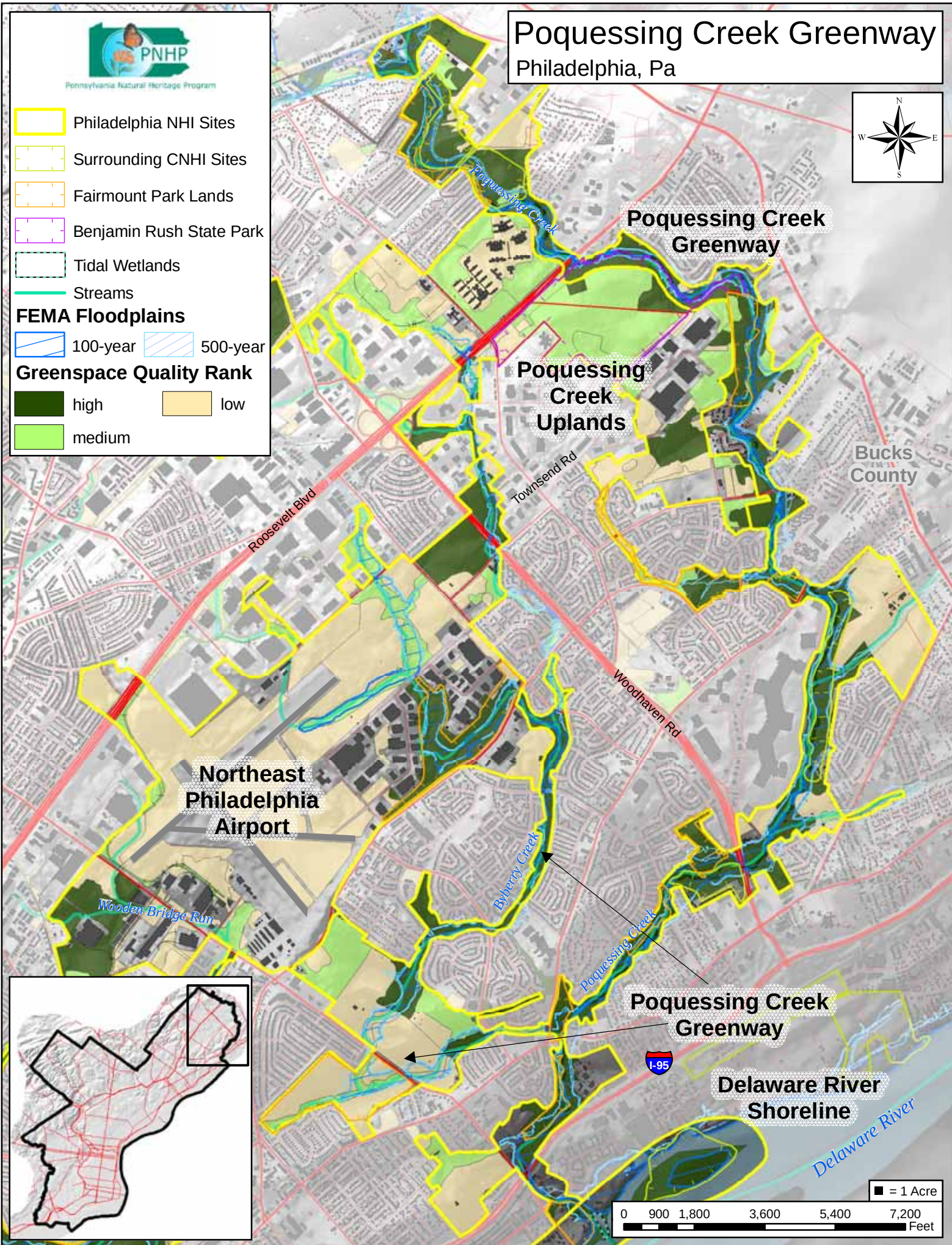
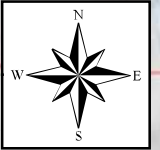


Pennsylvania Natural Heritage Program

- Philadelphia NHI Sites
- Surrounding CNHI Sites
- Fairmount Park Lands
- Benjamin Rush State Park
- Tidal Wetlands
- Streams
- FEMA Floodplains**
 - 100-year
 - 500-year
- Greenspace Quality Rank**
 - high
 - low
 - medium

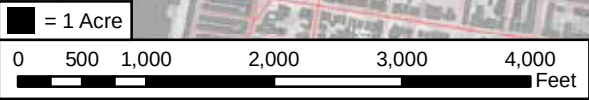
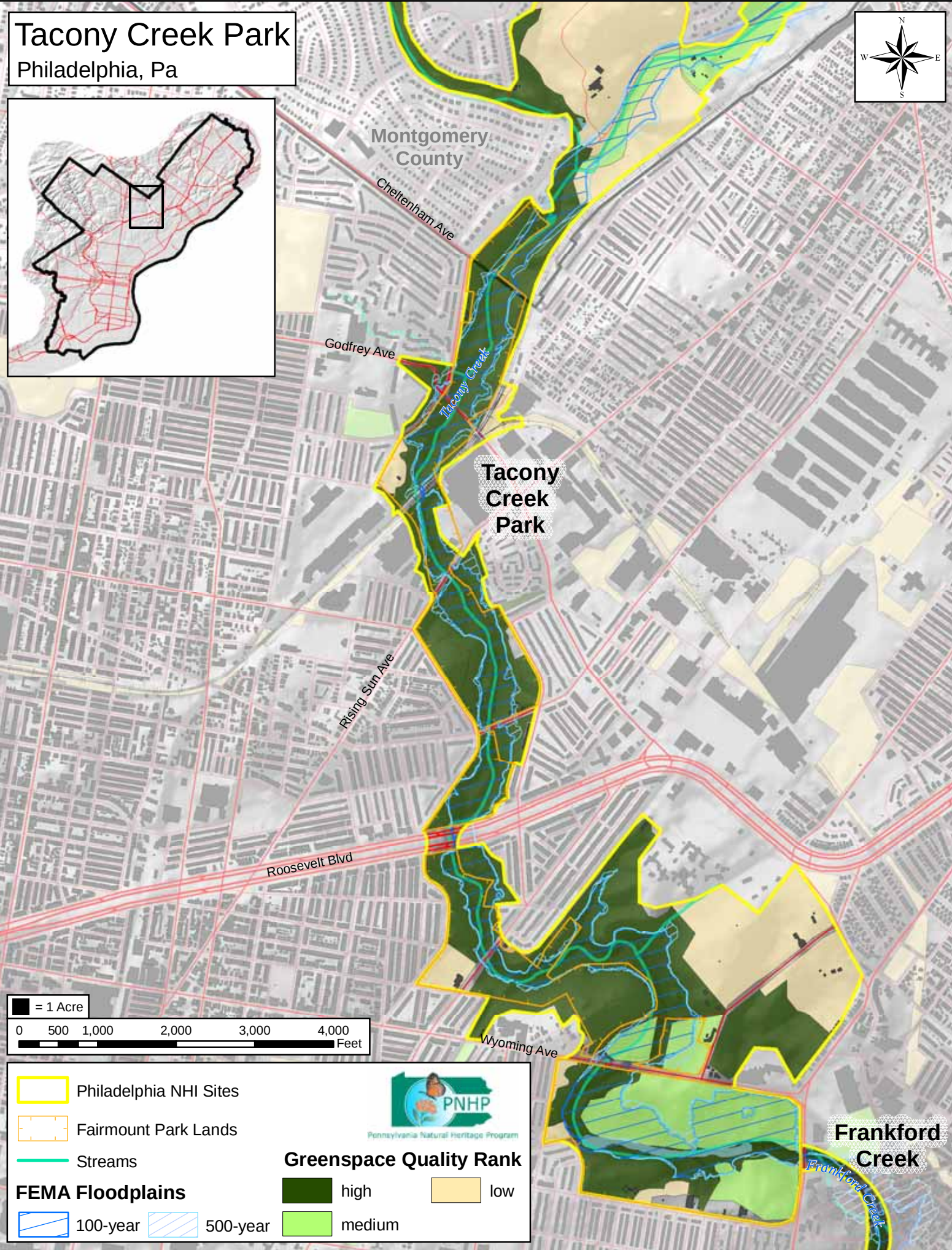
Poquessing Creek Greenway

Philadelphia, Pa



Tacony Creek Park

Philadelphia, Pa



Philadelphia NHI Sites

Fairmount Park Lands

Streams

FEMA Floodplains
 100-year 500-year

Greenspace Quality Rank
 high medium low

Wissahickon Valley

Philadelphia, Pa

Wissahickon
Creek
Landscape



Montgomery
County



Lower Schuylkill
Landscape

Wissahickon
Valley

Schuylkill
River
Uplands

Ridge Ave.

Bells Mill Rd
Bells Mill Run

Wises Mill Rd

Creshelm Creek

Wissahickon Creek

Lower
Schuylkill
Landscape



Montgomery
County

Henry Ave.

Walnut Ln

School House Ln

■ = 1 Acre

0 800 1,600 3,200 4,800 6,400 Feet



Pennsylvania Natural Heritage Program

- Philadelphia NHI Sites
- Surrounding CNHI Sites
- Schuylkill Center for Env. Education
- Fairmount Park Lands

Streams

FEMA Floodplains

100-year 500-year

Greenspace Quality Rank

high low

medium



FAIRMOUNT PARK SYSTEM

Fairmount Park System Overview

The Fairmount Park Commission (FPC) was formed in 1867 by an Act of the Pennsylvania Assembly to manage public open space within Philadelphia. In that act the FPC was charged to "maintain [the Park] forever, as an open public place and park, for the health and enjoyment of the citizens [of Philadelphia], and the preservation of the purity of the water supply to the City of Philadelphia." However, the park system in Philadelphia dates back to the original Lemon Hill estate that was purchased in 1844 to preserve the quality of the city's drinking water. This open space was quickly utilized by the public as a ready escape from the urban landscape and was declared Fairmount Park on September 20, 1855. Over time the FPC acquired additional plots through purchase and major land donations and today manages approximately 13 square-miles of parkland of which around 7.5 square-miles is managed as natural area.

Now surpassing 150 years of service and looking to the future of the park system, the FPC authorized a major inventory and evaluation of the parks natural resources, which produced the 1999 *Fairmount Park System: Natural Lands Restoration Master Plan* (<http://www.anasp.org/research/pcer/projects/fairmount/index.php>). This extensively detailed report outlines the natural resources of the park and, in an effort not to duplicate existing work, PNHP did not conduct surveys that overlapped with this plan. Much of the park-specific information is adapted from the master plan.

PNHP did conduct surveys within the park system at specific locations as requested by FPC and in additional locations to supplement prior searches and update records on known locations of rare species. The FPC-selected locations were primarily restoration sites where restoration success was gauged and reported to FPC in a separate document.

Threats and Disturbances

The single greatest threat to the health of the natural areas of the Fairmount Park System is non-native



Poster of Fairmount Park during the United States Centennial, circa 1876, nine years after the park's dedication.

invasive species (see invasives species section, pg. 15). These species directly compete with the native plants and animals, reducing their ability to combat diseases and reproduce. A concerted effort to reduce existing outbreaks of non-native species and prevent the spread of new non-native invasive species is needed.

Additional on-going disturbances within the park system are erosion of streams from the improper management of stormwater flows and unauthorized trails through natural areas. During rain events these bare, unmanaged trails have the potential to mobilize large quantities of sediment directly into waterways and degrade stream quality.

One continual threat to the park system is pollution. Whether it is an individual's litter from lunch, illegal dumping of trash or building waste, smog from traffic, or large chemical spills into the waterways, it all has an effect on the health of the park. Especially damaging are chemical and oil spills upstream of the park and along the tidal reach of the Delaware River; these are the disturbances most removed from the control of the FPC.

Conservation and Restoration Recommendations

The key to preserving the natural areas within the Fairmount Park System is to be proactive rather than

FAIRMOUNT PARK SYSTEM

reactive. Ideally, the natural areas that border private lands should not end at a blue grass “wall of lawn”, but should integrate into the private lands. This introgression can be achieved by working with private landowners to educate them on how their actions affect the health of the park. Similarly, instances in which practices on private property have encroached on natural areas or park property, such as lawn mowing and dumping of yard waste, need to be redressed.

Illegal dumping still occurs within park lands. Dumped material may be in the form of yard waste, household trash, or truckloads of junk. All instances of illegal dumping need to be addressed, but not necessarily in the same manner. Private landowners who dump their yard waste in the park need to be educated that just because the park is a natural area does not mean it is an appropriate or legal repository for their grass clippings. Areas where trash is being dumped need to be cleaned and posted, and if this is ineffective, monitored for continued dumping.

Within the park’s natural areas, non-native invasive species pose a significant threat to existing native species and ongoing restoration efforts. It is very important that non-native invasive species be controlled in a systematic manner before, during, and after any restoration effort, and actively managed in any high-value natural area.

Additionally, deer population levels within portions of the park system are too high to allow natural regeneration of native vegetation. In areas with high deer populations a restoration project is likely to become a salad-bar for the deer if they are not excluded or removed from the area.

Stormwater management needs to be addressed to protect the health of the creeks, streams, and rivers of the park system in coordination with the Philadelphia Water Department, PennDOT, the US Army Corps, and other managing agencies.

Finally, it is critical to continue the proactive program of public education on the economic, social, and environmental value of the park system. The public must understand the value they receive from the parks and other natural areas in and around the city even if they are not using them on a daily basis.

The Parks of the Fairmount Park System

Cobbs Creek Park and Greenway

This is one of the younger and more ecologically disturbed parks within the Fairmount Park System. Running from north of the city line, Cobbs Creek joins with Darby Creek shortly before entering Tinicum Marsh and finally the Delaware River. This waterway forms a natural, if incomplete, greenway from the Delaware River. Acquisition of the land for this park began in 1904 and did not conclude until 1929.

Disturbance of the landscape around Cobbs Creek Park is extensive, with a majority of the watershed (77%) being developed (ANSP, 1999). This development has severely affected the hydrology of the creek through very high storm flows and very low base flows, resulting in low aquatic species diversity. Additionally, the majority of the forest within the park is young and significantly disturbed by invasive species, but there are a few exceptions.



A large tuliptree (*Liriodendron tulipifera*) in Cobbs Creek Park with a diameter in excess of 7 feet.

FAIRMOUNT PARK SYSTEM

An important goal for the park should be the completion of the greenway all the way to the John Heinz National Wildlife Refuge. Linking this park to the wildlife refuge would not only complete a green link for wildlife through the otherwise urban environment, but would also increase ease of access to the wildlife refuge for the residents of the city.

Additionally, this park supports one of only a handful of populations of elephant's foot (*Elephantopus carolinianus*) found in the Commonwealth. This species, common much further south in the US, is restricted to the southeastern corner of Pennsylvania, but is doing well in the park.

Karakung Golf Course Woods

There are patches of woods within Cobbs Creek Park that have large mature trees that form a dense closed canopy and support a diverse native flora. Karakung Woods is one of these with several tuliptree (*Liriodendron tulipifera*) over five feet in diameter with one individual exceeding seven feet in diameter.

Additionally, there is an impressive array of spring flowers and native shrubs in the understory indicating a relatively low amount of disturbance over the past 100+ years.

There is a significant emerging non-native invasive species problem at this site. A small patch of jetbead (*Rhodotypos scandens*) was observed, and scattered areas of devil's walkingstick (*Aralia elata*), bush honeysuckles (non-native *Lonicera* spp.), and princess and pagoda tree (*Paulownia tomentosa* and *Styphnolobium japonicum*) were found. Additionally, Japanese honeysuckle (*Lonicera japonica*) and Oriental bittersweet (*Celastrus orbiculatus*) form an impenetrable curtain around the border of the woods.

Within the woods are several areas where trash and waste have been dumped in the past and where stumps, grass clippings, flowerbed refuse, rotted timbers, and broken concrete continue to be deposited. It appears that the refuse from golf course maintenance has expanded along a trail as dumping spots have filled up. The areas of trash should be cleaned up and deposits from golf course



photo source: PNHP

A clump of Walter's barnyard-grass (*Echinochloa walteri*) at the main lagoon in FDR Park.

maintenance should be stopped or limited to a set area, with the remaining deposits removed.

Fairmount Park

Fairmount Park is one of the oldest parks in the United States. Within the park proper are numerous historic buildings, several important thoroughfares including I-76, ponds and reservoirs, the Schuylkill River, pastoral parklands, and areas of relatively natural vegetation. This combination gives the park a truly mixed-use environment and poses significant management challenges while offering unique opportunities.

Many of the highest quality natural areas within the park are located within steep stream ravines that empty directly into the Schuylkill River. The majority of the small watersheds that comprise these streams are completely contained within the park, allowing for the mitigation of most of the factors

FAIRMOUNT PARK SYSTEM

affecting the streams. The primary impact on many of these streams is uncontrolled stormwater flows from the significant amount of impermeable surface found within the park. Better management of these storm flows could increase the water quality in these streams, allowing for increases in the native organisms they support. Additionally, the East Park Reservoir is an important migratory stop for birds and supports breeding habitat for pied-billed grebes (*Podilymbus podiceps*), which fledged young in 2007.

Franklin Delano Roosevelt (FDR) Park

Originally part of the massive freshwater marsh complex that covered the southern portion of the city, the area that is now FDR Park and the Philadelphia Sports Complex was slowly ditched and drained to increase the available dry land. Created as League Island Park around 1900, FDR Park obtained its present form during a major redesign for the 1926 Sesquicentennial Exposition that included the construction of the various ponds and JFK (then Philadelphia Municipal) Stadium.

Hosting a swimming pool in Meadow Lake until 1996, the ponds today are highly eutrophied (overloaded with nutrients) and sediment filled. The ponds do maintain a marginal tidal connection, allowing them to support several species of concern.

Among these species of concern are one state sensitive species, one dragonfly species, and one plant species. The sensitive species of concern utilizes the ponds for most of its life cycle and depends on good water quality to survive. The dragonfly, the Halloween Pennant (*Celithemis eponina*), is found in the less managed areas of the ponds where there is abundant emergent aquatic vegetation for it to perch on and hunt from. The plant, Walter's barnyard-grass (*Echinochloa walteri*), is a reminder that this area once had a significant link to the tidal Delaware River. This species is almost always found in areas with the regular change in water level associated with the tide and is only found around the margins of the tidal basins in the park.

Through management of the nutrient inputs into the ponds, careful dredging and potential expansion of the ponds, and a controlled increase in the tidal exchange in the ponds the habitat and water quality in the park could be greatly increased and improved. Additionally, this would open up the possibility for the restoration of a small portion of tidal marsh as an educational exhibit within the park.

Pennypack Park

Pennypack Park originated in 1910 when the need to provide additional public open space was perceived. By 1916 a significant proportion of the 1,750 acre park was in city ownership. Today the park supports significant areas of natural habitat intermixed with conventional parklands, playgrounds, and athletic fields.

Pennypack Creek has tidal flow up to the Frankford Avenue Bridge, where natural falls have slowed erosion of the river. These falls were the impetus for early development in the area as they acted as a natural dam for mills to draw water from. The first mill on Pennypack Creek was constructed in 1687, with the creek supporting 30 mills by 1800 (ANSP 1999). These mills grew in size and their effect on the creek continued to increase with the advancements of the Industrial Revolution. Further



Pennypack on the Delaware Park tidal marsh with inset Halloween Pennant (*Celithemis eponina*) Dragonfly.

FAIRMOUNT PARK SYSTEM

Listed Plant Species found a Pennypack on the Delaware Park

Annual wild rice	<i>Zizania aquatica</i>
Field dodder	<i>Cuscuta pentagona</i>
Multiflowered mud-plantain	<i>Heteranthera multiflora</i>
River bulrush	<i>Schoenoplectus fluviatilis</i>
Salt-marsh water-hemp	<i>Amaranthus cannabinus</i>
Showy bur-marigold	<i>Bidens laevis</i>
Subulate arrowhead	<i>Sagittaria subulata</i>
Swamp beggar-ticks	<i>Bidens bidentoides</i>

impacts on the park were generally limited until after World War II, when the upper watershed of the area was developed. This greatly decreased the amount of permeable surfaces, causing an increase in storm flows and a decrease in base flows for the creek.

Efforts to increase the amount of permeable surface within the watershed, increase groundwater infiltration and recharge, and manage stormwater flows could mitigate the damage done to the creek and restore some of the lost species and ecological functions.

Pennypack on the Delaware Park Wetland Mitigation Site

Pennypack on the Delaware Park is a mitigation site. This site, formerly a polluted industrial area, was restored to upland grassland and tidal marsh in 2005. Our surveys indicate that the restoration effort has been successful in creating both a warm-season grassland and a functional tidal marsh. We were very surprised at the level of plant diversity present in the tidal marsh. During surveys eight plant species of concern were found along with the Swarthy Skipper (*Nastra lherminier*), a butterfly, and the Halloween Pennant (*Celithemis eponina*), a dragonfly. It appears that the local seed bank is either still intact or being replenished by Tinicum Marsh and other marshes in the watershed suggesting that tidal wetland restoration projects around Philadelphia could expect a significant level of native plant recolonization. One issue of concern at the site was a significant number of non-native invasive species including common reed (*Phragmites australis*), narrowleaf cattail (*Typha angustifolia*), and European alder (*Alnus glutinosa*). These three species are introduced to North America and have the potential to take over and degrade wet sites very quickly. This would be especially detrimental to the rare plants found here and to animals that utilize the open mudflats, such as

shorebirds. We noted several dozen feeding shorebirds during our survey, indicating that this site is important to both local and migratory birds. Overall, this is an excellent site that should serve as an example of tidal restoration possibilities in Philadelphia.

Poquessing Creek Greenway

Poquessing Creek Riparian Corridor

The Poquessing Creek Greenway was one of the last areas in the city to have parklands protected. Dominated by agricultural lands until the 1950s housing boom, much of the land that is protected today is what remains after development. As a result, the majority of the parklands are thin corridors of green along the creek in an otherwise developed landscape.

Poquessing Creek has one of the smallest watersheds in the city, with its headwaters lying just over the



Portion of Poquessing Creek with intact riparian forest and a well-developed forest structure

photo source: PNHP

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Philadelphia border in Montgomery and Buck Counties. The creek, from its headwaters to its tidal mouth on the Delaware River, is only 11 miles draining a mere 25 square miles.

This small size should make for only small changes in stream flow during storms, but because of the level of development in the area and the poor management of runoff the stream is exceptionally flashy. This has resulted in a highly disturbed hydrology in the stream causing incised banks, low base flow, and high storm flow.

Additionally, significant areas within the floodplain, including several wetlands, have been heavily impacted by the illegal dumping and the use of all-terrain vehicles (ATVs) and 4x4s.

Nevertheless, there are several areas of note within the riparian corridor that contain large native trees, some of which are over 5 feet in diameter. Within the narrow forested floodplain are several areas with small natural rock walls and several small skunk-cabbage seeps, each having the potential to support unique species. These rock outcrops extend to the creek in several places and act as natural dams in some spot.

Threats and Disturbances

Non-native invasive species are thoroughly established along the Poquessing Creek floodplain. Individual Oriental bittersweet (*Celastrus orbiculatus*) vines several inches in diameter and reaching to the tops of 100+ft trees, along with acres of impenetrable Japanese knotweed (*Polygonum cuspidatum*), were observed. Norway maple (*Acer platanoides*), tree-of-heaven (*Ailanthus altissima*), and several other non-native invasive tree species have invaded the canopy. Japanese stilt-grass (*Microstegium vimineum*) has also invaded the floodplain in many areas, forming a mat thick enough to suppress regeneration in some areas.

Evidence of both historic and recent illegal dumping is found throughout the riparian corridor. These areas are also often sources of invasive species when landscaping waste is dumped in natural areas.

The damage to the floodplain from ATVs and 4x4s along Poquessing Creek has destroyed significant



photo source: PNHP

Extensive wetland and vegetation damage within the Poquessing Creek floodplain from unauthorized ATV and 4x4 use.

areas of floodplain and the denuded areas are likely mobilizing sediment during storms.

These storm flows are also affecting the health of the creek and the floodplain. The bed of the creek has been eroded downward as a result of the large increase in flow with even small rains that cause water levels to surge. As a result the banks are very steep with little or no vegetation. Additionally, aquatic vegetation and macroinvertebrate diversity are severely reduced by these storm flows that simply flush organisms out of the river.

Conservation and Restoration Recommendations

The Poquessing Creek corridor is the least contiguous of the major parks within the Fairmount Park System. Comprising several separate and disjunct units, this park has a significant amount of fragmentation. Nonetheless, it provides important greenspace and buffering of Poquessing Creek and is connected to Benjamin Rush State Park. As such, this area should be looked to as an important area for continued acquisition and establishment of easements to protect open space and fortify environmental quality, with the eventual goal of creating a contiguous greenway along Philadelphia's northern border.

Picking one or another of the threats and disturbances to the Poquessing Creek Riparian Greenway without addressing the whole suite of issues will only be a stop-gap measure. To restore and preserve this area, ATVs and 4x4s need to be

FAIRMOUNT PARK SYSTEM

permanently excluded from the area and their damage needs to be repaired, illegal dumping needs to be stopped with dumped materials removed, storm flows need to be mediated, invasive species need to be controlled, and native plantings are needed throughout the greenway.

Together these actions can restore this small stream to a beautiful, functional system that provides not only environmental benefit to the area, but acts as a green gateway along the northern edge of the city.

Tacony Creek Park

Tacony Creek Park was formed in 1915 when the City of Philadelphia approved an ordinance for the purchase of the land (ANSP 1999). The Tacony Creek valley was primarily in agriculture as late as the 1910's and remained an open farm-like landscape until the 1940's. Consequently, the forest within the park is very young, with few mature trees and an underdeveloped forest structure.

Tacony Creek is severely impacted by stormwater flows from the surrounding developed area, with 80% of the watershed in development (ANSP 1999). One stormwater outflow channel in Juniata Park (part of Tacony Park) drains approximately one-eighth of the city's area. Additionally, numerous dams along the creek prevent the migration of fish up and down the stream, impair water quality, and restrict sediment movement within the channel.

Wissahickon Valley

Wissahickon Park, much like Fairmount Park, was originally created to secure clean drinking water for the city, but it followed a much different path of development. Purchase of the land that constitutes the park began in 1867, with additional parcels being acquired over the next 20 years (ANSP 1999). Today the park is composed primarily of natural forested land and offers a picture of what the forested ravines and uplands of Philadelphia looked like 300 years ago.

This picture belies the history of the valley. The first dam and mill were built at the mouth of the Wissahickon in 1686. Over the subsequent century-and-a-half an additional 23 milldams were built along Wissahickon Creek and its tributaries just within the city limits. The surrounding woods were often used as sources for raw materials and the creeks were commonly used to get rid of waste, at times flowing in brilliant colors from the dye-wastes dumped into it. These milldams, in some cases still present, caused significant changes in the rivers hydrology and ecology by changing temperatures and flow patterns and limiting sediment movement and fish migration.

With the creation of Wissahickon Park the last of these mills closed in 1884 and many of the dams have deteriorated and failed or been intentionally removed. There is resistance to removing the remaining dams because of historical value or the cost of moving imbedded infrastructure, but retention of the dams necessitates that they be maintained to state standards at FPC's expense (see Dams section in Disturbances chapter, pg. 14).

The northern end of the site abuts the Wissahickon Creek Landscape, as site called out in the Montgomery County Natural Heritage Inventory. This site, noted for inclusion of the Green Ribbon



photo source: PNHP

Houston Meadow restoration area in Wissahickon Park.

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Preserve, maintains significant areas of floodplain forest along Wissahickon Creek. Additionally, Fort Washington State Park contains a large patch of interior forest habitat.

Houston Meadows Restoration Site

Houston Meadows represents a small reminder of what most of the uplands in Wissahickon Park looked like when the park was created. Used extensively for logging, farming, grazing, and pasture lands, these areas contained extensive meadows and fields. Today this area is extensively overgrown with shrubs and small trees and has a significant invasive species problem.

This meadow already supports two species of concern that are likely to benefit from expansion of the meadows. These plants, forked rush (*Juncus dichotomus*) and round-leaved thoroughwort (*Eupatorium rotundifolium*), are species of open meadows that will die if they receive too much shade.

Plans are underway to restore this area into a native meadow landscape. Through the process of cutting larger trees, removing invasive species, conducting

controlled fires in existing grassy areas, and actively replanting native species, a significant area around the meadow is slated for restoration.

Threats and Disturbances

The primary threats to this site are succession to woody vegetation and invasion by non-native plant species. Smaller threats include unmanaged paths that are eroding the surrounding vegetation.

Conservation and Restoration Recommendations

FPC is actively working to maintain and expand the meadow area through active management of the woody species, removal of the non-native invasive species, and replanting of rare and lost plant species.

These efforts, if continued over the long-term, stand to greatly improve the quality of Houston Meadows, increasing the site's viability into the future.



photo source: Andrew Strassman, PNHP

Small tributary to Wissahickon Creek with intact floodplain, but significant bank erosion from stormwater inflows.

John Heinz National Wildlife Refuge – Tinicum Marsh

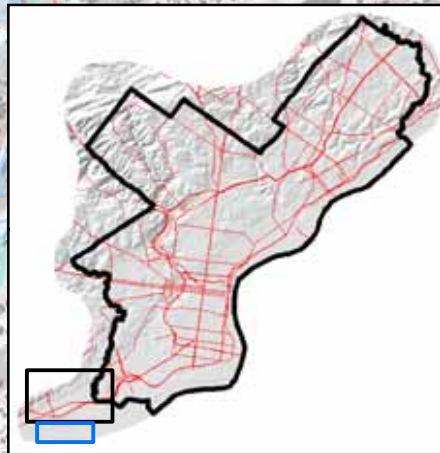
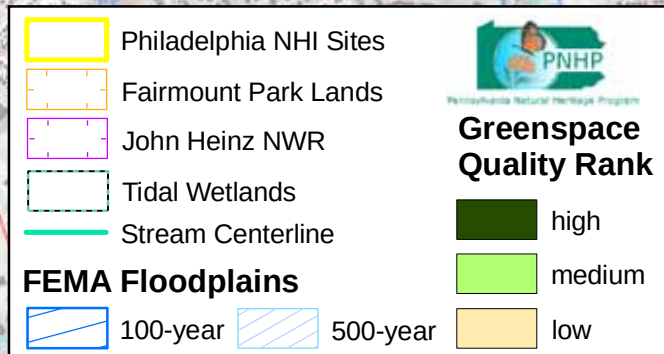
	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
John Heinz (Tinicum) National wildlife Refuge			Immediate Conservation Priority and Exceptional Significance			
American bittern (<i>Botaurus lentiginosus</i>)	B	G4	S1B	PE	1989	E
Annual wild rice (<i>Zizania aquatica</i>)	P	G5	S3	PR	1991	A
Freshwater intertidal marsh	C	G3G4	S1	N	1991	B
Great egret (<i>Casmerodius albus</i>)	B	G5	S1B	PE	1984	E
Least bittern (<i>Ixobrychus exilis</i>)	B	G5	S1B	PE	1991	A?
Marsh wren (<i>Cistothorus palustris</i>)	B	G5	S2S3B	CR	2004	E
Northern harrier (<i>Circus cyaneus</i>)	B	G5	S3B	CA	1991	E
River bulrush (<i>Schoenoplectus fluviatilis</i>)	P	G5	S3	PR	1991	A
Round-leaved thoroughwort (<i>Eupatorium rotundifolium</i>)	P	G5	S3	UTF	1986	B
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	C
Sensitive species of concern 2	-	-	-	-	-	-
Sensitive species of concern 3	-	-	-	-	-	-
Sensitive species of concern 4	-	-	-	-	-	-
Sensitive species of concern 5	-	-	-	-	-	-
Sensitive species of concern 6	-	-	-	-	-	-
Sensitive species of concern 7	-	-	-	-	-	-
Sensitive species of concern 8	-	-	-	-	-	-
Subulate arrowhead (<i>Sagittaria subulata</i>)	P	G4	S3	PR	1994	BC
Virginia rail (<i>Rallus limicola</i>)	B	G5	S3B	N	1991	E
Walter's barnyard-grass (<i>Echinochloa walteri</i>)	P	G5	S1	PE	1986	BC
Wild senna (<i>Senna marilandica</i>)	P	G5	S1	PE	2007	BC
Wrights spike rush (<i>Eleocharis obtusa</i> var. <i>peasei</i>)	P	G5TNR	S1	PE	1994	B
Little Tinicum Island			Immediate Conservation Priority and Exceptional Significance			
Annual wild rice (<i>Zizania aquatica</i>)	P	G5	S3	PR	2007	D
Bugleweed (<i>Lycopus rubellus</i>)	P	G5	S1	PE	2005	BC
Freshwater intertidal mudflat	C	G3G4	S1	N	1991	B
Little-spike spike-rush (<i>Eleocharis parvula</i>)	P	G5	S1	PE	2005	B
Long-lobed arrow-head (<i>Sagittaria calycina</i> var. <i>spongiosa</i>)	P	G5T4	S1	PE	2005	AB
Multiflowered mud-plantain (<i>Heteranthera multiflora</i>)	P	G4	S1	PE	2007	AB
River bulrush (<i>Schoenoplectus fluviatilis</i>)	P	G5	S3	PR	2005	E
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	C
Sensitive species of concern 5	-	-	-	-	-	-
Shrubby camphor-weed (<i>Pluchea odorata</i>)	P	G5	S1	PE	1991	D
Smith's bulrush (<i>Schoenoplectus smithii</i>)	P	G5?	S1	PE	1991	B
Subulate arrowhead (<i>Sagittaria subulata</i>)	P	G4	S3	PR	2005	BC
Walter's barnyard-grass (<i>Echinochloa walteri</i>)	P	G5	S1	PE	1991	B
Wrights spike rush (<i>Eleocharis obtusa</i> var. <i>peasei</i>)	P	G5TNR	S1	PE	2005	B

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

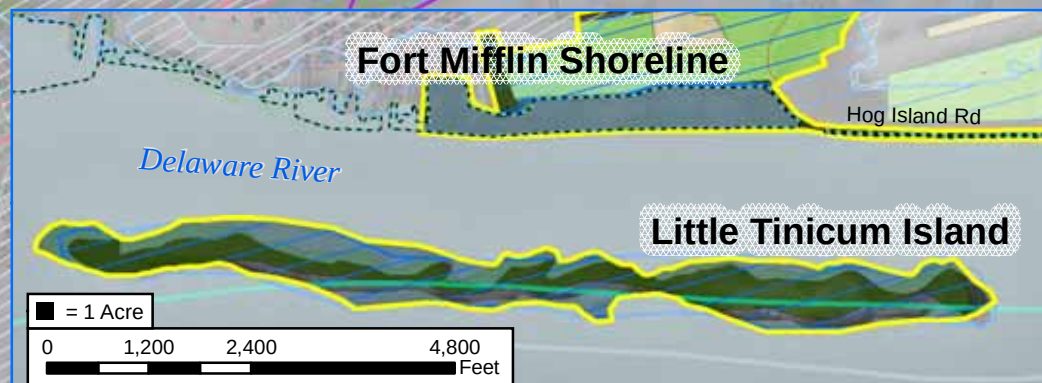
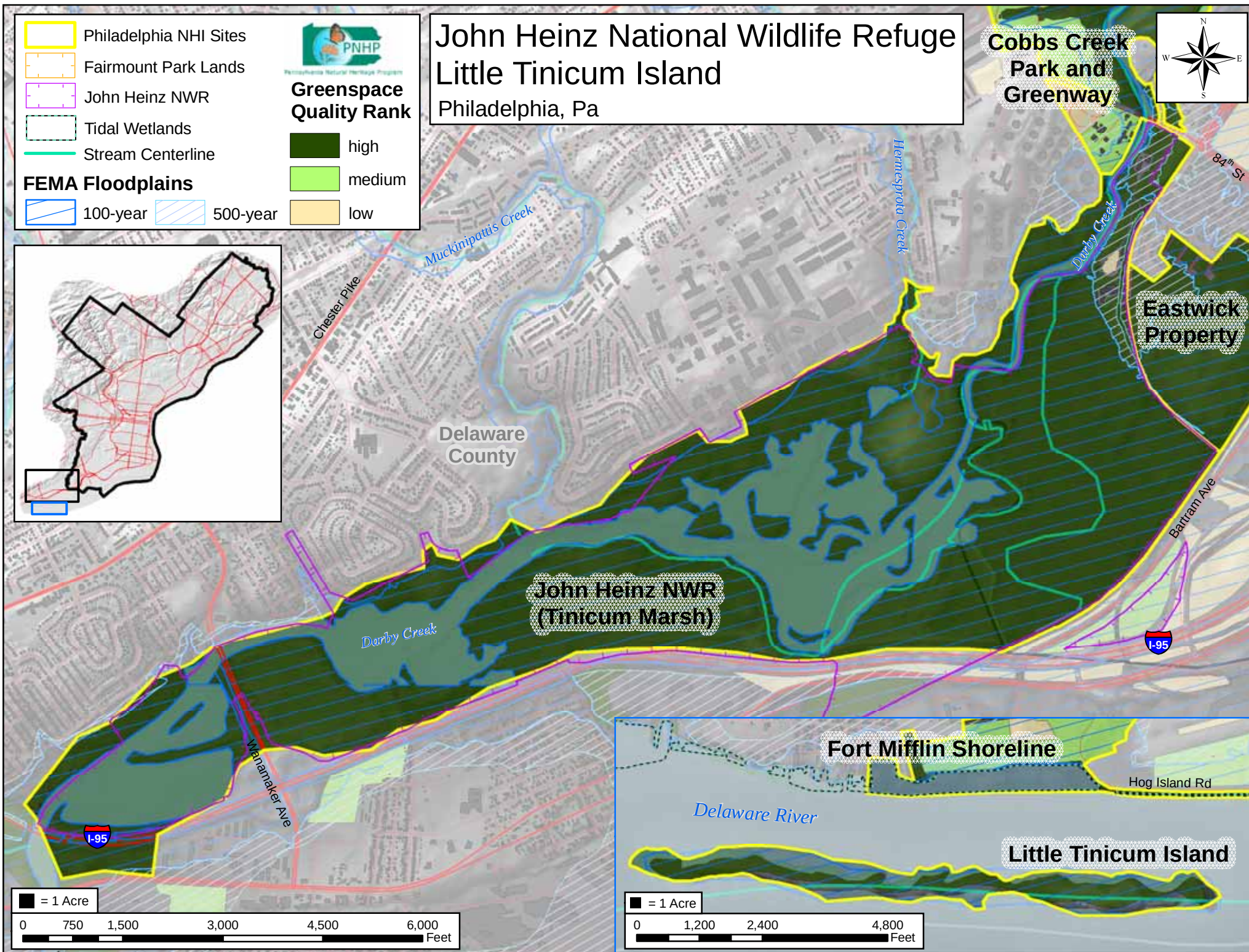
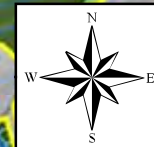


John Heinz National Wildlife Refuge

Little Tinicum Island

Philadelphia, Pa

Cobbs Creek
Park and
Greenway

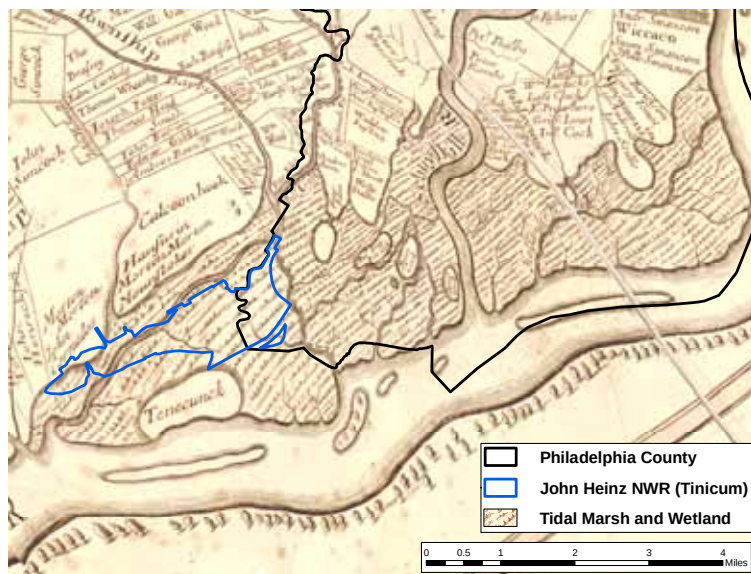


JOHN HEINZ NATIONAL WILDLIFE REFUGE (TINICUM MARSH & LITTLE TINICUM ISLAND)

History of Tinicum Marsh

Tinicum Marsh, part of the John Heinz National Wildlife Refuge (NWR), is what remains of the vast freshwater tidal wetland that covered the southern portion of Philadelphia at the time of colonization. This marsh covered between 10 and 20 square miles (6,400-12,800 acres) and supported an untold diversity and density of plants and animals. This large marsh was just part of an extensive marsh system that extended up the Delaware River from the Delaware Bay to well past Philadelphia.

The marsh was left relatively undisturbed until the early 1800's when the city began to construct ditches and levees throughout the marsh on the east bank of the Schuylkill River. In the mid-1800's the city grid system of roads extended over the area, with Broad Street extending south to League Island (then still an island) and by 1886 the area was covered with farms, factories, rail lines, and shipyards. By the 1926 sesquicentennial celebration in Philadelphia, League Island and the entire marsh east of the Schuylkill River were gone.



The historic coverage of Tinicum Marsh based on a georectified map of the area from 1695. The location and size of John Heinz NWR is only approximate and for explanatory purposes.

The marsh on the west bank of the Schuylkill River survived for a much longer period of time. Though extensively diked and levied during the 1800's, it remained tidally influenced and marsh-like over much of the area. Major degradation of the area started with the construction of a massive shipyard on Hog Island during World War I. Abandoned during the Great Depression, the island was bought by the city from the federal government and expanded the original Philadelphia Municipal Airport, which reopened in 1940. Closed during World War II, the airport reopened in 1945 for the beginning of the jet age and quickly expanded over the marsh. With major expansion projects at the airport every decade continuing to the present, much of the wetland in this area is underneath the over 4-square mile airport.

The small remaining pieces of tidal marsh below the confluence of Darby and Cobbs Creeks were severely threatened in 1969 with the planned expansion of Interstate 95 directly through the marsh and the expansion of a landfill into the marsh. Through the coordinated efforts of a large number of people this area was designated by the US Congress as the Tinicum National Environment Center in 1972. This forced the redirection of I-95 and the closure and capping of the landfill. In 1991 the center was rededicated in memory of Pennsylvania



A portion of the tidal Darby Creek flowing down to Tinicum Marsh

JOHN HEINZ NATIONAL WILDLIFE REFUGE (TINICUM MARSH & LITTLE TINICUM ISLAND)

Senator John Heinz who had worked very hard to see that the marsh was protected.

Over the years the refuge has weathered many insults from leaking landfills, oil spills, pipeline breaks, and invasive species, and yet it still survives and supports a diverse range of rare and important species.

Today the refuge is undergoing active restoration to manage invasive species, remove fill, restore wetland species, mitigate the effects of past chemical and oil spills, and increase the availability of the space for public use.

History of Little Tinicum Island

Managed as part of the William Penn State Forest, Little Tinicum Island was acquired by the state in 1982 because of the unique suite of species it supports. This island is all that remains of an extensive chain of low, sandy marsh, surrounded islands that extended downriver from League Island and included Mud Island (the location of Fort Mifflin), Little Mud, Redbank, Woodberry, and Reed Islands in the Delaware River; Province, Carpenters, Boon's, and Big Tinicum Islands along the shore; Little Tinicum Island and Chester Island at the downstream end of the chain. For further detail see the 1777 Fort Mifflin map on page 86.

Geologically, these islands were transient, continually being built, eroded, and moved by the flow of the river. This process offered a wide variety of habitat for species as new sand and mud flats were exposed while others eroded away.

Today, this process of erosion and rebuilding continues, though in a much diminished fashion. Historical air photos from 1937 show that Little Tinicum Island was excavated, probably for fill, and was reduced to around 85 acres at high tide, divided among three separate islands. By 1971 much of the island had been rebuilt by the river and was once again a single island the covered around 155 acres with large areas of sparse vegetation. Today Little Tinicum Island covers approximately 130 acres at high tide, but appears to be shrinking. Because of excavation for the shipping channel, patterns of sediment erosion and deposition have changed, with the river preferentially filling in the deep channel rather than the high island. Additionally, the large

wakes of the ocean-going freighters that use the Delaware River channel are often in excess of six-feet tall and have caused significant erosion on the up- and downstream ends of the island, shortening it by over 800 feet since the 1971 photo.

Rare Species

The Tinicum Marsh system, both within the John Heinz NWR and on Little Tinicum Island, hosts a suite of species which in Pennsylvania are found only along the tidal Delaware River. These species, while common in healthy freshwater tidal ecosystems, are limited to the marsh and a few nearby locations because they are the limit of tidal influence within the Commonwealth.

These species fall into three general groups: plants; birds, and herptiles.

The wetland-dependent plants of concern are found in different portions of the marsh depending on their specific habitat needs. Some, such as subulate arrowhead (*Sagittaria subulata*) and multi-flowered mud-plantain (*Heteranthera multiflora*), depend on regular exposure and inundation by the tide of the mudflats they live on. A few species specialize on the permanently water-saturated shoreline habitat, such as Smith's bulrush (*Schoenoplectus smithii*) and Walter's barnyard-grass (*Echinochloa walteri*). Others, like annual wild rice (*Zizania aquatica*), are marsh obligate species that have managed to maintain a foothold in the refuge.



Edge of a portion of the tidal marshlands at John Heinz NWR.

photo source: PNHP

JOHN HEINZ NATIONAL WILDLIFE REFUGE (TINICUM MARSH & LITTLE TINICUM ISLAND)

Among the rare bird species are three general groups. The first is the group that feeds along the interface between water and vegetation like Great Egret (*Casmerodius albus*). The second group, composed primarily of rails such as the Virginia Rail (*Rallus limicola*), utilize the flooded vegetation for foraging and nesting. A third group prefers the more grassland-like structure of the marsh. Among these species is the Marsh Wren (*Cistothorus palustris*).

The marsh supports a wide range of reptiles and amphibians, two of which are species of special concern. These two species depend on the continued cleanup and restoration of the marsh to survive. Additionally, they also require control of predators (such as skunks, opossums, and raccoons) around their breeding areas to increase the survival chances of their young.

All of these listed species depend in one way or another on the two listed natural communities that occur on the refuge. These listed communities, freshwater intertidal marsh and freshwater intertidal mudflat, are only found in a very limited area of the Commonwealth along the Delaware River. This area is also highly urbanized, making the remaining areas of these communities even rarer and more important to preserve and maintain.

Threats and Disturbances

The entire site is highly affected by several different disturbances and is continually threatened by new ones. A primary disturbance is the significant areas of non-native invasive plants that have invaded the marsh. Species such as common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*) do not provide the same type and quality of habitat as the native species they displace.

Another disturbance is the significant change in flooding regime that has occurred through the diking and impounding of portions of the marsh. These areas no longer maintain the same pattern of tidal exchange they once did, and as a result cannot support tidal marsh species. In a similar manner, the massive increase in impermeable surface around the refuge has resulted in a significant increase in stormwater runoff and a noticeable decrease in base flow from Darby Creek and other groundwater sources. Both of these hydrologic changes have negatively impacted the health of the marsh.



Impounded wetland at John Heinz NWR providing foraging habitat for numerous bird species including Great Egret (*Ardea albus*).

A significant source of historic disturbance to the marsh was the draining and filling of large sections of habitat. Most of these areas are unrecoverable, but some have to be actively dealt with. One, the 45-acre Folcroft Landfill, potentially contains toxic substances and is monitored for leakage.

More recent disturbances have been the expansion of Interstate 95 along the southern edge of the marsh. This, along with the continued expansion of the Philadelphia International Airport, has greatly decreased air quality at the marsh and greatly increased noise pollution in this Important Bird Area (see pg. 27).

Additionally, two oil spills have affected the marsh in recent history. In the winter of 2000 a pipeline that travels under the eastern end of the refuge ruptured, spilling 192,000 gallons of oil into the area. In 2004 the oil tanker Athos I hit an abandoned and uncharted anchor, ruptured its hull, and spilled 30,000 gallons of oil into the Delaware River.

JOHN HEINZ NATIONAL WILDLIFE REFUGE (TINICUM MARSH & LITTLE TINICUM ISLAND)

Conservation and Restoration Recommendations

Conservation and restoration goals at Tinicum Marsh should be approached as either short-term or long-term in scope. Short-term goals are achievable on the current refuge with a limited to moderate commitment of resources, while long-term goals are potential projects within and outside the refuge that will increase the health of the marsh system and its sustainability, but will require a much greater commitment of resources.

In the short-term, ongoing efforts to systematically remove invasive species from the refuge and replace them with native tidal marsh species should be continued and expanded. To facilitate this process an on-site grow-out station for native plants should be investigated.

Ongoing efforts to collect trash brought in by the tide and by storm events within the Darby and Cobbs Creeks watershed should be continued and expanded as possible. Trash collection events should be looked at as excellent opportunities to involve the community in the care of the refuge.

The continued promotion of the John Heinz National Wildlife Refuge as an environmental education center is also vital. Not only is it important for the

refuge to maintain its place as a critical aspect in local curriculum, but promoting and pervading the understanding that Tinicum Marsh is a vital link in the national chain of natural areas will strengthen its place in the community.

Over the long-term, more ambitious and resource demanding goals should be examined. Primary among these is the reestablishment of tidal marsh within as much of the refuge as is feasible. This restoration process will mandate the removal of large areas of fill and the extensive reworking of the hydrology of the sites along with the replanting of native tidal species and the management of non-native invasive species. Additionally, adjoining pieces of property should be examined for purchase or easement with the intent to increase the natural buffer around the refuge.

Over the long-term, the storm surges from Darby Creek will need to be addressed. These flows result from poorly managed stormwater in the highly developed watershed and antiquated sewage management infrastructure. To address these issues will require systemic changes across the watershed that address how development is permitted and how stormwater is managed.

Monitoring the effect of climate-change induced sea level rises on the marsh system will be important in directing the conservation of the marsh. With most of the refuge near, at, or *below* sea level, even a small increase in the mean water level stands to adversely affect the marsh and the species the depend upon it. Assessing how sea level changes are progressing and how they are affecting the marsh will help direct conservation efforts.



Tidal mudflats at Tinicum Marsh providing shorebird foraging habitat

Eastwick Property

Eastwick Property	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Eastwick Property		Immediate Conservation Priority and Notable Significance				
Field dodder (<i>Cuscuta pentagona</i>)	P	G5	S3	TU	2007	CD
Forked rush (<i>Juncus dichotomus</i>)	P	G5	S1	PE	2007	CD

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile; U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Eastwick Property

Philadelphia, Pa



Cobbs Creek Park and Greenway

Lindbergh Ave.

Maio Lanza Blvd

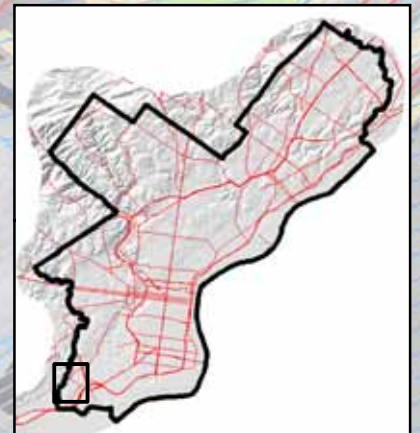
84th St

Barram Ave.

Dorby Creek

Eastwick Property

John Heinz National Wildlife Refuge



0 300 600 1,200 1,800 2,400 Feet

- Philadelphia NHI Sites
- Fairmount Park Lands
- John Heinz NWR
- Stream Centerline
- FEMA Floodplains**
 - 100-year
 - 500-year



- Greenspace Quality Rank**
- high
 - medium
 - low

Eastwick Property

The Eastwick Property, owned and maintained by the Philadelphia Redevelopment Authority, is at first glance not particularly interesting. Mainly overgrown with non-native invasive species, this site was a planned housing development that ran into issues because of its history.

At the time Philadelphia was settled, this property was deep in Tinicum Marsh, which covered an estimated 10 and 20 square miles (6,400-12,800 acres). Shortly after settlement, the area was diked to restrict tidal flow to allow for agricultural use and this is how it remained until the early 1900s. Around this time the area began to be filled with various materials resulting from Philadelphia's growth including dirt, trash, and building remains. However, as a historic tidal marsh, the site has issues with settling and stability. Beyond that, the entire site is within either the FEMA 100-year or 500-year floodplain.

These problems and various legal issues have prevented the redevelopment of the Eastwick Property into an urban hardscape. With this hold on redevelopment, the site has reverted to a wild, if weedy, landscape that is supporting two plant species of concern. These two species, field dodder (*Cuscuta pentagona*) and forked rush (*Juncus dichotomus*) are both residents of disturbed areas and do well in this environment. These species likely originated in the John Heinz National Wildlife Refuge, which the property abuts on both its south and west sides.

Today very little of Tinicum Marsh is left (approximately 200 acres) and what remains is contained within John Heinz National Wildlife Refuge. Because this site shares so much border with the Refuge it acts as a buffer against the continued development within the Eastwick Neighborhood. Development of this site would remove the last buffer between developed areas and the Refuge, further alter the already highly modified hydrology of the site, and remove any chance for the future expansion or remediation of historic Tinicum Marsh.

This habitat also acts as one of the last remaining large areas of unfragmented scrub or shrubland

habitat in Philadelphia. This habitat is important to birds throughout the year with different species using it at different times of the year. During the breeding season it can host bird species common to grasslands and edge habitat; during migration it can host most migratory passerines; during the winter it can host species common to the tundra and steppe habitats.

This allows the site to act as not only a buffer to an exceptionally important natural area, but to offer habitat to a diverse suite of different birds throughout the year.

Threats and Disturbances

The greatest threat to this site is its conversion to a developed landscape. Beyond that the site is almost completely dominated by invasive non-native species. Additionally, the site has numerous active illegal dumping sites on it along with 100+ years of fill and refuse, and some areas of gray infrastructure from the original development attempt.

Conservation and Restoration Recommendations

This site should be added to the John Heinz National Wildlife Refuge as a buffer against further development. Because of the site's lack of elevation above sea-level and proximity to rivers it is entirely within the FEMA 100- and 500-year floodplains.



The Eastwick Property looking south towards John Heinz National Wildlife Refuge and Tinicum Marsh (behind the tree line.)

photo source: PNHP

EASTWICK PROPERTY

refuge thereby diminishing attempts to mitigate non-native invasives species

This should not be seen to suggest that the site, in its current state, is lacking ecological value. The buffer from development the site offers is extremely important. Additionally, the safe-haven the site provides to birds is of incalculable value. If this site were lost to development these species might be left with no appropriate habitat within the city.

This suggests that a restoration plan for the site could be very aggressive in scope and extent. Restoration of a mix of newly created tidal wetlands intermixed with shrubland and meadow habitat would allow for an extensive network of trails with vistas of both the wetland land within the refuge and the skyline of downtown Philadelphia.



photo source: PNHP

A portion of the Eastwick Property showing its grassland-like characteristics with many late-summer and fall blooming plants.

This suggests that development of the site may be prohibitively difficult and expensive, and be ecologically damaging. A better and less expensive option could be the transformation of the site into a large, green gateway to the refuge inviting enhanced use by the public through biking and walking trails connecting the nearby Southeastern Pennsylvania Transportation Authority (SEPTA) station on S. 84th Street to refuge facilities. This would allow for increased access not only from Philadelphia proper, but open up access, via train connections, to the rest of the East Coast and potentially spur local economic redevelopment.

Ecologically, this area is almost a blank slate. The plant species of concern found on the site are likely “common” throughout the adjacent wildlife refuge and the predominance of non-native invasive species within the site may also be acting as a seed reservoir. This could cause the continual reinfection of the

Fort Mifflin Shoreline

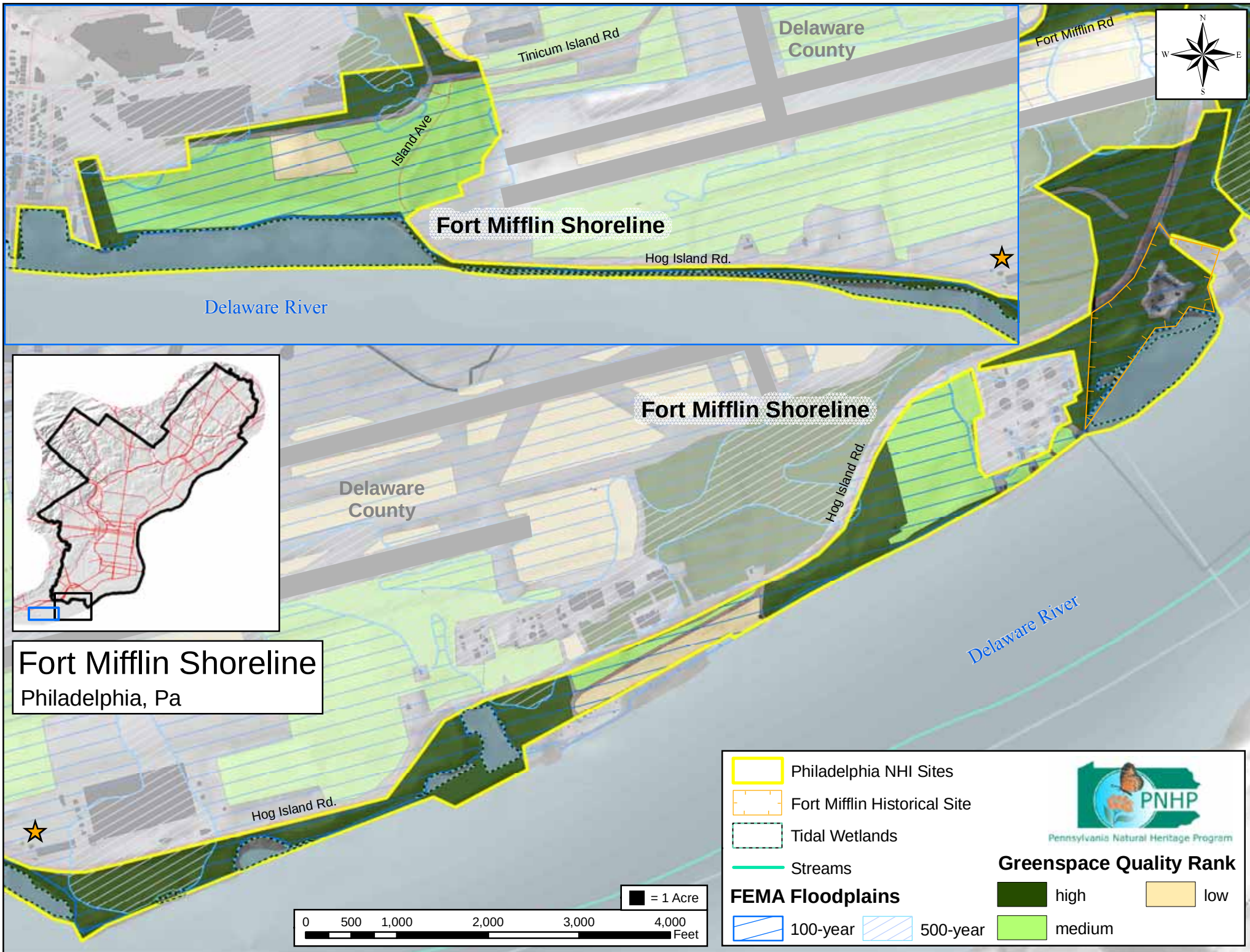
	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Fort Mifflin Shoreline		Near-term Conservation Priority and High Significance				
Bugleweed (<i>Lycopus rubellus</i>)	P	G5	S1	PE	2005	E
Eastern mudminnow (<i>Umbra pygmaea</i>)	F	G5	S3	CP	2001	B
Annual wild rice (<i>Zizania aquatica</i>)	P	G5	S3	PR	1982	D
Little-spike spike-rush (<i>Eleocharis parvula</i>)	P	G5	S1	PE	2005	E
Long-lobed arrow-head (<i>Sagittaria calycina</i> var. <i>spongiosa</i>)	P	G5T4	S1	PE	2005	E
Multiflowered mud-plantain (<i>Heteranthera multiflora</i>)	P	G4	S1	PE	2005	E
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	C
Sensitive species of concern 5	-	-	-	-	-	-
Shrubby camphor-weed (<i>Pluchea odorata</i>)	P	G5	S1	PE	2005	E
Velvety panic-grass (<i>Panicum scoparium</i>)	P	G5	S1	PE	2004	E
Wrights spike rush (<i>Eleocharis obtusa</i> var. <i>peasei</i>)	P	G5TNR	S1	PE	2005	D

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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



FORT MIFFLIN HISTORIC SITE

Fort Mifflin Historical Site

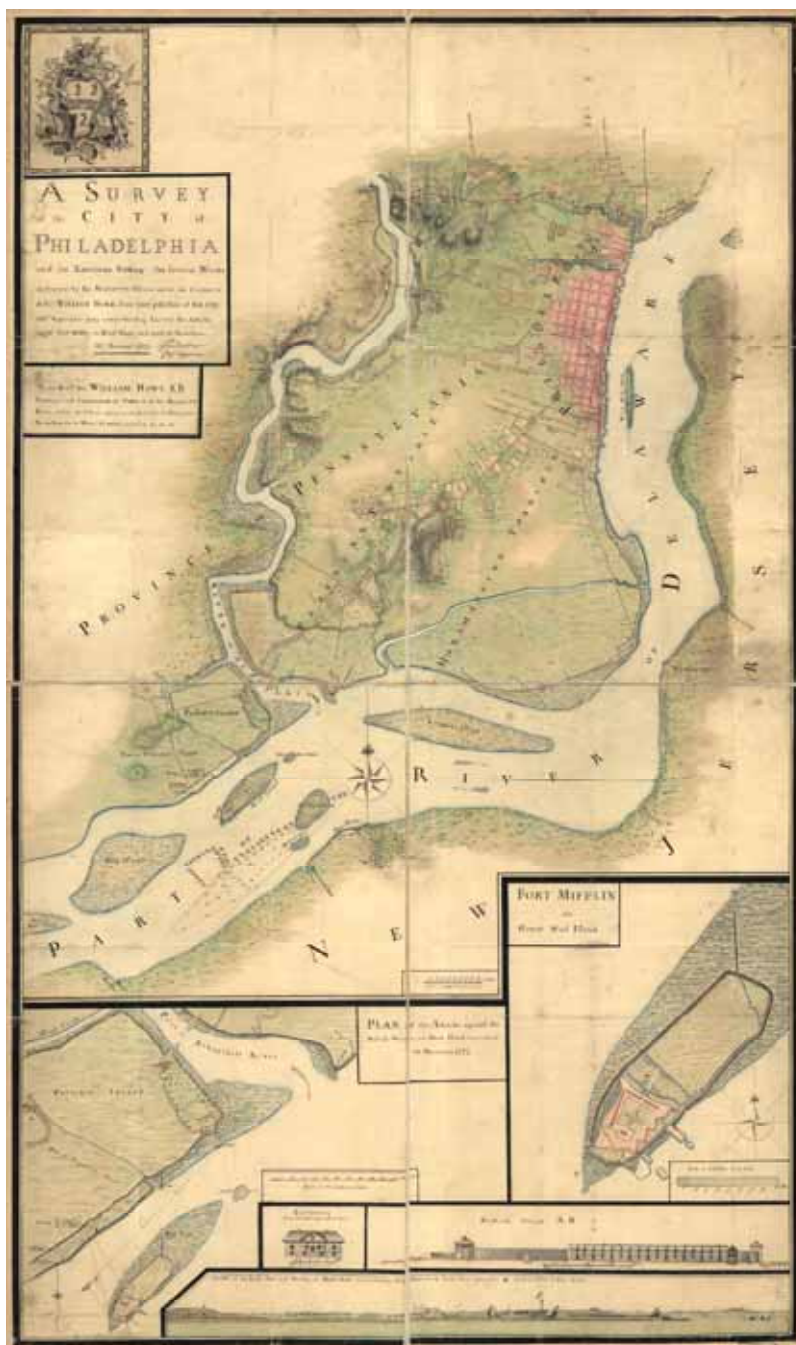
Fort Mifflin originally sat on one of the islands that formed a chain along the Delaware River extending downstream past Tinicum Marsh. This fort, taken by the British during the Revolutionary War, was designed to protect the Philadelphia harbor and river traffic from invading forces, but was not completed until after the war. Occupied as a military fort from 1771 until 1952 when it was deeded to the City of Philadelphia, Fort Mifflin was the longest continually occupied fort in the United States.

Fort Mifflin and the surrounding shoreline remain biologically important because they maintain aspects of the original tidal marsh that composed the area. Surrounding Fort Mifflin are remnants of the original moat. This moat still maintains tidal flow and supports tidal species of concern. The tidally-influenced wetlands that dot the shoreline between the fort and the mouth of Darby Creek and Tinicum Marsh also support species of concern. These wetlands have formed where bulkheads leak or have failed and around other inlets. The common feature among all the remaining tidal wetlands at this site seems to be protection from the large, destructive wake produced by shipping traffic in the Delaware River.

In addition to the wetlands are extensive aquatic beds of American eelgrass (*Vallisneria americana*) along the shore. These beds seem to be confined to a narrow portion of the river that remains submerged by no more than four feet of water at low tide. These beds act as nurseries for young fish and provide habitat for many aquatic insects along with freshwater mussels. These beds are surprisingly intact given the severity of boat wakes in this area and indicate that other factors may be allowing their recovery.

Threats and Disturbances

Airport expansion is a primary threat within this site. While this land is primarily composed of wetlands and floodplain, airport expansion has rarely been stopped by these conditions.



A 1777 map of the attack on Fort Mifflin by the British Navy, which resulted in the capture of the fort by British forces. The map clearly shows the chain of islands that existed along the Delaware River south of Philadelphia and the extensive area of tidal marshland.

An additional threat could be the repair of the bulkheads along the shoreline in a manner that inhibits existing tidal flow. This tidal flow supports the creation and maintenance of tidal wetlands along this stretch of river while the remaining bulkheads protect the wetlands from erosive freighter wakes.

FORT MIFFLIN HISTORIC SITE

photo source: Andrew Strassman, PNHP



Tidal wetland dominated by spatterdock (*Nuphar lutea*) along the Delaware River downstream from Fort Mifflin.

The disturbances to this site are severe and extensive. As the historic map shows, a significant portion of this area was river channel that is now covered with fill. Additionally, with the exception of Little Tinicum Island, all of the islands on the above map (pg. 86) are now part of the mainland or have been excavated out of the river. This modification to the landscape has drastically altered the topology and ecology of the area, removing large swaths of tidal marsh and estuary habitat while severely altering and constricting the flow of the river.

Another disturbance at this site, common throughout the Philadelphia area, is the extensive colonization by non-native invasive species. This is especially evident in the tidal area. In many of the marshes non-native narrow-leaf cattail (*Typha angustifolia*) and common reed (*Phragmites australis*) predominate to the exclusion of almost all other species.

Conservation and Restoration Recommendations

Protection of the existing open space in this site needs to be a priority. Once open space is lost to development it is effectively unrecoverable. Additionally, restoring existing degraded habitat is far cheaper and easier than recreating habitat on a formerly developed site.

Once protection of this area is secured, habitat improvement should be a primary goal. Given the

extensive list of rare species found within this site, increasing the habitat available to these species could allow their populations to increase.

Habitat improvement can be accomplished through several actions. The easiest would be removal and control of invasive species. This would allow native species the opportunity to expand their populations and suppress future invasions of non-native species.

More costly and difficult improvements could be accomplished through increasing the extent of land open to tidal flow and the rate at which the tide is exchanged. Beyond that would be the excavation of fill from formerly tidal areas in an effort to restore tidal marsh. These efforts would increase the available habitat for the rare tidal wetland plants supported in this area.



Tidal backwaters form the remains of the moat that once surrounded Fort Mifflin. This area provides habitat for several species of concern.

map source: Andrew Strassman, PNHP

U.S. Army Corps of Engineers Yard

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
US Army Corps of Engineers Yard		Opportunistic Conservation Priority and Notable Significance				
Big bluet (<i>Enallagma durum</i>)	O	G5	S3	N	2007	E
Bugleweed (<i>Lycopus rubellus</i>)	P	G5	S1	PE	2005	E
Great egret (<i>Casmerodius albus</i>)	B	G5	S1B	PE	1990	C
Halloween pennant (<i>Ardea (Celithemis) eponina</i>)	O	G5	S2S3	N	2007	E
Peregrine falcon (<i>Falco peregrinus</i>)	B	G4	S1B,S1N	PE	2007	E
Sensitive species of concern 5	-	-	-	-	-	-

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Army Corps Yard

Philadelphia, Pa

Schuylkill River
Oil Lands - South



Mingo Creek
Tidal Area

Army Corps
Yard

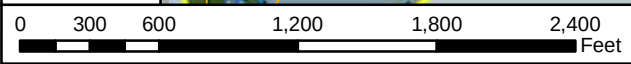
I-95

Fort Mifflin Rd

Delaware River

Fort Mifflin
Shoreline

1 Acre



- Philadelphia NHI Sites
- Fort Mifflin Historical Site
- Tidal Wetlands
- Streams
- FEMA Floodplains
 - 100-year
 - 500-year



Greenspace Quality Rank

high	low
medium	

UNITED STATES ARMY CORPS OF ENGINEERS YARD

Army Corps Yard

This site is still actively used by the US Army Corps of Engineers for the storage of dredging material from maintenance of the shipping. The species of concern found on this site are able to utilize the highly modified habitat this provides to their advantage as the surrounded landscape offers little in the way of greenspace or open space. Additionally, the pools on site are neither natural nor tidal. They are the result of the impoundment of water from the dredging materials and rain water with the entire site surrounded by large, tall earthen walls.

However, this site provides excellent hunting habitat for adult dragonflies and damselflies with several species of concern noted at the site feeding on the extensive aggregation of insects over the ponds. It seems likely that these species of concern are reproducing in wetlands in the surrounding landscape and simply refueling and maturing here. This is a vital aspect of odonate life-cycles with an extend period of feeding and growth proceeding reproduction. This growth often occurs at a different location than reproduction.

The same is true for the Peregrine Falcon (*Falco peregrinus*) noted at this site. This species is regularly seen hunting the pigeons (*Columba livia*) and shorebirds that frequent this site. The falcons

nest nearby and this site falls within their primary hunting grounds.

Additionally, the edge of the site along the tidal shoreline of the Delaware River supports bugleweed (*Lycopus rubellus*).

Threats and Disturbances

There are currently no threats to this site. It is highly disturbed by the current use and continuation of these activities is unlikely to decrease the existing habitat value.

A future threat to this site would be conversion from the current use to a developed urban hardscape. Even though the site currently provided only limited environmental services, it greatly surpasses the environmental service provided by urban development.

Conservation and Restoration Recommendations

This site, much like the Schuylkill River Oil Lands, is still being actively used for its intended purpose, the storage of dredging materials from the maintenance of the shipping channel. As such our recommendations are based on potential future availability of the site for uses other than storage of dredged material.

If this site becomes available for other uses, conversion to green space or, ideally, a natural area should be examined. This site is part of the extensive tidal wetland complex that once covered the Delaware River shoreline west of the Schuylkill River. Restoration to this site to a tidal wetland would greatly improve the environmental quality of the area. Additionally, it would greatly improve the visual quality of an area currently dominated by industrial uses.



photo source: PNHP

A view southeast over one of the spoil lagoons towards Interstate 95 and the Girard Point Bridge.

UNITED STATES ARMY CORPS OF ENGINEERS YARD

Mingo Creek Tidal Area

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Mingo Creek Tidal Area			Immediate Conservation Priority and Notable Significance			
Needham's skimmer (<i>Libellula needhami</i>)	O	G5	SH	N	2007	E

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

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Mingo Creek Tidal Area

Philadelphia, Pa

Tidal Schuylkill River Corridor

Schuylkill River Oil Lands - South

Schuylkill River

Mingo Creek

Penrose Ave

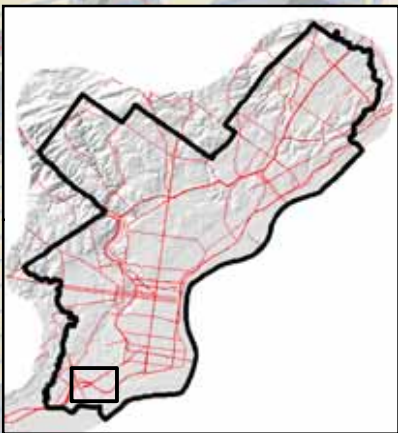
Hog Island Rd

Mingo Creek Tidal Area

Army Corps Yard

Enterprise Ave

Island Ave



 Philadelphia NHI Sites

 Fairmount Park Lands

 Streams

FEMA Floodplains

 100-year

 500-year

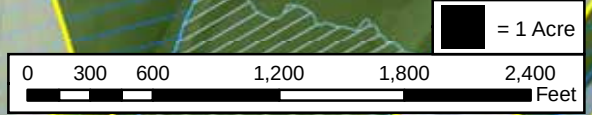
 high

 medium

 low

Greenspace Quality Rank


Pennsylvania Natural Heritage Program



MINGO CREEK TIDAL AREA

Mingo Creek Tidal Area

This site encompasses roughly 450 acres of land being used for a variety of purposes. Foremost within the site are the remains of Mingo Creek. Formerly a tidal creek, the outflow is now controlled and the resulting impoundment is used to manage stormwater runoff.

At the mouth of the outflow of Mingo Creek is a significant area of tidal mudflat. This area lacks the normal tidal mudflat plant species and offers a substantial opportunity for restoration if outfall from Mingo Creek is moderated to prevent erosion.

West of the end of the Mingo Creek impoundment are two open areas that appear to maintain water for a significant portion of the year. These areas, while unlikely to support any species of concern given their size, condition, and surrounding land use, offer opportunities for natural stormwater runoff management.

South of Mingo Creek is an extensive area of wetland crossed by numerous ditches and dikes. This is potentially a remnant of the drained tidal marsh that once covered the area. It was near this area that a dragonfly species not seen in the Commonwealth since 1945 was re-found. Needham's skimmer (*Libellula needhami*) is a species common much further south along the US Atlantic coast. If this area is a remnant wetland it offers restoration possibility for around 100 acres.



photo source: Andrew Strassman, PNHP

Needham's skimmer (*Libellula needhami*) found within this site.

A final area of interest within this site is Italian Gardens. This area, just north of the Army Corps Yard, supported a community gardens until recently when the gardeners were relocated to another community garden just west of Bartram's Avenue at the west end of the site.

Threats and Disturbances

At the south end of this site is an area with extensive damage from unauthorized ATV and 4x4 truck use. This area, adjacent to the Philadelphia International Airport, has also seen significant illegal dumping of residential and construction waste and abandoned burned cars. These activities have disturbed the landscape to the point that intervention will be needed to restore the area.

Throughout this site non-native invasive plant species compose a significant proportion of the vegetative cover. Any restoration effort on this site will necessitate a significant investment in time and resources to control these species.

The greatest threat to this site would likely be expansion of airport infrastructure over this area of open space. Building on this area would eliminate any environmental benefit being provided.

Conservation and Restoration Recommendations

The primary goal for this site needs to be securing its protection from development. Without designation as an area protected from development the



photo source: PNHP

Looking north at the Penrose Avenue Bridge within a portion of the Mingo Creek site's remnant wetland.

MINGO CREEK TIDAL AREA

investment of resources to protect and enhance the ecological value of this site is unwarranted.

Once protection is secured wetland restoration and enhancement should be a primary goal. This habitat type has a high ecological value, especially as the size of the wetland increases. A 100-acre wetland, even one that is artificially managed, will provide habitat for numerous species of concern and offer educational opportunities otherwise unavailable to the public.

Along with this restoration of wetlands, control of non-native species within the site should be an important goal. Extensive “forests” of paper mulberry (*Broussonetia papyrifera*) and tree-of-heaven (*Ailanthus altissima*) exist on the site. While these species do provide shade and some environmental services, they provide little or no habitat for native species. Replanting the invaded areas with native tree species appropriate to the site and managing their establishment will not only increase the environmental services rendered by the site, but increase the amount of habitat available to native species.

Exclusion of ATVs and 4x4 trucks from this area is also critical. These vehicles have created large areas denuded of vegetation which induces significant erosion from both wind and rain, resulting with these areas offering little habitat value. Additionally, the landscape impacts of off road ATV and 4x4 truck use discourages the investment of resources into land restoration when there is a severe risk of restoration work being destroyed.

Finally, illegal dumping on and around this site needs to be recognized and controlled through active enforcement of existing statutes. Existing piles of trash and burned cars need to be cleaned up and ready access to the site blocked to prevent further abuse.



Extensive area of illegal dumping and portion of the area severely disturbed by unauthorized ATV and 4x4 activities. Portions of the elevated I-95 Interstate are seen in the background.

photo source: PNHP

Philadelphia Navy Yard

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Philadelphia Navy Yard		Near-term Conservation Priority and High Significance				
Bugleweed (<i>Lycopus rubellus</i>)	P	G5	S1	PE	2007	CD
Field dodder (<i>Cuscuta pentagona</i>)	P	G5	S3	TU	2007	CD
Forked rush (<i>Juncus dichotomus</i>)	P	G5	S1	PE	2007	C
Osprey (<i>Pandion haliaetus</i>)	B	G5	S2B	PT	2003	E
Sensitive species of concern 1	-	-	-	-	-	-
Velvety panic-grass (<i>Panicum scoparium</i>)	P	G5	S1	PE	2007	BC

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

- Philadelphia NHI Sites
- Fairmount Park Lands
- Tidal Wetlands

Streams

FEMA Floodplains

- 100-year
- 500-year



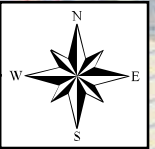
Pennsylvania Natural Heritage Program

Greenspace Quality Rank

- high
- low
- medium

Philadelphia Navy Yard

Philadelphia, Pa



FDR Park

Broad St

Pattison Ave



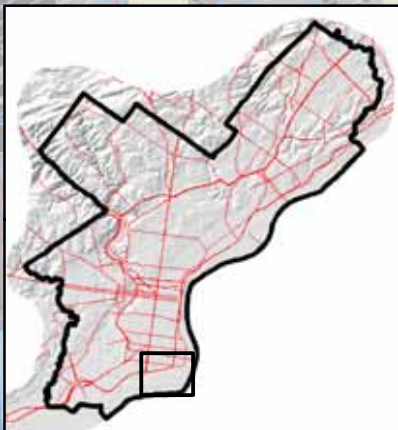
Schuylkill Expressway

League Island Ave

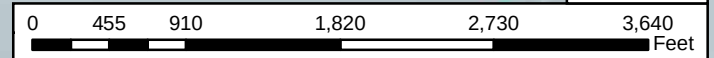
Patrol Rd

Philadelphia Navy Yard

Delaware River



1 Acre



Philadelphia Navy Yard

League Island, a large island separated from mainland Philadelphia by a secondary channel of the Delaware River, is today the backbone of what remains of the Philadelphia Navy Yard. This area supported scattered shipbuilding from the 1700's onward with ship demand, and the ships themselves, eventually outgrowing the existing shipyards. In 1868 the federal government purchased League Island for \$1.00 from the City of Philadelphia. This brought the Philadelphia Navy Yard into existence. Until its closing in 1996, the Philadelphia Navy Yard produced, repaired, and retrofitted ships, including the production of an amazing 53 ships during World War II among which were some of the 45,000 ton-displacement Iowa-class battleships.

Even before officially closing, large areas of the Navy Yard were reverting to natural cover. This opened up large areas to colonization by grassland species with the lower, wetter areas supporting wetland species. Finally, below the wetlands on the east side of the property is an abandoned dock that has partially filled with sediment from the Schuylkill and Delaware Rivers. This area is being naturally colonized by tidal wetland plants greatly increasing the stability of the sediments and the ecological value of the site.

Today the areas north and east of the remains of Mustin Field, a Navy airbase that once supported seaplanes, supports several plant species of concern. In total 118 plant species were identified at the site during a single survey. Of these 118 species, 46 were not known in Pennsylvania at the time of colonization.

This naturalization is especially visible in the return of Bald Eagles (*Haliaeetus leucocephalus*) to this



photo source: Ann Rhoads, Morris Arboretum

PNHP staff surveying the grassland species within the Philadelphia Navy Yard.

site. Normally, the locations of Bald Eagle nests are not publicly revealed, but the publicity surrounding this individual location allows us to present further information. The nest was initially observed in 2007 with great public fanfare. This attracted a large amount of attention with people trying to discover the nest's location. Bald Eagles are a species that is very sensitive to direct nest disturbance. Eventually, the nest failed with the adults abandoning it. This may have been due to direct disturbance or, more likely, the result of younger birds nesting in an area they were unfamiliar with. A nest built by younger eagles often fails during its first year as the adults acquire their parenting skills. As such, this pair re-nested at the Navy Yard in 2008 and successfully fledged one eaglet. This is probably the first wild-born Bald Eagle in the city in well over 300 years.

Threats and Disturbances

The clearest threat to this site is development of the open space. This would remove all the ecological value the site has accumulated since on-site ship construction stopped.

Further disturbances include the historic diking and filling of the extensive freshwater tidal marsh that existed on the site and the filling of the channel that once separated League Island from the mainland (see map on pg. 86).

A final disturbance, to both the sites and the two major rivers that adjoin it, is the bulkheads around the site. These bulkheads constrict and constrain the

Selected Navy Yard grassland and wet meadow plant species

Broom-sedge	<i>Andropogon virginicus</i>
Dotted smartweed	<i>Persicaria punctata</i>
Fall witchgrass	<i>Digitaria cognatum</i>
Field beadgrass	<i>Paspalum laeve</i>
Grass-leaved goldenrod	<i>Euthamia graminifolia</i>
Hyssopleaf thoroughwort	<i>Eupatorium hyssopifolium</i>
Panic grass	<i>Dichanthelium acuminatum</i>
Path rush	<i>Juncus tenuis</i>
Soft rush	<i>Juncus effusus</i>

PHILADELPHIA NAVY YARD

natural flow and flood of the rivers preventing their natural daily and seasonal flooding.

Conservation and Restoration Recommendations

Conservation of this site must begin with the protection of the existing open space from development. If this area is developed its ecological value will be irreparably lost.

Once this area is protected control of non-native invasive plants and restoration of native species should begin to help protect the species of concern on the site. The species are all residents of open, sparsely vegetated areas and do not do well in the shade of woody plants

Future restoration of wetlands and tidal flow on the site should be considered. This area could be used to help mitigate stormwater flows while providing a habitat type (wetland) that is of the utmost ecological and educational value. This habitat would provide nesting, hunting, and hiding locations for numerous species of concern in the area and greatly improve the local habitat quality for the Bald Eagle nest.

Schuylkill River Oil Lands – North & South

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
	Global	State			

NATURAL HERITAGE SITES

Schuylkill River Oil Lands – North and South

*Opportunistic Conservation Priority and No
Significance*

None currently known

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

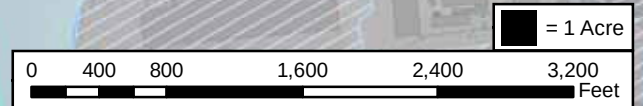
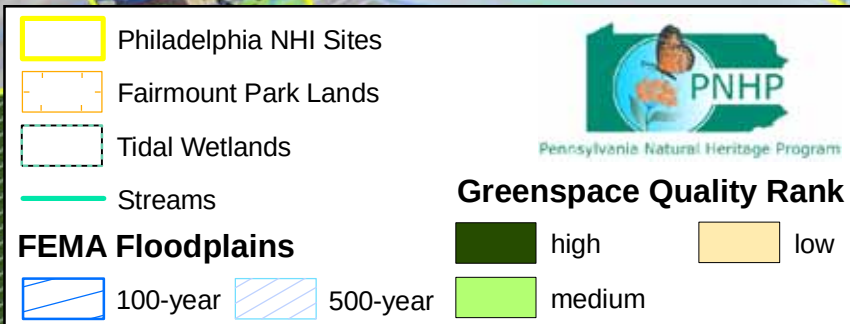
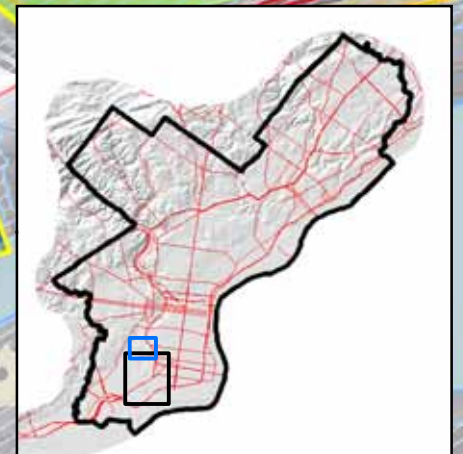
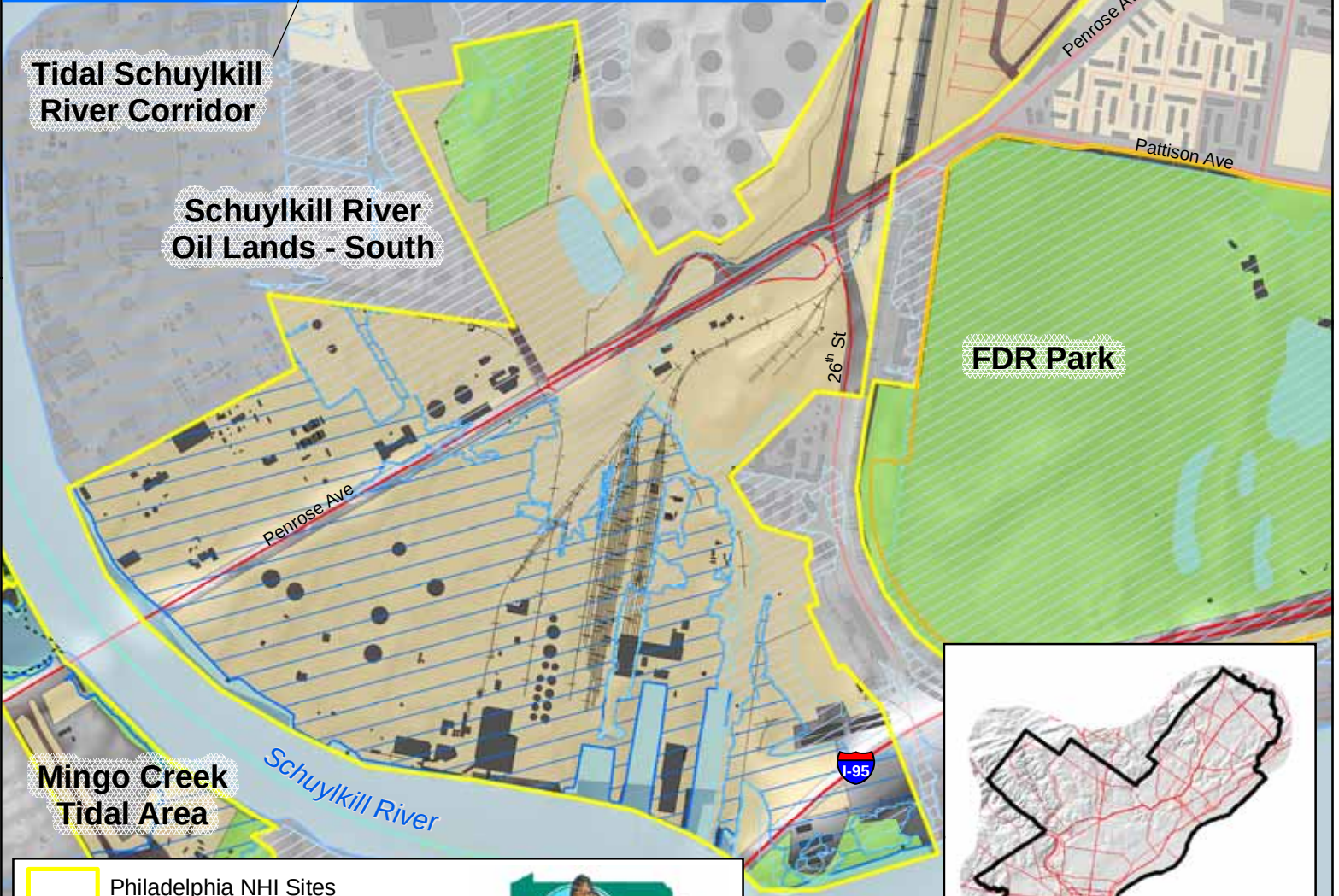
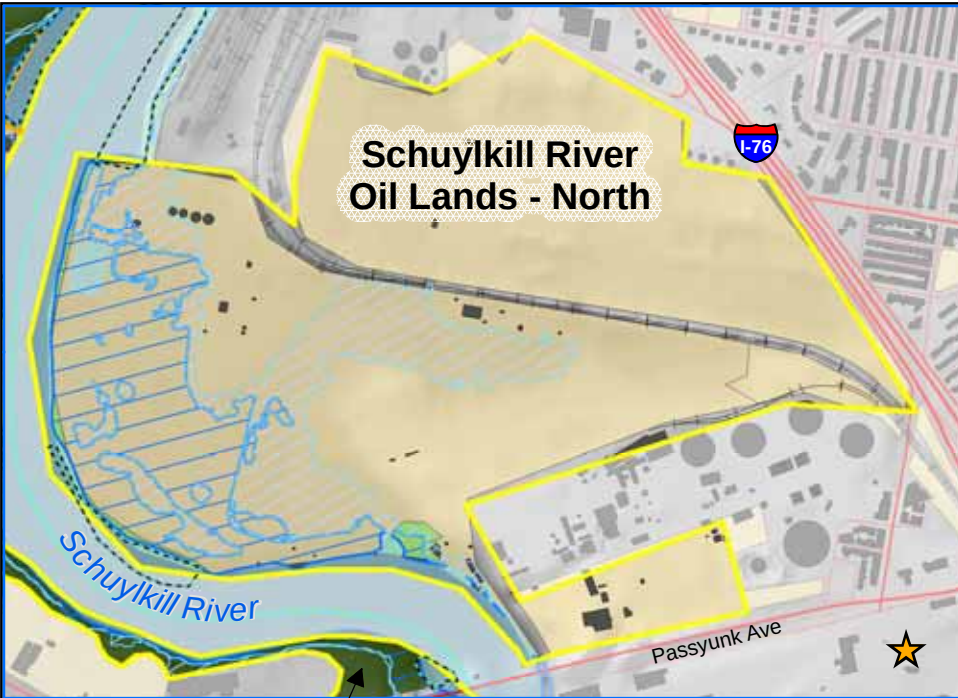
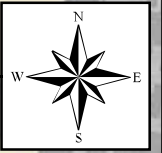
² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Schuylkill River Oil Lands

Philadelphia, Pa



SCHUYLKILL RIVER OIL LANDS

Schuylkill River Oil Lands

species that frequent tidal marshland along the tidal Schuylkill and Delaware Rivers.

These two sites present very interesting habitat restoration opportunities, but only in the future. Both sites are part of the massive Sunoco Oil Refinery complex that covers in excess of 1.5 square miles (960 acres) on the east bank of the Schuylkill River in Philadelphia. This complex, while still actively receiving and processing oil, no longer utilizes the entire property.

This presents the potential that portions of the complex will become available for other land uses in the future. If land within these sites does become available the portions within the 100-year floodplain should be considered for natural greenspace at the very least. More ambitious plans could look to restore tidal and riparian connectivity to the areas.

Threats and Disturbances

This entire stretch of the Schuylkill River is highly disturbed from the industrial complexes that have existed here for well over 150 years. The ecological disturbance at these sites is complete with little to no permanent vegetation, large areas of filled floodplain, and bulkheads along the majority of the river.

Additionally, the industrial complexes that have existed here have jointly contributed to pollution of the landscape. The level, distribution, and toxicity of pollution on these sites are unassessed, but will likely cause restrictions on future land use options, precluding significant and expensive remediation.

Conservation and Restoration Recommendations

Without a full understanding of site availability or conditions there is no call for conservation or restoration on these sites. As this information becomes available plans should be created that address restoration needs.

However, there is the potential for immediate restoration along the shoreline. Several denuded mudflats exist along the east bank of the Schuylkill River in this reach and these could be replanted to native tidal vegetation. This would reduce sediment mobilization and increase the available habitat for

SCHUYLKILL RIVER OIL LANDS

Tidal Schuylkill River Corridor

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Tidal Schuylkill River Corridor		Immediate Conservation Priority and Notable Significance				
Annual wild rice (<i>Zizania aquatica</i>)	P	G5	S3	PR	1984	X?
Peregrine falcon (<i>Falco peregrinus</i>)	B	G4	S1	PE	2005	E
River bulrush (<i>Schoenoplectus fluviatilis</i>)	P	G5	S3	PR	2007	BC
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	B

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

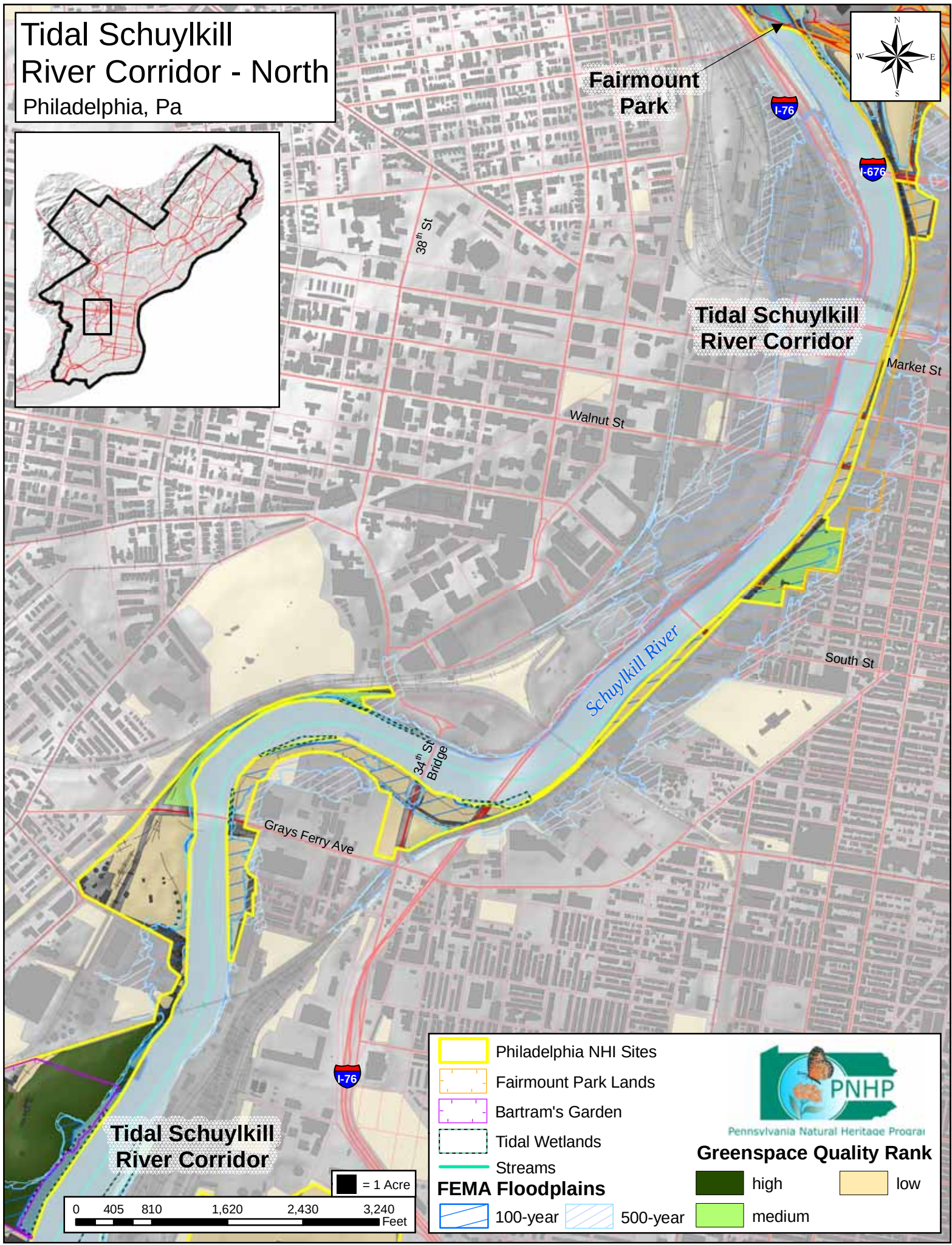
² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Tidal Schuylkill River Corridor - North

Philadelphia, Pa



 Philadelphia NHI Sites

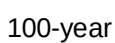
 Fairmount Park Lands

 Bartram's Garden

 Tidal Wetlands

 Streams

 FEMA Floodplains

 100-year

 500-year

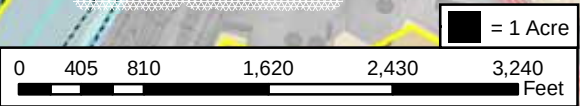

Pennsylvania Natural Heritage Program

Greenspace Quality Rank

 high

 medium

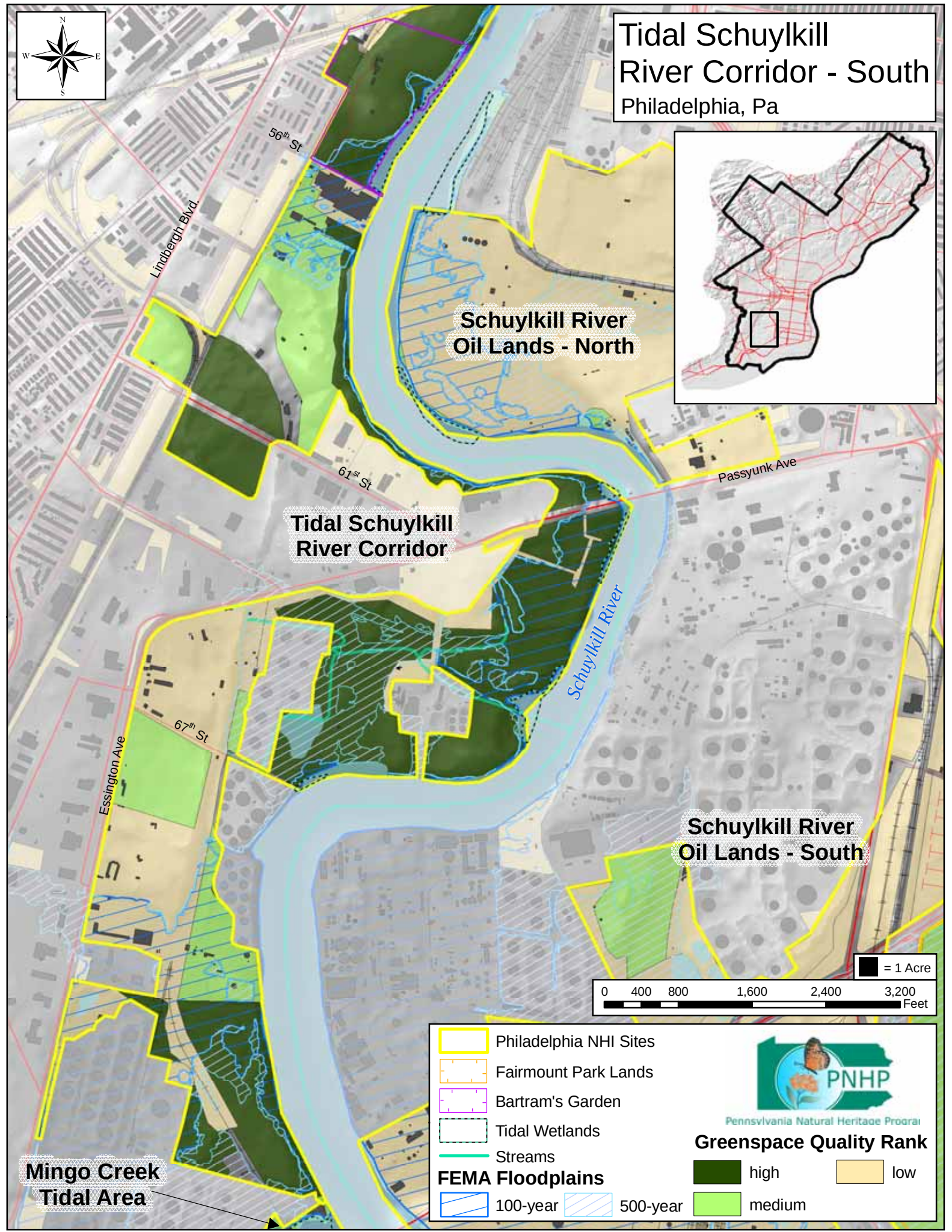
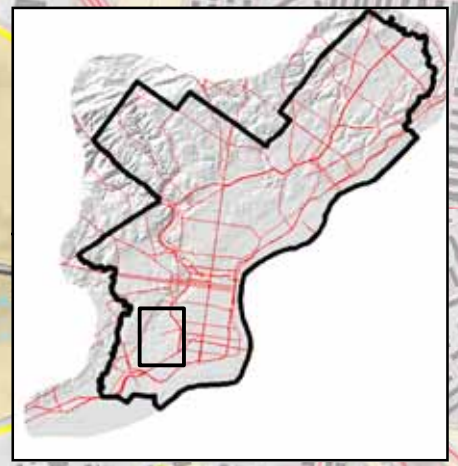
 low





Tidal Schuylkill River Corridor - South

Philadelphia, Pa



Schuylkill River Oil Lands - North

Tidal Schuylkill River Corridor

Schuylkill River Oil Lands - South

Mingo Creek Tidal Area

- Philadelphia NHI Sites
- Fairmount Park Lands
- Bartram's Garden
- Tidal Wetlands
- Streams
- FEMA Floodplains
 - 100-year
 - 500-year



Greenspace Quality Rank

high	low
medium	

SCHUYLKILL RIVER CORRIDOR

Tidal Schuylkill River Corridor

The northern half of this site is composed of a narrow strip of undeveloped land that runs along the east bank of the Schuylkill River from the south end of Fairmount Park to I-76. Currently, plans are being reviewed for a pedestrian and bike bridge over the railroad tracks below Walnut Street since the tracks preclude safe access to the river. This will greatly improve the safety of access to this site and the river shoreline.

South of this narrow strip are several large areas of derelict or undeveloped land. These areas, while dominated by non-native invasive plants, offer significant areas of greenspace along the river shore and include the DuPont Crescent shoreline and the National Heat and Power property. The Schuylkill River Development Corporation is examining these areas for redevelopment opportunities and is currently working on improvements in the area to facilitate access.

Bartram's Garden, on the west bank of the Schuylkill River south of Grays Ferry Ave, lies at the upstream end of an extensive strip of green, undeveloped land that continues south to the Delaware River. Managed as a farm by the Quaker John Bartram more than 250 years ago, Bartram's Garden is dedicated to preserving the history of the Bartram residence and farm and maintaining the garden and natural habitat on the site. Situated on 45 acres, the garden maintains a botanical collection of both native and non-native plants, a grassland planted with prairie species, and a tidal wetland. The site is open to the public and serves as an educational destination for many children and as a well known local art gallery. The tidal wetland at Bartram's Garden also supports two plant species of concern that are often found on the Schuylkill and Delaware Rivers in areas with tidal flow.

Downstream of Bartram's Garden are several open areas that historically supported industrial complexes. These sites have been cleared of buildings and are being examined for redevelopment opportunities. As redevelopment is examined the inclusion of an appropriate and functional riparian buffer and publicly accessible greenspace should be considered.

Below these old industrial sites, on and around the point of land called Point Breeze, is an extensive scrap yard. The total coverage of land just for used cars in this area is approximately 90 acres. Though the coverage of used cars has been decreasing over the past several years, approximately 20 acres of cars are still within the 100-year floodplain.

Along the southern end of Point Breeze and extending down to the south end of the site is land still actively used by the oil industry. Because of safety concerns PNHP scientists were not able to secure permission to survey within these lands. Within these lands are extensive areas of wetland and forest that are likely influenced by tidal flows and seasonal floods. We assessed these sites using aerial photos and believe they resemble habitat known to support species of concern. If development is planned within these sites we highly recommend that the areas are first surveyed for species of concern and natural habitat.



photo source: PNHP

Open land along the DuPont Crescent shoreline on the Schuylkill River, part of the original DuPont chemical complex.

SCHUYLKILL RIVER CORRIDOR

This entire site is within the tidal reach of the Delaware River and it is not uncommon for the river level to change by 5 feet within one tide cycle (twice each day). Throughout this site the Schuylkill River maintains a tidal connection to the Atlantic Ocean via the Delaware River and Delaware Bay. This connection is facilitated by the fish ladder at the Fairmount Dam; the ladder allows thousands of fish to pass this obstacle every year. However, a very small amount of tidal habitat has been noted along this site. This lack of tidal habitat is caused by the steel and concrete bulkheads that confine the river within this site. These concentrate the flow of the river, precluding the formation of mudflats and preventing the river from reaching potential riparian wetlands.

This portion of the Schuylkill is the proposed location for the Schuylkill River Trail. This trail will eventually connect Pottsville (Schuylkill County) to Fort Mifflin via a continual path along the river.

Threats and Disturbances

This stretch of the Schuylkill River is highly disturbed. As one of the first areas in the Commonwealth colonized by Europeans and the heart of Philadelphia industrial production for well over a century, the land has little connection to its pre-colonial condition. In some areas the development along the banks has removed all signs of the original riparian wetlands and floodplain forests.

Despite the proportion of the site is within the 100-year floodplain, the area has been significantly built out. This indicates that the undeveloped natural areas within the 100-year floodplain remain unprotected from future development. Also, these areas are likely dominated by non-native invasive plant and animal species that can colonize the highly disturbed soils.

Having a large number of scrap cars and oil industry tanks and infrastructure within the 100-year floodplain is also highly problematic. During flooding episodes the chance of an uncontrolled release of toxic substances is greatly increased by their presence. Furthermore, in flooded conditions it becomes much more difficult and expensive to control or mitigate pollution events.



photo source: PNHP

The created wetland at Bartram's Garden showing a significant area of wetland plants and the plant species of concern, salt-marsh water-hemp (*Amaranthus cannabinus*), in the foreground.

Flooding events along the Schuylkill River are only exacerbated by the confinement of the river within bulkheads, which has greatly altered the river's flow patterns. This confinement, along with inefficiently managed stormwater flows, causes the river to rise more quickly and higher than it would with intact floodplains and a landscape that absorbs rainwater. While significant mudflats exist within this tidal stretch of river, they support little or no vegetation because of recurrent high flow conditions, historic and current pollution, and uncontrolled boat wakes that continually remobilize sediments and wash away colonizing plants.

Conservation and Restoration Recommendations

This portion of the river offers the greatest opportunity within Philadelphia for a significant restoration of natural river and floodplain habitat. There is already a significant area of undeveloped greenspace from Passyunk Avenue (Point Breeze)

SCHUYLKILL RIVER CORRIDOR

south to Penrose Avenue. It is very important that this stretch of greenspace be preserved from development.

Once the area is protected from development it can be examined for restoration opportunities. Among these opportunities will be the control of non-native invasive species and planting of appropriate native species. Other opportunities may be the restoration of areas of floodplain through reducing the height of or completely removing existing bulkheads. With the removal of the bulkheads the possibility of expanding the existing mudflats in the area can be examined along with replanting to native tidal plants. Revegetation will facilitate their stabilization and increase their environmental value by opening them up to new suites of species.

A final need in the southern portion is the removal, as possible, of scrap cars and oil industry infrastructure from the active floodplain. These areas will eventually flood again as they have many times in the past and the continued storage of toxic substances within this area will only increase the future costs of site remediation.

The characteristics of the northern portion of this site make full environmental restoration in this area impractical. The degree of disturbance to the natural system, level of development in the surrounding area, and available space simply prevent this. Ideally, planting this area with native trees common to the river ecosystems of southeastern Pennsylvania and managing a park-like habitat will facilitate the movement of animals along this green corridor.

Open space and greenspace protection and safe public access across this site need to be priorities. Safe publicly accessible greenspace should be a requirement for redevelopment permits along the river. Once open space and access are secured, removal of non-native trees and replanting of native trees that are adapted to the highly disturbed land would be appropriate. These trees would increase the environmental value of the area, help to alleviate the urban heat-island effect, and greatly improve the aesthetic quality of the site.

Continuation of the Schuylkill River Trail through this area will promote the ecological conservation and restoration goals for the site. By introducing the public to the potential and importance of natural areas along the Schuylkill River through safe and easy access, a greater awareness of the issues facing the site will develop.



photo source: Andrew Strassman, PNHP

Schuylkill River, at Bartram's Garden, looking upriver at the downtown Philadelphia skyline.

Schuylkill River Uplands

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Schuylkill River Uplands			Near-term Conservation Priority and Notable Significance			
Oblique milkvine (<i>Matelea obliqua</i>)	P	G4?	S1	PE	2008	E
Reflexed flatsedge (<i>Cyperus refractus</i>)	P	G5	S1	PE	1997	C
Round-leaved thoroughwort (<i>Eupatorium rotundifolium</i>)	P	G5	S3	UTF	1986	A

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

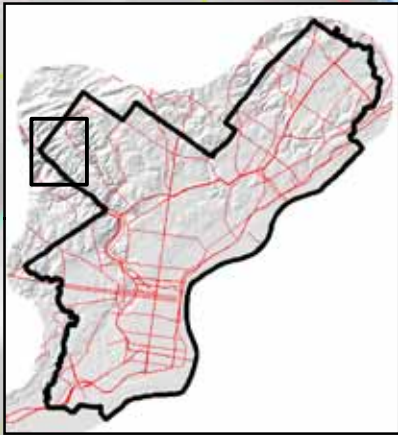
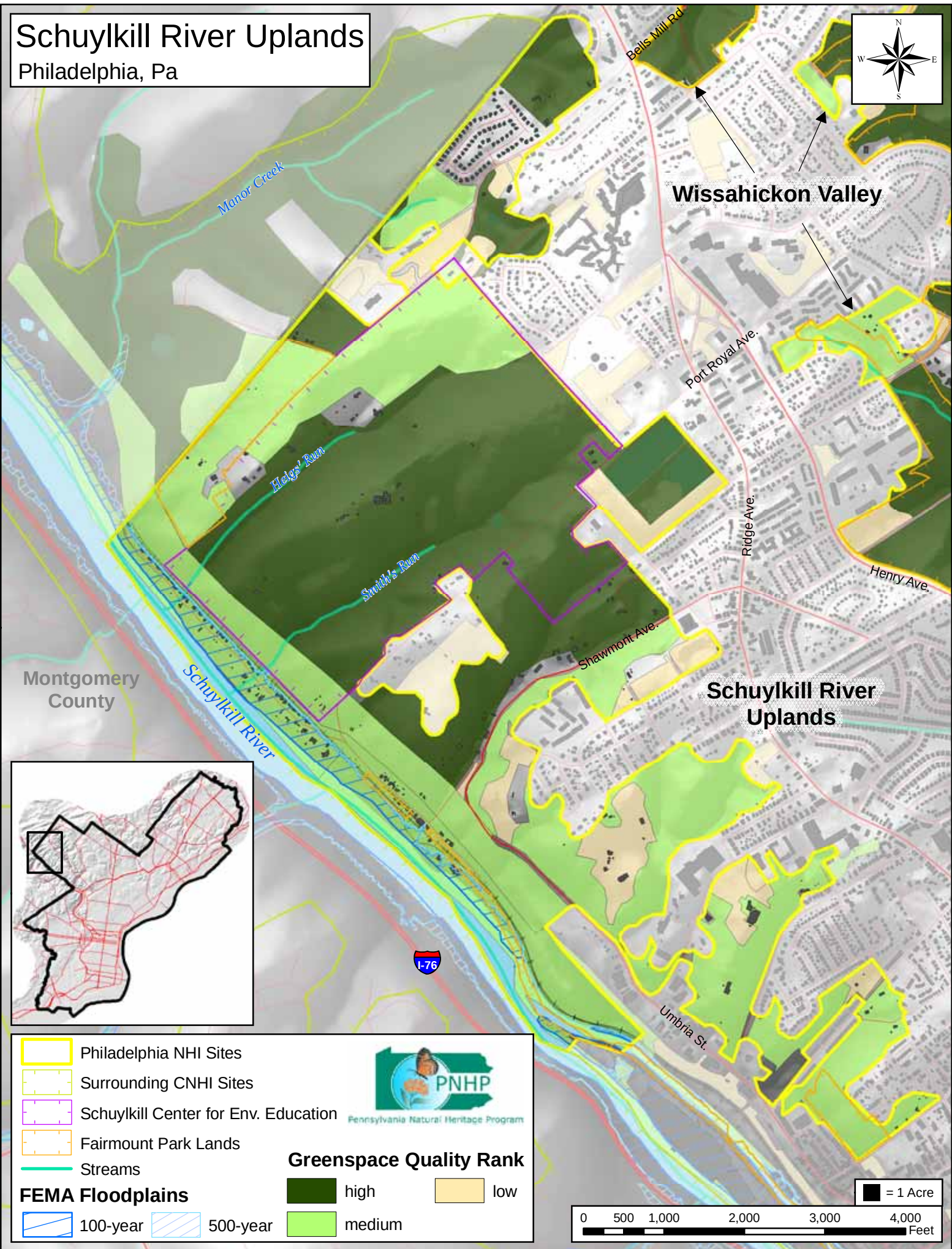
² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Schuylkill River Uplands

Philadelphia, Pa

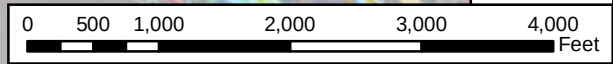


- Philadelphia NHI Sites
- Surrounding CNHI Sites
- Schuylkill Center for Env. Education
- Fairmount Park Lands
- Streams
- FEMA Floodplains**
- 100-year
- 500-year



Greenspace Quality Rank

 high	 low
 medium	



SCHUYLKILL RIVER UPLAND

Schuylkill River Uplands

The Schuylkill River Uplands is composed of a large tract of undeveloped forestland along the Schuylkill River's east bank in the north part of the city.

Primarily owned and managed by the Schuylkill Center for Environmental Education (SCEE) with some areas owned by the city, this site was primarily used for agriculture until the 1960's. This land use history has resulted in a generally young forest with little structure intermixed with open meadow areas.

However, within this site are patches of much older forest, potentially in excess of 250 years old. These older forests are located along the steep streams that feed into the Schuylkill River. They contain many much larger and older trees, a well developed layer of duff (leaf litter) and coarse woody debris, and a much more diverse species composition. These characteristics indicate that the forest has been moderately undisturbed for well over a century if not longer.

Within these small steep narrow creek valleys are many skunk cabbage seeps and several small ponds. These small wetlands support numerous plants, insects, and amphibians that are dependent on wetlands and are otherwise not found in the area.

Running along the west side of the site is a large power line right-of-way that is maintained in an open-meadow-like manner. This area offers important habitat for many grassland species of plant and bird. Additionally, it offers excellent habitat for many species of butterfly by providing habitat for both caterpillar host plants and nectar plants for adults.

A final point of interest within the site is the Roxborough Reservoir. This reservoir is at the highest point in the city and once held water pumped up from the now abandoned Shawmont Waterworks. Today the reservoir is no longer in use and has become a mix of wetland, meadow, and woodland habitats.

Within the site are three known occurrences of rare plants. Two are found in open meadow habitats where woody plants and trees are controlled on a regular basis. The first, oblique milkvine (*Matelea obliqua*), is a trailing vine related to milkweeds that is generally rare throughout its range and critically imperiled in the Commonwealth. An important nectar species for many insects, oblique milkvine is also a very beautiful plant. The second, round-leaved thoroughwort (*Eupatorium rotundifolium*), is also dependent on open areas to survive, is found in open patches throughout the site, and is also an important nectar plant from many insects.

Threats and Disturbances

This site contains large areas where non-native invasive species dominate the landscape. Among the most prominent invasives are several species of tree and shrub from Asia that are significantly suppressing the regeneration of native species. Japanese stilt-grass (*Microstegium vimineum*) is also invading many of the woodland sites and smothering large areas of the forest floor.

In the meadows and grasslands many of the non-native species are irreversibly established, but most are relatively free of woody species.



photo source: Andrew Strassman, PNHP

The power line cut along the western edge of the site showing the open, grassland-like habitat.

SCHUYLKILL RIVER UPLAND

Throughout the site there is evidence of extensive regeneration suppression from deer browsing. Deer prefer to browse on native plants so areas that are lush green may be found to only support non-native invasive plant species that the deer will not eat.

A final threat to this area is continued development of the remaining open land not under protection and increased use of the roads through the area by commuters from Montgomery County resulting in increased vehicle wildlife incidents.

Conservation and Restoration Recommendations

This area has undergone a significant transformation over the past three centuries and the landscape will need help to be restored. Active management of the non-native invasive species will be needed to allow native species the opportunity to develop. In areas

where native species have been extirpated, replanting and management will be needed once invasive species have been controlled.

Additionally, the deer population in this area will need to be controlled. It has become apparent that reducing deer populations to carrying capacity may not be adequate to restart regeneration, and that it may take decades of low deer populations with active replanting for forested areas to recover from deer damage.

Specific attention should be given to ensure that proper management of stormwater runoff continues. The streams flowing through this area are high gradient and prone to erosion, but are generally healthy. Improper stormwater management could quickly and irrecoverably degrade these streams.



photo source: Andrew Strassman, PNHP

One of the small creeks running through the SCEE property with a well vegetated floodplain and ample riparian wetlands.

Byberry Creek Upland Forest

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
	Global	State			
NATURAL HERITAGE SITES					
Byberry Creek Upland Forest			Near-term Conservation Priority and Local Significance		

None currently known

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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



Byberry Creek Upland Forest

Philadelphia, Pa

Montgomery County

Poquessing Creek

Proctor Rd

Byberry Rd

Audubon Ave

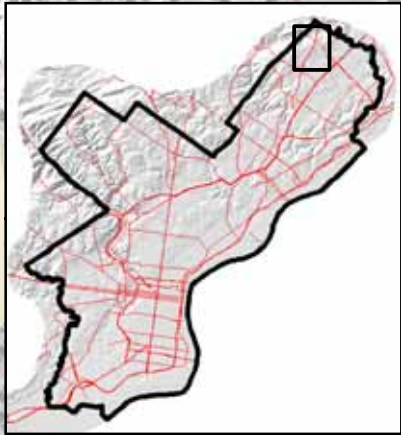
Rennard St

Bustleton Ave

Byberry Creek Upland Forest

Poquessing Creek Upland

Byberry Creek



- Philadelphia NHI Sites
- Fairmount Park Lands
- Stream Centerline
- FEMA Floodplains**
 - 100-year
 - 500-year

Greenspace Quality Rank

high	low
medium	



1 Acre



BYBERRY CREEK UPLAND FOREST

Byberry Creek Upland Forest

This site is composed of a 90-acre woodland connected to the headwaters of Poquessing Creek by a narrow strip of undeveloped land that leads into Montgomery County. This site shows evidence of extensive disturbance but maintains a good diversity of native species.

Within the site are several distinct habitat type including mature forest, forested wetland, regenerating forest, and a shrubby open area along the southeastern edge.

The forested wetland is the headwater for a small stream the flows into Walton Creek south of Roosevelt Avenue. This area also contains a large stormwater outflow pipe originating somewhere to the north. Interestingly, the wetland supports a small patch of persimmon (*Diospyros virginiana*) trees.

The forested areas show a mix of native and non-native invasive species typical of the area. American beech (*Fagus grandifolia*), red oak (*Quercus rubra*), and tuliptree (*Liriodendron tulipifera*) dominate the overstory with northern arrow-wood (*Viburnum recognitum*), highbush blueberry (*Vaccinium corymbosum*), and spicebush (*Lindera benzoin*) composing the understory.

The area of the forest undergoing regeneration contained the most diverse ground cover. This area shows signs of a selective harvest of trees in the last 10–15 years with the resulting regeneration being composed of numerous native and non-native species.

Byberry Creek Upland Forest: selected forbs

Black-cohosh	<i>Actaea racemosa</i>
Horse-balm	<i>Collinsonia canadensis</i>
Wild sarsaparilla	<i>Aralia nudicaulis</i>
Spikenard	<i>Aralia racemosa</i>
Broad beech fern	<i>Phegopteris hexagonoptera</i>
Sessile-leaved bellwort	<i>Uvularia sessilifolia</i>
Perfoliate bellwort	<i>Uvularia perfoliata</i>

Byberry Creek Upland Forest: selected shrubs

Pinxter-flower	<i>Rhododendron periclymenoides</i>
American filbert	<i>Corylus americana</i>
Highbush blueberry	<i>Vaccinium corymbosum</i>
Spicebush	<i>Lindera benzoin</i>



photo source: PNHP

A portion of the forest with American beech (*Fagus grandifolia*) intermixed with tuliptree (*Liriodendron tulipifera*).

Threats and Disturbances

This area is highly susceptible to parcelization and development. The surrounding land use is almost entirely a highly developed urban setting. This land use choice has made this forest block a natural island within a concrete and asphalt sea.

The highly developed landscape has contributed to large amounts of uncontrolled stormwater runoff. Some of this runoff is directly piped into the woods and headwaters of the small creek running through the woods. The large occasional flows from this outfall have contributed to the degradation of the wetland and the stream it feeds.

Invasive species are also having a direct negative impact on the area. An extensive array of non-native invasive plants is supplanting the native plants, decreasing their availability to the native animals that rely on them for food and habitat.

Conservation and Restoration Recommendations

The primary goal at this site should be its protection from development. Without a guarantee that it is safe from development any restoration effort is meaningless. In addition, the corridor between the main forest block and Poquessing Creek is vitally important to preserve as a linking greenway between the woods and the riparian corridor.

Once the area is protected, an effort should be made to mitigate the impacts caused by urban runoff into

BYBERRY CREEK UPLAND FOREST

the wetland by implementing various green infrastructure improvements. The outfall should either be moved to a more suitable location or redesigned to cause less impact.

Non-native invasive species within the site need to be controlled to increase the health of the system. Of the 177 plant species documented at the site, 50 (28%) were not found in the Commonwealth at the time of colonization. As these species are controlled it is critical that the holes be revegetated with native species appropriate to the site, whether in the wetland, the riparian area, or the upland forest.



photo source: PNHP

The large stormwater outfall culvert in Bayberry Creek Upland Forest. The adjacent streambanks show the erosion effects of the surge in water levels associated even with small rainstorms.

Poquessing Creek Uplands & Benjamin Rush State Park

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
	Global	State			

NATURAL HERITAGE SITES

Poquessing Creek Uplands & Benjamin Rush State Park

*Immediate Conservation Priority and Local
Significance*

None currently known

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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



Poquessing Creek Uplands & Benjamin Rush State Park

Philadelphia, Pa

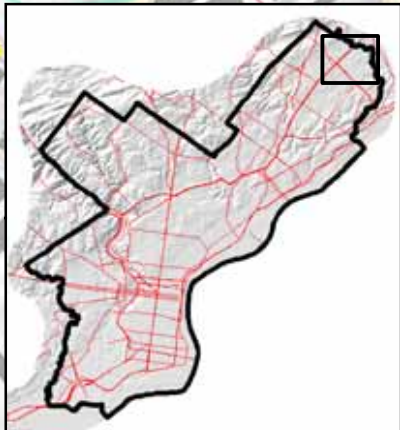
Byberry Creek Upland Forest

Poquessing Creek Greenway

Poquessing Creek Uplands

Poquessing Creek Greenway

Northeast Philadelphia Airport



 Philadelphia NHI Sites

 Surrounding CNHI Sites

 Benjamin Rush State Park

 Fairmount Park Lands

 Streams

FEMA Floodplains

 100-year

 500-year


Pennsylvania Natural Heritage Program

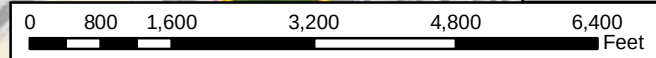
Greenspace Quality Rank

 high

 medium

 low

1 Acre



POQUESSING CREEK UPLAND

Poquessing Creek Uplands & Benjamin Rush State Park

Composed of open grassy areas and recreational fields intermixed with a few forested riparian corridors; this site represents a majority of the accessible open space remaining in this part of the city.

At the center of this site is Benjamin Rush State Park. Housed within the state park is the largest community garden in the world. The garden currently covers around 10 acres and provides recreation and sustenance to many people. Also within the state park is a small area devoted to radio-controlled model planes, which is managed through mowing.

This park hosts several large open fields primarily composed of non-native weedy species intermixed with native grasses and forbs. These areas are known to support grassland birds on occasion and the usability of the fields for these bird species could be greatly increased by restoring the vegetation to native meadow species.

There are also scattered patches of woods around the park and toward Poquessing Creek. These patches are heavily invaded by non-native species and show evidence of recent and repeated disturbance.

This pattern of significant levels of disturbance and high levels of non-native invasive species is evident throughout the site. No areas of mature forest were

noted, the open areas were generally weedy or mowed, and the small riparian areas were very weedy and had significant amounts of refuse in them.

Threats and Disturbances

The erosion of open space in this area continues with the recent demolition of the old Pennsylvania State Hospital and complete clearing of the grounds. The current design proposals for this site show little to no public open space, no greenspace, extensive areas of impermeable surface with no on-site stormwater remediation, and a very limited buffer between developed areas and Poquessing Creek.

Most existing open areas within this site are extensively colonized by non-native invasive plant species, which seriously affect the general ecological health of this site. Additionally, deer populations along this portion of Poquessing Creek are very high, with extensive evidence of deer browse on native plants throughout the site and little or no native plant regeneration noted.

Within and directly south of Benjamin Rush State Park is extensive damage caused by unauthorized 4x4 and ATV use. Impacted habitats includes uplands, riparian forest, and even several wetlands. These denuded areas are promoting the spread of non-native invasive plants and causing significant sediment mobilization into Poquessing Creek because of the large areas of bare and highly disturbed ground.

A final disturbance within this area is runoff from impermeable surfaces. Poor management of rain water from the large roofs and extensive parking lots in the immediate area causes a drastic increase in runoff during even small rainstorms. This is especially evident in the small waterways and on the banks above Poquessing Creek where deep gullies have been eroded.

Conservation and Restoration Recommendations

Securing greenspace within the Poquessing Creek Uplands should be a primary goal. Conversion of the open areas into impervious surfaces will further impact the hydrology and health of Poquessing Creek and the small streams that feed it.



photo source: PNHP

A portion of the area managed as grassland at Benjamin Rush State Park.

POQUESSING CREEK UPLAND

Management of the stormwater flows within the watershed will be needed to improve the health of the creek. This can be accomplished by keeping undeveloped areas undeveloped and by the installation of “green” stormwater management technology on existing gray infrastructure. This technology includes water-permeable paving systems, constructed “wetlands” to retain building and parking lot runoff, water gardens imbedded within normal landscaping, and green roofs, among many other options.

Access to the community garden should be maintained and encouraged. This link to local food production is vital to public understanding of and appreciation for the ultimate source of food and acts as an excellent educational opportunity.

Access routes used by 4x4s and ATVs must be permanently blocked. Unless these routes are closed with violators facing meaningful consequences for continued trespassing, any restoration effort in this area is meaningless. Once these areas have been rendered inaccessible to motor vehicles, restoration efforts can begin.

Once opens pace has been secured it should be restored to native cover as possible. Within the grassy areas, native species should be sown in as non-native invasive species are removed and controlled. In riparian areas, native trees should be planted to stabilize banks and provide shade to reduce water temperatures and increase the quantity and quality of the riparian habitat.



One of several large open fields within the Poquessing Creek uplands site displaying a wealth of fall flowers and an extensive area of early-successional habitat

photo source: PNHP

Northeast Philadelphia Airport

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
	Global	State			

NATURAL HERITAGE SITES

Northeast Philadelphia Airport

*Opportunistic Conservation Priority and
Local Significance*

None currently known

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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

Northeast Philadelphia Airport

Philadelphia, Pa



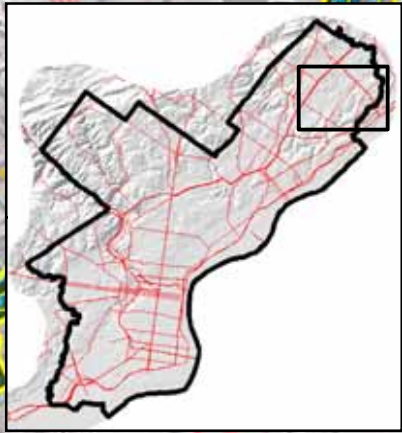
Northeast Philadelphia Airport

Pennypack Park

Poquessing Creek Upland

Poquessing Creek Greenway

Poquessing Creek Greenway



- Philadelphia NHI Sites
- Surrounding CNHI Sites
- Fairmount Park Lands
- Streams
- FEMA Floodplains
- 100-year
- 500-year



PNHP
Pennsylvania Natural Heritage Program

Greenspace Quality Rank

 high	 low
 medium	



Northeast Philadelphia Airport

The Northeast Philadelphia Airport site represents a significant area of open space in north-central Philadelphia. While the majority of the land, managed by the city's Airport Administration, is not publicly accessible, it can be managed in a manner that increases its ecological value and health and increases the quantity and quality of ecological services it provides to the area.

Additionally, several significant open areas exist outside the city-owned area and these can be managed to increase the amount of publicly available greenspace and create greenways between several widely separated green areas already in existence.

Many of the potential corridors in the site follow small creeks and waterways. These waterways are degraded by improperly managed stormwater runoff, trash from the surrounding development, and a lack of vegetation. Their restoration should be a priority.

Threats and Disturbances

While this site is mainly secure as open space for the safe operation of the airport, several smaller connecting patches are unprotected. It is vital to the ecological functioning of this site that these areas be protected and maintained as open space.

Along the creeks and waterways of the site, runoff from parking lots, roads, and roofs remains a primary concern. These large swaths of impermeable surfaces deflect and concentrate runoff in unnatural and environmentally damaging ways during heavy rains, which encourages erosion within the streams. The increased erosion allows non-native invasive species greater colonization opportunities. Along these waterways are areas already dominated by non-native invasive species of little ecological benefit and their spread should not be encouraged. Additionally, these high flows regularly "flush" out aquatic species that have managed to colonize the streams, further decreasing the biological value of the waterways and the entire site.

Conservation and Restoration Recommendations

First, the protection of open areas not already protected needs to be accomplished. These open spaces are needed to fulfill the ecological potential of this site as a linkage between other existing areas of greenspace.

Once these areas are protected, an effort needs to be made to restore them to native vegetation. To increase the habitat quality for grassland passerine birds, allow the grassed areas away from the runways to remain unmown until early fall. Ideally, these areas should only be mowed every 1 to 3 years in early spring to prevent woody species from colonizing and promote regeneration of the grasses. Additionally, increasing the length of time between mowings will reduce the monetary costs incurred through fuel, equipment maintenance, and labor expenses.

Cost-effective and ecologically based methods of stormwater management are also needed throughout this site. Options include created wetland impoundments that can collect runoff and release it in a controlled manner, rain gardens to slow runoff and facilitate infiltration, and permeable paving systems to decrease runoff from paved surfaces.

NORTHEAST PHILADELPHIA AIRPORT

Frankford Creek

Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
	Global	State			

NATURAL HERITAGE SITES

Frankford Creek

*Enhancement Conservation Priority and Local
Significance*

None currently known

¹ A = Amphibian; B = Bird; C = Community; F = Fish; L = Lepidopteran; O = Odonate; P = Plant; M = Mammal; R = Reptile, U = Unionid (Mussel)

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



FRANKFORD CREEK

Frankford Creek

The Frankford Creek corridor offers the opportunity to reconnect the green of Tacony Park to the blue of the Delaware River shoreline. Traveling through a highly developed area with little available greenspace, this channel offers a space to replant trees and improve the visual and ecological value of the area.

Along this entire corridor the landscape is highly disturbed from development. Throughout the site development occurs to the very edge of the creek with the majority of the creek confined within concrete and steel walls. Additionally, a major portion of the creek has a concrete lined bottom. This lining offers little or no opportunity for riparian habitat, offers no chance of bottom habitat, and severely impairs stream health.

From Castor Avenue downstream to the mouth of Frankford Creek there are two dam crossings acting as impermeable barriers to anadromous fish migration, preventing tidal flow, and potentially exacerbating flooding.

At Aramingo Avenue a major change occurs along Frankford Creek. This is the approximate point where the original channel ceases to exist. Historically, the natural channel would have continued along the approximate path of I-95 and joined with the Delaware River through the dead-ended inlet at Bridge Street. The current path Frankford Creek takes to the Delaware River is entirely manmade and engineered to empty the creek as quickly as possible. This emptying includes not only water, but also aquatic organisms that have colonized the stream.

The undeveloped buffer along Frankford Creek, non-existent on the upstream end of the site, grows progressively wider as the site approaches the Delaware River. From the rail bridge downstream to the creek mouth this potential greenspace offers significant opportunity for restoring riparian habitat in the floodplain.

Threats and Disturbances

There is very little damage left to do to this creek that has not already been done. The original channel has been destroyed, the floodplain has been filled and constrained with steel and concrete, the bottom has been turned into concrete in sections, and portions have been dammed.

Conservation and Restoration Recommendations

Despite the level of disturbance to Frankford Creek and the surrounding land there remains the possibility of restoring a significant portion of the environmental function this area once possessed.

A primary goal should be the establishment and permanent protection of a green and publicly welcoming riparian corridor between Tacony Park and the Delaware River



photo source: PNHP

Looking upstream near the mouth of Frankford Creek. Note the well developed riparian forest.

FRANKFORD CREEK

shoreline along Frankford Creek. The foundation for a functioning riparian corridor already exists increasing the possibility of completion in a short period of time.

The goal for this riparian corridor should be the eventual reconnection of river function with the floodplain. This can only be accomplished through restoration of the river channel to a more natural state by reduction or removal of the current channel armoring. Ideally, this floodplain would be composed of native plant species to provide shade, cover, and food to the local environment.

Key to restoration of health in this system is the removal of the two dams within the site. These dams act as barriers to fish passage, closing off all upstream sections to migratory fish species such as American shad (*Alosa sapidissima*) and white perch (*Morone americana*) among several others.

Delaware River Shore

	Taxa ¹	PNHP Rank ²		State Legal Status ²	Last Seen	Quality ³
		Global	State			
NATURAL HERITAGE SITES						
Delaware River Shoreline			Immediate Conservation Priority and Notable Significance			
Beggar-ticks (<i>Bidens laevis</i>)	P	G5	S3	TU	2008	E
Bugleweed (<i>Lycopus rubellus</i>)	P	G5	S1	PE	1998	BC
Freshwater intertidal marsh	C	G3G4	S1	N	1998	B
Golden club (<i>Orontium aquaticum</i>)	P	G5	S4	WATCH	1993	C
Multiflowered mud-plantain (<i>Heteranthera multiflora</i>)	P	G4	S1	PE	1998	BC
Osprey (<i>Pandion haliaetus</i>)	B	G5	S2B	PT	2003	E
Slaty skimmer (<i>Libellula incesta</i>)	O	G5	S3S4	N	2007	E
Subulate arrowhead (<i>Sagittaria subulata</i>)	P	G4	S3	PR	2007	AB
Swamp beggar-ticks (<i>Bidens bidentoides</i>)	P	G3G4	S1	PE	2008	BC
Swarthy skipper (<i>Nastra lherminier</i>)	L	G5	S3	N	2007	E
Salt-marsh water-hemp (<i>Amaranthus cannabinus</i>)	P	G5	S3	PR	2007	C

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² Please refer to Appendix III (pg. 166) for an explanation of PNHP ranks and legal status

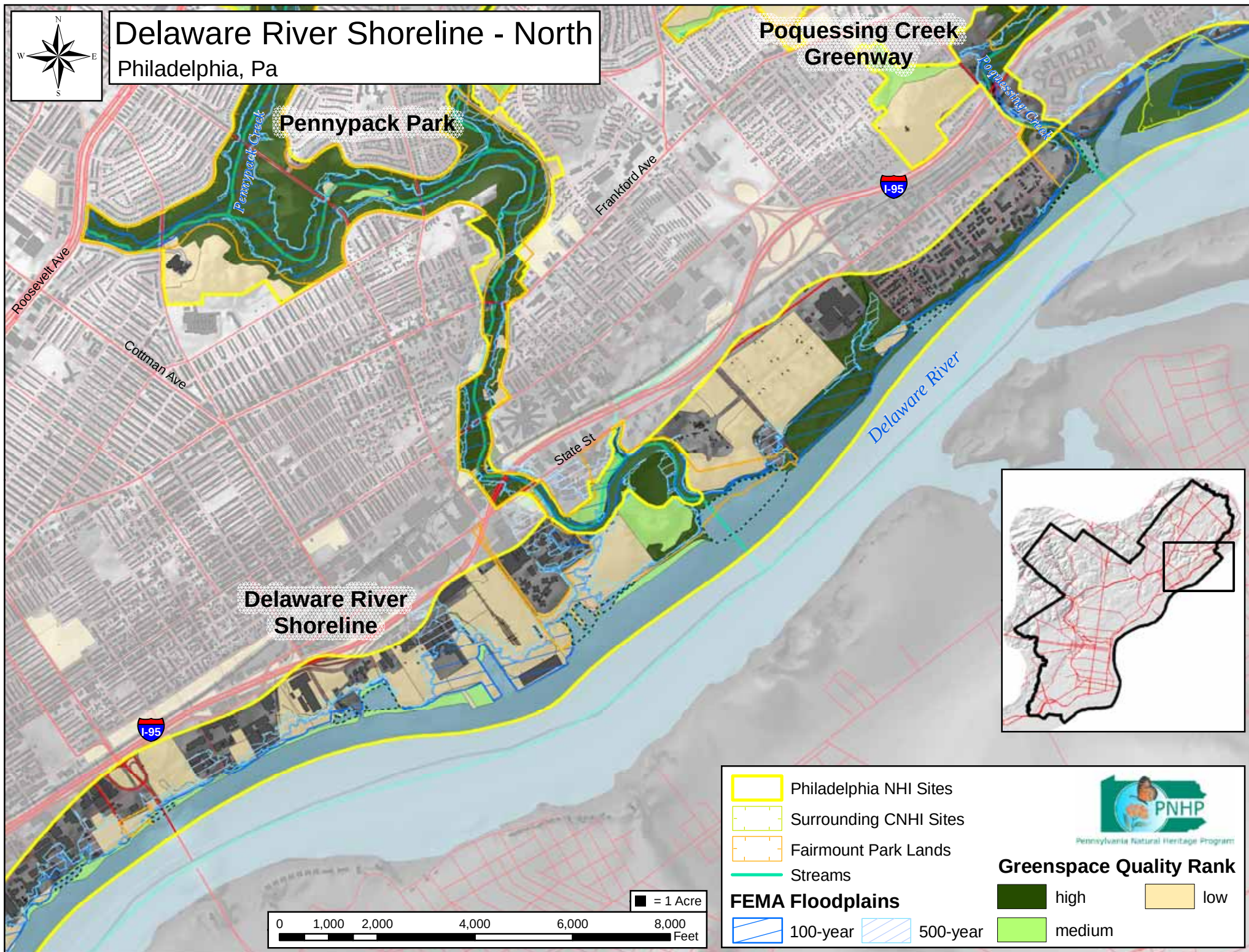
³ Please refer to Appendix IV (pg. 169) for an explanation of quality ranks

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



Delaware River Shoreline - North

Philadelphia, Pa



Pennsylvania Natural Heritage Program

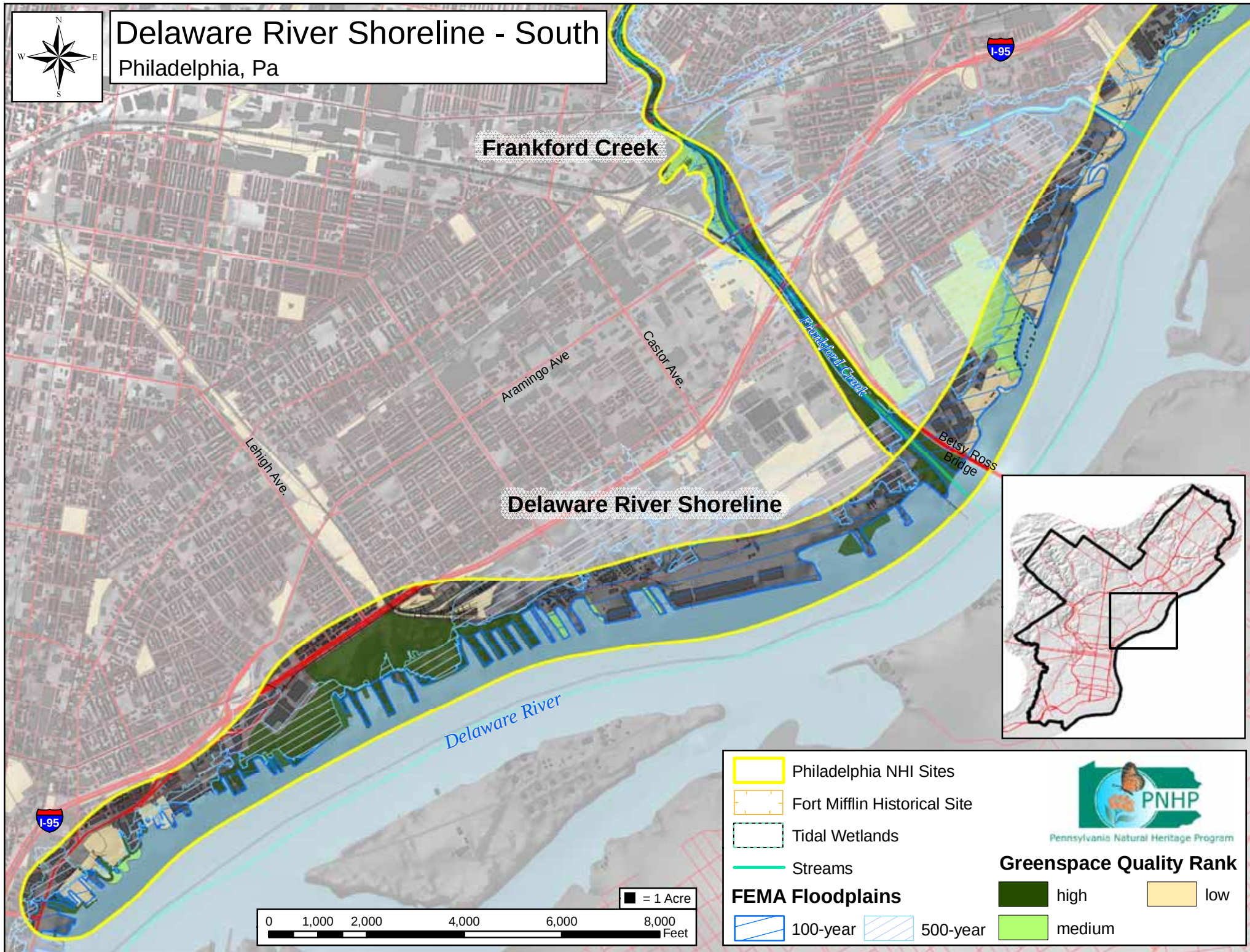
Greenspace Quality Rank

high	low
medium	



Delaware River Shoreline - South

Philadelphia, Pa



Frankford Creek

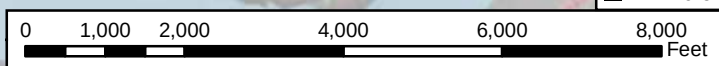
Aramingo Ave

Castor Ave

Delaware River Shoreline

Delaware River

Betsy Ross Bridge



Philadelphia NHI Sites

Fort Mifflin Historical Site

Tidal Wetlands

Streams

100-year

500-year

PNHP
Pennsylvania Natural Heritage Program

Greenspace Quality Rank

high	low
medium	

Delaware River Shoreline

Most of the area between the I-95 freeway and the Delaware River has been greatly modified from the extensive system of tidal marshes that used to dominate the shoreline. Marshes were drained and filled to provide additional land for the expansion of Philadelphia and its ports. Most of this area is still within the floodplain of the river and is likely to be subject to future flooding from increasingly unpredictable weather patterns. The Delaware River shoreline in Philadelphia currently supports a mix of uses. Formerly, this area was a very active shipping and industrial hub of North America. While still an important entryway for sea freight, much of the riverfront has seen considerable change in the past few decades. Many areas that had been associated with shipping and industry have been demolished, leaving various large and small patches of vacant ground and their associated piers along the riverfront.

Since much of the Delaware River shoreline in Philadelphia is currently transitioning from past industrial and shipping activity, the city is presented with an excellent opportunity to recreate a continuous greenway corridor along this stretch of the river. This strip of land lends itself well to the reestablishment of a ribbon of native vegetation that will help provide habitat for native plants and animals while filtering and trapping runoff from the city before it enters the river. In addition, the linear corridor can function as a portion of a public greenway along the length of the Delaware

riverfront. Such a public amenity would greatly improve the quality of life for all residents and visitors to the city. Future developments should be set back from the river shoreline to accommodate a 100-meter wide vegetated riparian buffer between the river's edge and development activity. The shoreline habitat can be improved by removing portions of the armored bulkheads and reconnecting the river to a portion of its natural floodplain. Replanting the riparian area in native trees and shrubs would enhance its ecological value.

The crumbling, paved footprints of past industrial activity are giving way to expanses of early successional vegetation. Vegetation has begun to colonize the unused piers and unpaved portions of the former industrial sites. Where the shoreline vegetation strip widens, it supports trees, shrubs, vines, and herbaceous vegetation between the rubble-armored hardened shoreline and the crumbling pavement of the former industrial sites. Along the periphery of the river, native species of plants and animals compete with introduced species for the limited space and resources available for their use. This disturbed strip of vegetation is frequently dominated by invasive non-native trees such as tree-of-heaven, princess tree, Norway maple, Siberian elm, white poplar, and white mulberry, but also contains native trees including sycamore, silver maple, pin oak, black cherry, hackberry, red maple, honey locust, walnut, red oak, green ash, tulip poplar, black willow, slippery elm, and box elder. Invasive shrubs and vines frequently dominate the understory, including Japanese honeysuckle, porcelain berry, Asiatic bittersweet, multiflora rose, bush honeysuckles, common privet, barberry, paper mulberry, and autumn olive.

The abandoned wooden pilings, piers, and ramps within the river help to diminish the impact on the river shoreline of wave action from passing ships and may help to encourage the formation of tidal mudflats along this portion of the river. Many of the formerly active piers have been neglected for long enough that trees, shrubs, and herbaceous vegetation have colonized them. Between the vacant piers are areas of shallow water and deep mud that in some cases already support tidal mudflat vegetation. These small estuaries help support young fish populations, an essential ecological function of shallow water habitats along the river.



A view downriver along the Delaware River shoreline at the Benjamin Franklin Bridge.

DELAWARE RIVER SHORE

The following is an assessment of the riverfront, its current ecological value, and its restoration potential beginning at the Benjamin Franklin Bridge and continuing upstream to the Bucks County line at Poquessing Creek. The current threats and disturbances along with the conservation recommendation are within each site description.

Benjamin Franklin Bridge to Betsy Ross Bridge

The Delaware River shoreline between the Benjamin Franklin Bridge and the Betsy Ross Bridge contains many currently vacant parcels and inactive piers. The crumbling remains of the extensive shipping and industrial infrastructure that used to dominate this portion of the shoreline will ultimately be converted to other uses. The potential to restore ecologically viable habitats along this stretch of the river presents an excellent opportunity to also provide a corridor of public access to the riverfront. Future long-range goals for this section of the river should be to enhance the native ecology of the riverfront as well as provide public access and park space for the community.

The riverfront between **Benjamin Franklin Bridge and Ellen Street** is currently one of the most developed portions of this stretch of the river. The Delaware riverfront just north of the Benjamin Franklin Bridge contains recreational marinas associated with Penn's Landing and the Festival Pier. The northern half of the Festival Pier, at the end of Spring Garden Street, contains the remnants of former industrial or shipping activity, with most of the surface covered in crumbling pavement. A narrow fringe of woody vegetation occurs along the margins of the pier. To the north of the Festival Pier (Delaware Avenue at Penn Street) is an unused pier flanked by two shallow inlets that have good potential for tidal mudflat restoration. These shallow areas already have thick accumulations of silt and mud, and could be replanted with native tidal submerged aquatic vegetation. The unused pier has a thin perimeter of woody and herbaceous vegetation while the majority of the pier is bare ground.

The newly constructed Waterfront Square condominium complex occurs just north of this unused pier (Poplar Street at North Penn Street). This complex was built up to the river's edge, eliminating the potential for restoration of riverine habitat and excluding public access to the riverfront.



The Delaware River shoreline at Penn Treaty Park

Future development along the riverfront should be set back from the river's edge to accommodate a corridor of native vegetation and public access as part of a Delaware River Greenway for the city.

Between **Ellen Street and Shackamaxon Street** is a currently undeveloped parcel of land. This roughly 22-acre privately owned parcel could provide a significant increase in riverfront open space as an extension of Penn Treaty Park or as a continuation of a riverfront greenway. The riverfront at this location contains the remnants of a shipyard. Several older unused piers jut out into the river, forming shallow water coves suitable for tidal mudflat restoration. The abandoned wooden pilings and ramps within the river help to diminish the impact of wave action on the river shoreline from passing ships and may help to encourage the formation of tidal mudflats along this reach of the river. Trees, shrubs, and herbaceous vegetation have begun to colonize the unused piers and unpaved portions of the former industrial site.

Between **Shackamaxon Street and Marlborough Street** are two city-owned active industrial buildings adjacent to Penn Treaty Park. The narrow band of woody vegetation continues along the river shoreline; the vegetation is dominated by invasive trees and shrubs, but contains native elements as well.

Penn Treaty Park is a typical grassy park dominated by manicured lawns with cultivated shade trees and ornamental shrubs along asphalt walking trails leading to the river shoreline. The park

DELAWARE RIVER SHORE

provides an outdoor opportunity for city residents, but offers little in the way of habitat for native plants and animals. The small grove of large shade trees surrounding the statue of William Penn contains several native tree species such as ash, sycamore, and basswood, though others in the grove are non-native. There is no active regeneration of tree seedlings as the area below the canopy is maintained as a lawn. A very narrow strip of mostly herbaceous vegetation grows between the manicured lawn and the jumble of large stone and rubble armor along the shoreline. This narrow strip supports very sparse shoreline vegetation that includes native and non-native species competing for limited resources. A very small packed-sand beach exists at the base of the shoreline armor and is currently devoid of vegetation. Upstream from Penn Treaty Park along the Delaware River is the Delaware Station electrical generation plant (North Beach Street at East Palmer Street), which was constructed to the river's edge with extensive concrete seawall buttressing. There is currently no ecological potential at this section of the river.

Between **Montgomery Avenue and Allegheny Avenue** north of the electrical generating plant is an extensive area of currently undeveloped riverfront totaling over 200 acres. The southern portion of this area includes Riverside Industrial Park, while the northern portion includes the former shipping terminal at Port Richmond. This past industrial and shipping area spans from the Delaware Electrical Station to the Tioga Marine Terminal. Most of this area is currently vacant, though there are piles of coal, sand, gravel, other construction materials and a

few “tank farms” as one approaches Allegheny Avenue. This large post-industrial landscape has been cleared of many of its former structures and rail lines to leave a “blank-slate” landscape. The many abandoned piers and ship berths provide an undulating edge to the river, with narrow coves alternating with tree-covered piers reaching into the river. The piers are popular with fishermen, and both the terrestrial and aquatic components of the river's edge provide habitat for plants and animals. Much of the area has begun to revert to woody shrubs and trees, especially along the river's edge. Large expanses of herbaceous vegetation dominate the interior portions of the site. This area was not ground surveyed due to inability to obtain landowner permission, but it is likely that much of the vegetation is dominated by weedy introduced species with scattered early successional native species characteristic of the region. This large post-industrial area represents one of the best opportunities for ecological restoration along the riverfront due to its size. Future developments should be set back from the river shoreline to accommodate a 100-meter-wide vegetated riparian buffer and public greenway between the river's edge and development activity. In addition to the terrestrial opportunities, the coves have potential for mudflat restoration. Alternatively, the armor-sided piers could be demolished to allow a more natural shoreline to develop along the riverfront, reconnecting the river to a portion of its historic floodplain. Biological surveys of this area are necessary to determine its current plant composition and restoration potential.

Between **Allegheny Avenue and the Betsy Ross Bridge**, the Tioga Marine Terminal dominates the shoreline. Aerial photo interpretation indicates that the river shoreline is shallow in front of the Marine Terminal may support tidal mudflat vegetation. Inland from the Marine Terminal, between Delaware Avenue and I-95, there is another smaller ecological restoration opportunity area. This area currently supports an active sewage disposal plant and scattered tank farms; much of this area contains the crumbling remnants of past industrial activity. A few of the now vacant lots are used as parking lots and scrap yards. The crumbling paved surface is being colonized by early successional trees, shrubs, and herbs.



The mothballed Delaware Electrical Station.

DELAWARE RIVER SHORE

Between **Castor Avenue and Lewis Street** is a sewage treatment plant that includes over 50 acres of outflow treatment wetlands. These wetlands provide valuable habitat for migrating and resident waterfowl and may support a wetland plant composition typical of coastal plain and tidal habitats. No ground surveys of these wetlands were conducted due to inability to obtain necessary permission. These wetlands could become part of an effort to restore the historic tidal marshes that formerly existed at the confluence of Frankford Creek and the Delaware River. Biological surveys of these wetlands are needed to assess their ecological quality and restoration need/potential.

The banks of the tidally influenced Frankford Creek retain a 100- to 300-foot vegetated riparian buffer along both of its banks from I-95 downstream to the mouth of the creek. The riparian buffer along the creek is hemmed in by a rail line on the west and the Betsy Ross Bridge ramp on the east. While this portion of the creek has been channelized and manually rerouted from its original course, the creek retains a natural character. Portions of this creek side buffer are currently used as a scrap yard, which should be moved to a location where scrap yard activity would be less likely to impact the water quality of the local waterway. Restoration efforts could focus on improving the quality of the riparian buffer vegetation and reestablishing the former tidal marsh system that historically occurred at the confluence of Frankford Creek and the Delaware River.

Betsy Ross Bridge to Tacony-Palmyra Bridge

The mostly undeveloped Delaware River shoreline between the Betsy Ross Bridge and the Tacony-Palmyra Bridge provides an excellent opportunity to recreate a continuous greenway corridor along this stretch of the river. While industry and shipping dominated the shoreline in the past, those activities no longer occur along much of the waterfront, in most cases leaving only crumbling paved footprints as outlines of past activity. Almost the entire riverfront to within approximately 100 meters of the river's edge between the Betsy Ross Bridge and the Tacony-Palmyra Bridge is currently undeveloped and holds good potential for riparian corridor restoration along the Delaware River. Future developments should be set back from the river shoreline to allow for a 100-meter vegetated buffer between the river's edge and development activity. This strip of land lends itself to the reestablishment of a ribbon of native vegetation that will help provide habitat for native plants and animals while filtering and trapping runoff from the city before it enters the river. In addition, the linear corridor can function as a portion of a public greenway along the length of the Delaware riverfront. The shoreline habitat can be improved by removing the armored bulkheads and reconnecting the river to a portion of its natural floodplain. Replant the riparian area in native trees and shrubs to enhance its ecological value. An ongoing eradication and control effort will be necessary to prevent invasive species of plants from dominating the shoreline habitats.

Industry remains active between **Hedley and Orthodox Streets** to the river shore, though the potential for a greenway connection still exists. Much of the current industrial activity is set back at least 200 feet from the river's edge and could accommodate a habitat corridor and greenway connection.

Between **Orthodox and Buckius Streets** is a 70+ acre privately owned parcel of vacant land that extends from Richmond Street to the riverfront. This area bears a few footprints of previous structures, but for the most part is reverting to herbaceous and woody vegetation and appears from the air to already have begun to resemble a park. The vegetation is likely dominated by weedy introduced plants and early successional native species. A ground survey of this area was not



The remnants of the Tioga Marine Terminal

DELAWARE RIVER SHORE



photo source: PNHP

Parcel between Orthodox and Buckius Streets

conducted due to inability to obtain the necessary permission. The riverfront at this location contains a mix of rubble-armored seawall, dilapidated piers, and a few more natural looking habitats including a narrow sandy/gravel beach and a small but well-developed tidal marsh. The beach occurs along the river where the shoreline lacks armoring adjacent to two older piers. The tidal marsh occurs between one of the older piers and a small private boat launch. This mudflat habitat appears to contain common emergent aquatic vegetation like yellow pond-lily and pickerel-weed, but may also support less common tidal mudflat vegetation. Biological surveys of this area are recommended to determine its current ecological value and restoration potential. Future development should be excluded from the 100-year floodplain and set back from the river's edge at least 100 meters to provide a corridor of native terrestrial vegetation and public access as a continuation of a Delaware River greenway through the area. In addition, the small tidal marsh could be enhanced by removing obstructions to flooding in

this low lying area, increasing the potential for tidal marsh development.

Almost the entire riverfront in Bridesburg Borough between **Orthodox Street and the original mouth of the Frankford Creek** is currently undeveloped and holds good potential for riparian corridor restoration along both the Delaware River and Frankford Creek. Most of the riverfront to within approximately 100 meters of the river's edge is currently bare ground. Historically, a tidal marsh occurred where Frankford Creek enters the Delaware River. A good example of this habitat still occurs directly across the river in New Jersey where the Pennsauken Creek meets the Delaware River. The area of vacant land adjacent to the old mouth of Frankford Creek could support a partial restoration of this tidal marsh habitat.

Upstream of the original mouth of Frankford Creek is the Tacony Boat Launch, which is maintained by the Pennsylvania Fish and Boat Commission. The immediate shoreline is dominated by a narrow parking lot in front of a concrete seawall at the riverbank, which is interrupted by two small public boat ramps. A larger public parking area extends away from the river and occupies roughly five acres of potential open space along the river. Between the old mouth of Frankford Creek and this large parking area is an undeveloped area of about 12 acres. There is currently little activity on this undeveloped patch of ground; it has begun to revert to trees, shrubs, and other vegetation, and is beginning to function as a riparian buffer and green open space. The paved boat launch parking area along the riverfront provides no buffer from rainwater runoff and effectively funnels heated and contaminated city street runoff directly into the river. Since a large parking area already exists near the river, these shoreline parking areas should be removed and planted in native vegetation. Removal and conversion of the parking areas along the riverfront could provide for a 100-meter-wide vegetated riparian buffer between the old mouth of Frankford Creek and Sanger Street, a distance of about a quarter mile.

Between **Sanger Street and Comly Street** there currently exists an approximately three-acre vegetated parcel from the river's edge to the powerline right-of-way. This small stretch of riverfront lacks the shoreline bulkhead armor typical

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of most of the river in this section. It instead has a small beach or tidal mudflat and an adjacent forested floodplain. This vegetated area should be maintained as open green space at least to the powerline right-of-way. As future development activities progress along the river's edge and replace existing buildings, the river greenway should be widened to a minimum of 100 meters from the river's edge.

Between **Comly Street and Devereaux Street** there is little undeveloped shoreline. The riverfront appears to have a narrow beach-like shoreline in front of armored bulkheads, but industrial and commercial buildings currently crowd the river's edge, leaving only a very narrow strip undeveloped between the riverbank and the industrial buildings. The river is shallow where the buried Wissinoming Creek enters the Delaware River, exposing a tidal mudflat remnant habitat extending in front of a small private marina.

Between **Devereaux Street and the Tacony-Palmyra Bridge** are two large open spaces. One is a cemetery; the other is owned by the city and is tentatively to be developed as a city park known as Lardner's Point. The riverfront along this section is mostly bulkheaded or rubble armored, with some shallow water / mudflat habitats with aquatic vegetation between the bulkhead and the river at low tide. The wide vegetated parcels are dominated by early successional weedy native and non-native species of plants in upland meadow and shrubland habitats. An electric powerline parallels the river along a former railroad bed and should be considered the minimum setback for future development activities along the riverfront.

Tacony-Palmyra Bridge to Bucks County Line

Between the Tacony-Palmyra Bridge and the Bucks County line, there currently exist ample opportunities to provide a continuous riparian corridor along this entire stretch of the Delaware River shoreline. Most portions of the shoreline are currently undeveloped; any plans for future development should include a wide riparian corridor dominated by native vegetation along the river's edge to provide natural habitat for plants and animals as well as open space for public access to the river. Such a public amenity would greatly

improve the quality of life for all residents and visitors to the city.

Between **the Tacony-Palmyra Bridge and Magee Avenue** is an undeveloped parcel of land encompassing roughly 23 acres. This parcel contains the crumbling foundations of past industrial activity and is currently being colonized by trees and shrubs. The river shoreline appears to lack the heavy bulkheads of other sections of the riverbank, giving an impression of a natural shoreline.

For the next several blocks of riverfront between Magee Avenue and Disston Street, industrial buildings, including an auto salvage yard, crowd the shoreline, leaving a very narrow strip of vegetation between industrial activity and the river's bulkheaded shoreline.

Between **Disston Street and Princeton Avenue** are the remnants of past industrial activity on roughly 25 acres. Concrete pads and the impressions of building foundations remain at the recently cleared site. The Tacony Boat Launch, maintained by the Pennsylvania Fish and Boat Commission, fronts a portion of the shoreline to allow public access to the river. At the northern edge of the public boat launch, the buried remnant of Spewters Run drains into the Delaware River and forms a small mudflat delta extending upstream to the private marina. The public launch area is dominated by a paved parking area, a concrete boat ramp, and mowed lawn. Although public access for boaters is desirable, the large parking area crowds the shoreline, eliminating



The upland meadow at Lardner's Point.

photo source: PNHP

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the possibility of natural habitat along the riverbank. The parking area for the boat ramp should be moved outside of the recommended 100-meter riparian buffer zone, which at this site coincides with the FEMA 100-year floodplain. The existing bulkheads should be removed and the shoreline reshaped to more closely resemble the natural river shoreline.

The St. Vincent's Orphanage occupies most of the area between **Princeton Avenue and Cottman Avenue** east of Milnor Street. Most of the property is composed of open lawn with a few scattered shade trees. A narrow strip of trees line the river shoreline. A portion of the river shoreline is occupied by the Quaker City Yacht Club marina. The marina is flanked on both sides by tidal mudflat habitats, the northern one fairly large and supporting an extensive bed of aquatic vegetation that appears to be dominated by yellow pond-lily (*Nuphar lutea*). This mudflat habitat occurs in a shoreline indentation created by the extended reach of the marina and the adjacent shoreline. These shoreline features likely offer the tidal mudflat some protection from the erosive action of wakes of passing ships. Future survey efforts of the area should focus on this habitat for tidal mudflat species of concern. Preservation of the hydrologic conditions would help to support this tidal mudflat habitat. Most of the private marina property is within the 100-year floodplain along this section of the river, while most of the buildings of the St. Vincent's Orphanage are outside of the floodplain. The current land cover on the orphanage property is suitable for the continuation of a public greenway along the river. However, additional restoration plantings of trees and shrubs within 100-meters of the shoreline would help provide habitat for native plants and animals.

Between **Cottman Avenue and Rhawn Street** are nearly 100 acres of currently undeveloped riverfront that bear the imprints of past industrial and shipping activity. The shoreline here is armored with bulkheads, elevated shipping piers, and berths. Future development plans should provide for a 100-meter setback from the river's edge to accommodate a riverfront greenway. In addition, removal of the bulkheads and easing of the shoreline will help to restore more natural conditions along the riverbank, including the potential restoration of intermittent tidal marsh habitats. The areas between piers are beginning to exhibit tidal mudflat characteristics. These bits of habitat could be enhanced by



photo source: PNHP

The Delaware River shoreline at the Tacony-Palmyra Bridge reestablishing appropriate aquatic vegetation such as eelgrass (*Vallisneria americana*), yellow pond lily (*Nuphar lutea*), and pickerel-weed (*Pontederia cordata*). Reestablishment of native trees and shrubs along the riparian greenway will be needed.

Most of the riverfront between **Rhawn Street and Pennypack Street** is part of Pennypack Park. Much of the park is composed of lawn and dedicated to athletic fields, but the park also provides a variety of natural and restored habitats along this stretch of the riverfront. Of primary importance are the freshwater tidal marsh habitats. A freshwater tidal habitat area at the end of Rhawn Street includes a wide, shallow-water mudflat dominated by yellow water-lily and pickerel-weed that flanks both sides of an elevated concrete pier. Populations of two plant species of concern, salt-marsh water-hemp (*Amaranthus cannabinus*) and annual wild rice (*Zizania aquatica*), were documented within this freshwater tidal marsh habitat. The limited protection offered by the pier likely helps to insulate the mudflat habitat from the erosive action of the wakes of passing ships. Many of the park improvements complement the potential for habitat restoration along this section of the river. The park infrastructure, parking lots, and buildings are situated well away from the river shoreline. Many of the former bulkheads from this area have been removed and the shoreline softened to more closely resemble natural conditions along the riverbank. Shade trees have been planted within the 100-meter-wide riparian area along the river's edge; these plantings help provide a minimum of habitat

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along this portion of the greenway. The habitat value along the riverfront can be improved by creating occasional breaks in the riverbank to allow intermittent flooding that will encourage the establishment of freshwater tidal marsh habitat. The riverfront park is increasingly less cultivated as it nears the mouth of Pennypack Creek. This restoration project is described within the “Pennypack on the Delaware Park Wetland Mitigation Site” section of the Fairmont Park System site description.

Between the mouth of **Pennypack Creek and Arendell Avenue**, the riverfront is dominated by the Philadelphia Police and Fire Academy, the Baxter Water Treatment Plant, and Pleasant Hill Park. At the river’s edge adjacent to the Police and Fire Academy facilities is a roughly 25-acre, flat, undeveloped parcel that appears to have been elevated above the floodplain by past fill activity. A narrow strip of trees separates this open elevated area from an extensive tidal mudflat that has

developed at the mouth of Pennypack Creek and extends upriver for about 600 meters. The portion of the riverbank occupied by the water treatment plant has approximately 70 acres of covered reservoirs and a large settling pond separated from the river by a narrow dike. The tidal mudflat supports beds of aquatic vegetation that appear to be dominated by yellow pond-lily and pickerel-weed. This habitat should be the focus of future field surveys for freshwater tidal marsh species such as annual wild rice and salt marsh water-hemp, which occur in similar habitats nearby. Creating intermittent breaks in the elevated riverbank to allow periodic flooding of upland greenspace will encourage tidal marsh formation and enhance the wildlife value of this area.

Pleasant Hill Park contains several small ponds ringed by a mixture of native and introduced vegetation with scattered trees and shrubs. Sweet gum trees (*Liquidambar styraciflua*) occur frequently here with both mature and sapling trees present, indicating that they are reproducing naturally. This species is a common component of the coastal plain flora and is an appropriate selection for restoration plantings along the riverfront. The park infrastructure, especially the parking area, crowds the riverfront. While the boat launch by necessity needs to be at the river’s edge, additional impervious surfaces such as parking lots should be located outside of the 100-meter riparian buffer, with the buffer area restored to more natural habitats.

A narrow portion of Pleasant Hill Park extends between Linden Avenue and Arendell Avenue and includes a thin strip of grass and trees between Delaware Avenue and the seawall along the river. The adjacent pier and boat launch formerly hosted the Columbia Yacht Club marina. A shallow-water mud and gravel bar exists at the base of the seawall and currently supports sparse aquatic vegetation. This area was one of our greatest disappointments of this season’s fieldwork. Surveys in the 1980s found a large, functional, and extensive freshwater tidal marsh at this site. We visited this site twice over the 2007 field season and found no indication of any remnant marsh species, including the four species of concern formerly found here: annual wild rice (*Zizania aquatica*), subulate arrowhead (*Sagittaria subulata*), salt-marsh water-hemp (*Amaranthus cannabinus*), and swamp beggar-tick (*Bidens bidentoides*). The only wetland plant we found at



Columbia Yacht Club site with inset American eel yellow eel.

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photo source: PNHP

Salt-marsh water-hemp at Pennypack on the Delaware

the site is spatterdock (*Nuphar lutea*), a very resilient species. We have no direct indication as to the cause of the collapse of this system, but several possible scenarios exist: the presence of large flocks of resident, non-migratory Canada Geese may have grazed the marsh out of existence; erosive wakes from either the nearby boat ramp or large ocean-going freighters may have eroded the site; or natural events, such as severe flooding or winter ice-scour, could have destroyed the site. Regardless of the cause, the site has been severely altered in some manner and this warrants further investigation. One positive sign was a substantial population of elvers and yellow eels (immature American Eels) under the rocks at the site. Their presence indicates that the site is still playing an important ecological role even if it is not as significant as it once was. This site would make an excellent restoration project if the cause of the system's collapse can be determined and the necessary measures to prevent a second collapse can be undertaken.

From **Arendell Avenue north to the Philadelphia/Bucks County line** at Poquessing Creek the riverfront is bordered primarily by

residential development. There is currently a high degree of open space associated with each residence or cluster of residences. Large scattered shade trees and lawns flank the elevated seawall, with most of the residences set back 100-300 feet from the river's edge. This current land use can support an important component of the riverfront greenway along most of this section of the Delaware. Additional plantings of native trees and shrubs would help enhance the ecological value of this section of the riverfront. Future development plans for the area should include provisions for a 100-meter riparian buffer along the river's shoreline.

A substantial tidal mudflat has developed where Poquessing Creek enters the Delaware River and along the steep banks of Poquessing Creek at the Glen Ford (Glen Foerd) Mansion property. Most of the mudflat shoal currently lacks aquatic vegetation except at the banks of Poquessing Creek at Glen Ford, where the mudflat is dominated by pickerelweed and yellow water-lily. This mudflat habitat also supports two tidal marsh plant species of concern: salt-marsh water-hemp and subulate arrowhead. These populations were found in the tidally flooded zone of the creek in muddy substrate. They should persist as long as the current hydrologic conditions continue to encourage tidal mudflat development. The erosive action of boat wakes may have a consequential impact on this fragile habitat. The current land use at the Glen Ford Mansion property provides adequate habitat and riparian buffer for both the Poquessing Creek and the Delaware River shoreline.



photo source: PNHP

Subulate arrowhead (*Sagittaria subulata*) at the mouth of Poquessing Creek..

GENERAL CONSERVATION RECOMMENDATIONS AND CONCLUSION

Through the work required to complete this Natural Heritage Inventory (NHI), ecologists, botanists, and zoologists have explored many of the natural areas of Philadelphia County. Although many field hours were spent surveying the natural areas of the city, this work should not be considered a comprehensive inventory of *all* its biological resources. Additional explorations of the area will very likely yield additional populations of the species of concern listed in the report, as well species previously unknown to the county.

This work represents a continuation of a long history of efforts to inventory the biodiversity present within

the county. Some of the earliest survey work in this area was completed by botanists and other naturalists during the late 18th century. These early explorers documented many species in the area that are no longer present within the city.

How does Philadelphia County contribute to the known biodiversity in Pennsylvania?

Philadelphia has 316 records of species that are tracked within the Commonwealth, but only 76 of those records have been documented as still present within the county. A majority of these species are found within Tinicum Marsh and the tidal reach of

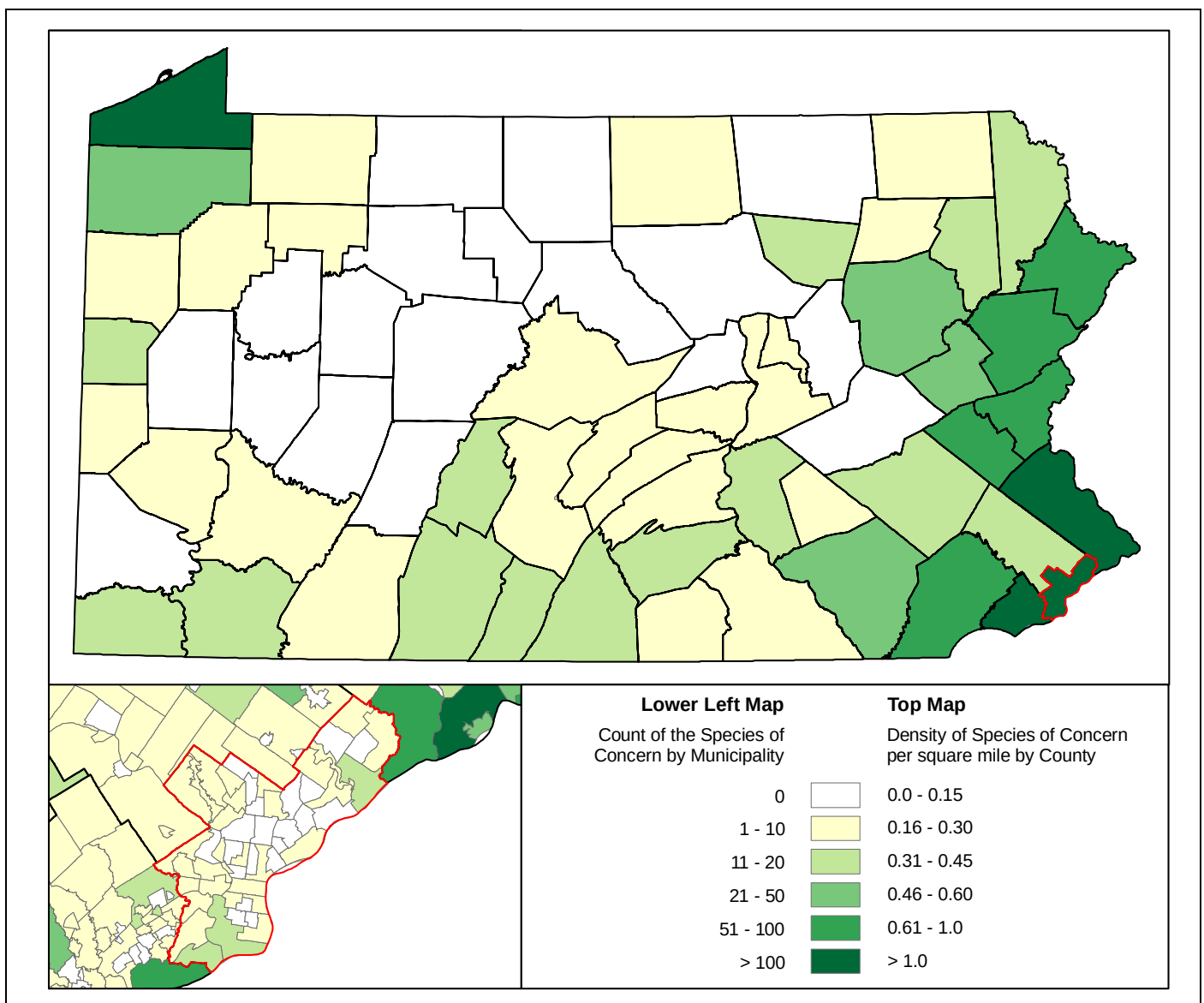


Figure 10: Distribution of rare, threatened, and endangered species by municipality, with darker colors indicating more occurrences of these species. Philadelphia neighborhoods are delineated in the lower left map to approximate local municipality boundaries. (PNHP Data 2008).

the Schuylkill and Delaware Rivers. Municipal breakdowns of this data are presented in Figure 10 (pg. 142).

Although Philadelphia County has one of the most developed waterfronts in the state, it contains a number of species that are confined to the tidal reaches of the Delaware River. Many of these species, such as subulate arrowhead (*Sagittaria subulata*) and multiflowered mud-plantain (*Heteranthera multiflora*), are only found in tidal mudflats.

A breakdown of the rare, threatened, and endangered species found in Philadelphia by their official state legal status is presented in Table 9. Additionally, one species in the county is currently protected through the US Endangered Species Act.

Land Use Planning in Philadelphia

Plan for biodiversity and ecological health

Providing for the future health of ecological resources in Philadelphia will require action on many fronts. Special consideration should be given to steward specific sites that host unique species and communities. Broad-scale planning efforts should endeavor to create contiguity of natural habitats through the preservation of existing open space and the creation of new greenspace. Restoration efforts to alleviate water pollution and restore ecological function to damaged landscapes and waterways should be undertaken, with special attention given to riparian and tidal habitat restoration.

One problem needing special attention within Philadelphia is the prevalence of non-native invasive species. Without active, coordinated, and targeted removal of these species followed by restoration and maintenance of native species, the existing natural areas within the city will continue to deteriorate. While daunting, this process can be achieved by the encouragement and mobilization of private citizens and public groups. Facilitating “weed warriors” groups within the city, such as the volunteer coordination program run by the Fairmount Park Commission, and providing for the replanting of native species in maintained areas will move the city toward the goal of preserving the biological health of the landscape.

Table 9. State status of species of special concern in Philadelphia County.

State Status	# of individual occurrences
PA Endangered (PE)	50
PA Threatened (PT)	4
PA Rare (PR)	18
Candidate Species (CP/CR/CA/WATCH)	13
Tentatively Undetermined (TU/UTF)	8
Undetermined Legal Status (N)	13

Refer to Appendix III (pg. 166) for a description of the state status.

Wetland/Aquatic Communities

Philadelphia’s aquatic systems have undergone substantial modification over the past 300 years. Once supporting extensive lowland and floodplain forests and 10 to 20 square miles of tidal marsh, today many of the rivers are confined by armored banks and less than one-third square mile of tidal marsh remains within the city proper. To restore water quality within the city these issues need to be addressed through large-scale planning initiatives. This can occur through reconnecting the 100-year floodplain to rivers and creeks throughout the city, actively restoring the tidal marsh on the Delaware and Schuylkill Rivers, and initiating a concerted effort to reduce combined sewage outflows and stormwater discharges throughout these watersheds.

Stewardship or restoration of native forest communities in and beyond riparian buffers along waterways will greatly improve water quality and enhance the habitat value for various aquatic and semi-aquatic species. Restoring the basic ecological functions of streams and wetlands will increase human welfare by ensuring the continued availability of quality water for human communities, enabling the restoration of healthy fisheries, and enhancing the quality of life for city residents.

One suggested project to meet these goals would be establishing a public greenway along the Delaware and Schuylkill Rivers that incorporates reconnection of the rivers to their floodplain and reestablishment of tidal marsh as components. This would create a green corridor along the city’s shore in a flood-prone area and act as a connector between the existing parks along the Pennypack, Wissahickon, and Frankford Creeks, with potential connection to Poquessing Creek and eventually Neshaminy State Park.

Forest Communities

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

In areas where these connections have been severed, reforestation can help to restore contiguous, usable habitat. In conjunction with the reforestation of riparian areas within Philadelphia through projects such as Treevitalize, reconnection of upland forests can be achieved. Projects to replant native trees along streets lacking tree cover and in areas of under- and unutilized land can quickly increase tree cover within Philadelphia. These planting projects provide not only the benefit of reducing the urban “heat island” effect, but act as stepping stones of natural habitat through the urban environment.

Evaluate proposed activity within and adjacent to sites

A very important part of encouraging conservation of the sites identified within the Philadelphia Natural Heritage Inventory is the careful review of proposed land use changes or development activities that overlap with or abut greenspace and open space. Such review is especially important when examining the large areas of open land along the Schuylkill and Delaware Rivers. These flood-prone areas are effectively within the river during times of flooding and should be considered unfit for major building projects. Conversion of these areas, especially the portions within the 100-year floodplain, to greenspace should be a priority as the redevelopment of Philadelphia’s waterfront is undertaken. The following overview should provide guidance in the review of these projects or activities.

- Always contact the Philadelphia City Planning Commission.

The City Planning Commission should be aware of all activities that may occur within greenspace and

open space in the city so that they can interact with the other necessary organizations or agencies to better understand the implications of proposed activities. The commission can also provide guidance to the landowners, developers, or project managers as to possible conflicts and courses of action.

- Conduct free online preliminary environmental reviews.

Applicants for building permits should conduct free online environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the 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.

Depending upon the resources contained within the Natural Heritage Area, the agencies/entities responsible for the resource will then be contacted. The points of contact and contact arrangements are determined on a case-by-case basis by the city and the Department of Environmental Protection. In general, the responsibility for reviewing natural resources is partitioned among agencies in the following manner:

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

PNHP and agency biologists can provide more detailed information with regard to the location of natural resources of concern in a project area when this information is available for public distribution, the needs of the particular resources in question, and the potential impacts of the project on those resources.

- Plan ahead.

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

- Work to minimize environmental degradation.

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

Submit Additional Data

As the state repository for biodiversity data, the Pennsylvania Natural Heritage Program (PNHP) appreciates all potential data regarding rare, threatened, and endangered species. Species we currently track are listed on our website at: <http://www.naturalheritage.state.pa.us/>

A form is presented in Appendix I (pg. 162) for the public to submit their sightings of rare species to PNHP.

The data presented in this report represent a snapshot of the species and ecological conditions present in the county. Natural systems are constantly changing due to variations in climate as well as impacts from human disturbance. Lack of access to some sites of interest prevented surveys that may have yielded additional information about the natural resources in the county. Therefore, this report focuses on the current conditions of the county. We hope that this report can be used as a working document and serve as a guide for conservation of known species of concern and the habitats and open space of importance, while also functioning as a guide to

identify important natural resources previously undocumented in the county.

PNHP can provide the county with formal updates to the data within this report at regular intervals (typically five years). Additionally, we can provide a series of additional biodiversity and conservation planning services to supplement the results of this inventory. Please contact PNHP for additional information regarding these services.

A Final Note on Species of Concern

The rare and endangered species highlighted in this report are some of the several hundred species in Pennsylvania that are threatened with extirpation or extinction. There are many strong reasons for protecting a species from extinction. The first is that if a species is allowed to go extinct, its ecosystem will have lost a significant element. The second is that endangered species may be indicative of fragile ecosystems that may have become degraded; protection of these species may help maintain the quality of the ecosystem. Additionally, degraded ecosystems may be indicators of negative influences on the system that could directly affect humans too (e.g., the pesticide DDT).

Another reason for protecting rare species is for their value as unique genetic resources, with immeasurable scientific and potential economic importance. Every species has the potential to provide significant information for future use in genetic research and medical practices.

Beyond these practical considerations, perhaps the most compelling reasons for stewardship are the aesthetic and ethical consideration; there is beauty and recreational value inherent in healthy, species-rich ecosystems.

The protection of rare and endangered species depends on several factors, including increasing scientific knowledge and concerted efforts by government agencies, private organizations, and individuals, as well as promoting awareness of the species through public education. The following section outlines general recommendations that are beginning steps to protect the species outlined in this report.

One of the main roles of this document is to integrate conservation information into the planning process.

This document, by showing the sites in the county with the most biological value, endeavors to alert planners, the public, and politicians to the steps necessary to secure the city's green future.

Existing protected sites help form the green backbone of the area. Currently unprotected sites within the county, once protected, will help secure the connections between existing open space to create a truly integrated and accessible system capable of providing recreation, economic opportunity, and ecological value concurrently.

General Recommendations

The following are general recommendations for protection of sites within a county adapted for the level of urbanization within Philadelphia.

Approaches to protecting a site are wide ranging, and factors such as land ownership, time constraints, and available tools and resources 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 and tools for natural areas 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 easement holder and will not be extinguished with new ownership. Tax incentives may apply to easements donated for conservation purposes.

Lease and management agreements also allow the landowner to retain ownership and temporarily ensure protection of land. There are no tax incentives for these conservation methods. A lease to a land trust or government agency can protect land temporarily and ensure that its conservation values will be maintained. This can be a first step to help a landowner decide if they want to pursue more permanent protection

methods. Management agreements require landowner and lessee to work together to develop a plan for managing resources such as plant or animal habitat.

Land acquisition by a conservation organization can be at fair market value, as a bargain sale in which a sale is negotiated for a purchase price below fair market value, or through donation with tax benefits that reduce or eliminate the disparity. Sites that can serve more than one purpose such as wildlife habitat, flood and sediment control, water supply, recreation, and environmental education are ideal.

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 measure 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.

Local zoning ordinances are among 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 floodplain management, and zoning to protect stream corridors and other drainage areas using buffer zones.

2. *Orient management and restoration plans to address species of special concern and natural communities as targets of conservation (not simply open or multi-use space) through the active maintenance of existing high-quality natural area and restoration of more degraded spaces.*

Many of the already protected sites (primarily within the city's park system) are in need of additional management to ensure the continued existence of the associated natural elements. Incorporating site-specific recommendations into existing management plans and preparing new plans for newly recognized resources will help protect the biological value of

sites. 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; and limiting recreational land use practices in areas. For example, some species simply require continued availability of a natural community to survive, while others need active management of the environment such as canopy thinning, mowing, or burning to maintain their required habitat.

Existing parks and conservation lands provide important habitat for plants and animals at both the county level and on a regional scale. For example, John Heinz National Wildlife Refuge serves as a nesting and wintering area for birds and as a stopover area during migration. 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 such as mowing grass to the edge of a natural area.

3. *Protect bodies of water with adequate natural buffers.*

Protection of waterways and wetlands 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, and locally significant habitats occur in wetlands and water bodies and are directly dependent on natural hydrological patterns and water quality for their continued existence. This is especially true in Philadelphia with the many tidal-wetland-dependent species found in the area.

Aquatic 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 a primary 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 natural areas.*

Development plans should provide for natural buffers between disturbances and sites identified in the Philadelphia Natural Heritage Inventory. Disturbances may include construction of new roads, road-improvement projects, utility corridor expansion, and fragmentation of the few existing large pieces of undeveloped land. Stormwater runoff from such activities results in the transport of nutrients and sediments into aquatic ecosystems while also causing alteration to the flow regime (Trombulak and Frissell 2000). County officials should encourage landowners to maintain vegetated buffers within riparian zones. Vegetated buffers (preferably of plant species native to Pennsylvania) help reduce erosion and sedimentation and provide shade that cools 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 the PNHP or natural resources agencies can provide further guidance regarding buffer considerations appropriate for various kinds of natural resources within Philadelphia.

5. *Increase the connectivity of the city's green space with surrounding landscapes through open space conservation.*

Encourage redevelopment in sites that already have existing infrastructure on them and not on sites currently functioning as greenspace or open space. The redevelopment of underdeveloped areas for residential, commercial, and industrial projects presents one way to encourage economic regrowth while allowing ecologically valuable areas to remain undisturbed. By compressing redevelopment into underdeveloped areas with existing infrastructure (roads, power, sewer, etc...), large pieces of open space can remain intact without impeding needed economic redevelopment. Additionally, networks of greenspace should be preserved or created to link existing greenspace into an interconnected and easily accessible network.

Care should be taken to ensure that protected natural areas do not become "islands" surrounded by development. In these situations, the isolation of the site reduces its value for wildlife. Careful planning can maintain natural environments and the plants and animals associated with them. A balance between redevelopment and the conservation of natural and scenic resources can be achieved by guiding

development away from the existing and potential open space.

6. *Encourage and utilize existing grassroots organizations interested in preserving and restoring the city's natural areas.*

City agencies 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 and neighborhood level. When activities threaten to impact ecologically important features and open space, the responsible agency should be contacted. If the needed governmental resources do not exist, private groups such as conservancies, land trusts, and watershed associations should be sought for ecological consultation and specific protection recommendations.

7. *Manage for control of known invasive species and early detection of new invasive species in key natural area.*

Invasive species threaten native diversity by dominating habitat used by native species and disrupting the integrity of the ecosystems they occupy. Management of invasive species depends upon the extent of establishment of the species. Because of the length of time since settlement, the amazing cultural diversity within Philadelphia, and its place as a center of trade it also hosts an unfortunate degree of colonization by non-native invasive species. Small infestations may be easily controlled or eliminated, but more well established populations might present difficult management challenges. Below is a list of sources for invasive species information.

- The Mid-Atlantic Exotic Plant Pest Council (MA-EPPC) is a non-profit organization (501(c)3) 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>
- 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 on the importance of ecological health in urban environments.*

If community members are not aware of the benefits they derive from local greenspace and natural areas, it is unlikely they will support its continued existence. An understanding of the value of urban ecological health will help motivate community involvement in the protection and enhancement of local environmental resources. Local environmental education programs are essential for fostering and maintaining this understanding and should be promoted and sustained over the long-term.

9. *Incorporate Natural Heritage Inventory information into city 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. Information in Natural Heritage Inventories can be readily included in comprehensive

plans, greenway and open space plans, parks and recreation plans, and regional planning initiatives. DCNR-funded greenway and open space plans, Heritage Region plans, and River Conservation Plans are good examples of planning efforts that reach beyond county boundaries and that can facilitate the preservation of greenspace and open space within the county.

Conclusion

Philadelphia's natural landscape is fragmented and degraded by three centuries of urban development, but maintains aspects of the original pre-settlement habitats. As the City of Philadelphia moves forward with urban infill plans and redevelopment of abandoned industrial areas, greenspace and natural areas must be a serious consideration. Significant and substantial opportunities exist for the fortification of rare species populations, the restoration of native habitat, and the reconnection of isolated patches of existing native habitat to form contiguous corridors of greenspace throughout the city. These greenspaces can help expand the already impressive Fairmount Park System into areas underserved by these amenities to help make Philadelphia a more attractive and ecologically sustainable place to live and work.

However, these opportunities are transient at best and if they are not utilized now the vision of William Penn for his City of Philadelphia will fade further into the past. Through the improvement of existing habitat and restoration of degraded areas, Philadelphia can contribute to the larger ecological picture of southeastern Pennsylvania and by doing so inspire an appreciation of the natural world in more of its residents as Penn intended.

GLOSSARY

Abandoned Mine Drainage (AMD) – drainage flowing from or caused by surface mining, deep mining, or coal refuse piles that are typically highly acidic or basic with elevated levels of dissolved metals (DEP).

Acidophilic – a plant that requires or prefers acidic soil conditions.

Alluvium – material such as sand, silt, or clay that is deposited on land by streams.

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

Anadromous – fish that live in saltwater, but migrate to freshwater habitats to reproduce.

Anthropogenic – human caused.

ATV – all-terrain vehicle.

Base flow – the portion of water in a creek, stream, or river resulting from groundwater inputs and not surface runoff.

Bedrock – the solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Bt (*Bacillus thuringiensis*) – an insecticide produced by the fermentation of a bacterium (Bt), used to control many caterpillar-type pests (e.g., gypsy moth).

Calcareous – composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.

Canopy – the layer formed by the tallest vegetation.

Carrying capacity – the number of individuals from a single species that a given area of land can naturally sustain for an indefinite time period.

Catadromous – fish that live in freshwater, but migrate to saltwater habitat to reproduce.

Circumneutral – pH between 5.5 and 7.

Co-dominant – where several species together comprise the dominant layer (see "dominant" below).

Community – an assemblage of plant or animal populations sharing a common environment and interacting with each other and the physical environment.

Core Habitat – areas intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance without substantial impact to the natural features.

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

DCNR – Pennsylvania Department of Conservation and Natural Resources.

Deciduous – refers to woody plants that lose their leaves seasonally.

DEP – Pennsylvania Department of Environmental Protection.

Dimilin – a commercially produced, restricted-use insecticide containing diflubenzuron as the active ingredient. Diflubenzuron, which has been used as a method to control gypsy moth, interferes with chitin production during the early stages of certain insects (DCNR, Division of Pest Management).

Dominant – the species (usually plant) exerting the greatest influence on a given community either by numerical dominance or influence on microclimate, soils and other species.

Ecosystem – an ecological community together with its environment, functioning as a unit.

Element – all-inclusive term for species of special concern and exemplary natural communities.

EPT richness – the total number of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) orders in a given sample.

Exceptional Value Waters (EV) – DEP designation for a stream or watershed which constitutes an outstanding national, state, regional or local resource, such as waters of national, state or county parks or forests; or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuges or State Game Lands, and other waters of substantial recreational or ecological significance. For more detailed information about EV stream designations, the reader is referred to the Special Protection Waters Implementation Handbook (Shertzer 1992).

Exotic – non-native; used to describe plant or animal species that were introduced by humans; examples include Japanese honeysuckle, purple loosestrife and grass carp; exotics present a problem because they may out-compete native species.

Extant – currently in existence.

Extirpation – removal of a species from part of its natural range; also referred to as “localized extinction”.

Fen – open-canopy peatland that has developed under the influence of basic-rich waters.

Floodplain – low-lying land generally along streams or rivers that receives periodic flooding.

Forb – non-grass herbaceous plant such as goldenrod.

Georectification – the process of adding coordinates (such as latitude and longitude) to a map to define its location in space.

Graminoid – grass or grass-like plant such as a sedge or a rush.

Gray infrastructure –the built areas (buildings, roads, parking lots, etc.) that may contribute to run-off and the heat island effect.

Green infrastructure – the undeveloped areas (forest, grass, streams, wetlands, etc.) that help mitigate and reduce run-off and the heat island effect while providing habitat.

Ground cover – low shrubs, herbs, and mosses that are found at or close to the ground surface.

Heat island –

Herptile – a reptile or amphibian.

Herpetofauna – the group of reptiles and amphibians found in a particular region.

Hibernacula – a location where animals hibernate.

Hibernation – the period of winter inactivity during which time normal physiological processes are reduced and a significant decrease in body temperature occurs. In Pennsylvania, true hibernation is shown by woodchucks, jumping mice, and bats.

High-Quality Coldwater Fisheries (HQ-CWF) – DEP designation (PA Code, Chapter 93) for a stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.

Hydrology – water system of an area including both surface water and ground water.

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

Invasive species – plants or animals that tend to spread and alter the overall makeup and character of sites. These invasions are either due to the introduction of an exotic species, or due to natural succession. The introduction of invasive species can often cause the breakdown of the natural community.

Lepidoptera – moths and butterflies.

Listed species – species that is monitored and considered to be of concern by PNHP.

Littoral – the area where water meets land, the shoreline.

Lacustrine – any species living in or process involving lakes.

Matrix – the form of land use or habitat that surrounds a focal patch of habitat.

Mesic – moist, not saturated.

Minerotrophic – groundwater fed; influenced by water that has been in contact with bedrock or soil, and is richer in mineral content than rainwater.

Native – describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities.

Natural Heritage Site – as used in this study, a site with either an exemplary natural community or species of special concern; not to be confused with the State Forest Natural Areas which are specific management units designated by DCNR Bureau of Forestry.

Neo-tropical – referring to the tropical locations in the new world; Mexico, Caribbean Islands, and Central and parts of Northern South America.

Non-point – refers to diffuse sources of pollution such as stormwater runoff contaminated with oil or pesticides.

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

Odonate – dragonflies or damselflies.

Oligotrophic – poor to extremely poor in nutrients; typically describes dilute waters with low base metal ion concentrations.

Palustrine – describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominately hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.

Peat – partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable.

PNHP – the Pennsylvania Natural Heritage Program.

POSCIP – Plant of Special Concern in Pennsylvania.

Prescribed burning – burning under controlled conditions; needed to maintain communities such as limestone glades and pitch pine barrens.

Respiration – the process that allows organisms of exchanging gases.

Riparian – that habitat or area next to a stream that is generally within the floodplain.

Rookery – the breeding ground of certain birds or animals, such as herons, penguins and seals.

Right-of-way (R-O-W) – strip of land occupied or intended to be occupied by a street, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer line, or other special use.

Sedge – grass-like herbaceous plant of the family Cyperaceae, especially members of the genus *Carex*.

Seeps – where water flows from the ground in a diffuse pattern and saturates the soil; lush herbaceous vegetation often grows in these wet areas.

Shrub – a perennial, woody plant that differs from a tree in its short stature (less than five meters in height) and typically multi-growth form.

Soil association – a group of soils that are geographically associated in a characteristic repeating pattern and defined and delineated as a single unit.

Soil series – groups of soils that have vertical profiles that are almost the same, that is, with horizons (layers) that are similar in composition, thickness, and arrangement.

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

Stream reach – referring to a specific stretch of a stream, creek, or river; i.e. the reach of the Schuylkill River between the Walnut Street bridge and the Gray's Ferry Avenue bridge

Subcanopy – in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).

Swamp – a wooded wetland, intermittently or permanently flooded.

Succession – natural process of vegetation change through time; over time, the plant species of a site will change in composition and structure as light and soil conditions change (e.g., a field that is left alone may, over time, be taken over by shrubs, then small trees and eventually a woodland).

Supporting Natural Landscape – identifies areas surrounding or adjacent to Core Habitat that are not considered the primary habitat of the species of concern or natural community, but may serve as secondary habitat. These areas provide support by maintaining vital ecological processes as well as isolation from potential environmental degradation. Supporting Natural Landscape areas may be able to accommodate some types of activities without detriment to natural resources of concern. Each should be considered on a site by site and species by species basis.

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

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

TNC – The Nature Conservancy.

Understory – layer of shrubs and small trees between the herbaceous layer and the canopy.

Upland – sites with well-drained dry to mesic soils.

Wetlands – areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.

WPC – the Western Pennsylvania Conservancy.

Vernal – occurring in the spring.

Xeric – extremely dry or droughty.

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APPENDICES

APPENDIX I: Site Survey Form

PLANT & ANIMAL SPECIES OF SPECIAL CONCERN REPORT (PLEASE INCLUDE A MAP)

SPECIES NAME:	SURVEYOR(S): (Please include your address & phone #)		
DATE OF VISIT:	TIME SPENT AT SITE:		
USGS QUADRANGLE:			
SITE NAME AND DIRECTIONS TO SITE:			GPS Coordinates: Latitude: _____ Longitude: _____ DATUM (e.g. NAD27, NAD83) _____
OWNER INFORMATION: • Public Land: give tract name: _____ • Private Land: Please fill out landowner info below. NOTE: We cannot accept data collected on private land if you did not have permission!			
Landowner Name:		Address:	
Phone Number:		City / State / Zip code:	
■ Landowner aware of the species of special concern? YES ____ NO ____ ■ Landowner aware that data are submitted to PA Natural Diversity Inventory? YES ____ NO ____ ■ Landowners are welcome to call the PNDI office in Harrisburg at (717) 772-0258 for more information. ■ IF A SPECIMEN WAS COLLECTED: Please ask for the landowner's signature for permission to save the specimen in a museum: Landowner Signature: _____ Date: _____ ■ Where is the specimen being held: _____			
HABITAT DESCRIPTION: Give a general description of the site. You might include other plant/animal species at site, substrate/soils, topography, land use, weather, etc. If revisiting a site, indicate any obvious changes to the habitat.			
DISTURBANCES/THREATS: Include human and/or natural disturbances and threats to the species at this site.			
SPECIES DATA: Fill out as much of the following as you can - include anything else you feel is of importance.			
♣ Give general description of what you saw (i.e.: found scat, heard song, animal crossing road, found plant in bog..)			
♣ Count or estimate the number of plants / animals you observed & estimate the size of the area they occupy.			
♣ Age and condition of individual(s) (i.e.: fresh adult butterfly; healthy mature plants - 50% flowering and with immature fruit...)			
♣ Behavior (animals) (i.e.: nectaring insect, breeding birds, turtle basking...)			
♣ If revisiting this site, compare the health and size of the population to previous visits.			
♣ Confidence level on Identification: ID Positive ID Somewhat Uncertain ID Unknown			
♣ Voucher specimen or photo taken? (Please include if possible)			
♣ Additional information:			

APPENDIX II: Community Classification

CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA

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

Community Ranks

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

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

APPENDIX II: (continued)

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

APPENDIX II: (continued)

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

* = Communities that are not tracked

APPENDIX III: Federal and State Status, and PNHP Program Ranks

FEDERAL STATUS

U.S. FISH AND WILDLIFE SERVICE CATEGORIES OF ENDANGERED AND THREATENED PLANTS AND ANIMALS

The following definitions are extracted from the September 27, 1985 U.S. Fish and Wildlife Service notice in the Federal Register:

- LE** - Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.
- LT** - Listed Threatened - Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.
- PE** - Proposed Endangered - Taxa proposed to be formally listed as endangered.
- PT** - Proposed Threatened - Taxa proposed to be formally listed as threatened.
- C1** - Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.
- C2** - Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules.
- C3** - Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three categories, depending on the reason(s) for removal from consideration.
- 3A--Taxa for which the Service has persuasive evidence of extinction.
- 3B--Names that, on the basis of current taxonomic understanding, usually as represented in published revisions and monographs, do not represent taxa meeting the Act's definition of "species".
- 3C--Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.
- N** - Taxa not currently listed by the U.S. Fish and Wildlife Service

STATE STATUS-NATIVE PLANT SPECIES

Legislative Authority: Title 25, Chapter 82, Conservation of Native Wild Plants, amended June 18, 1993, Pennsylvania Department of Environmental Resources.

- PE** - Pennsylvania Endangered - Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.
- PT** - Pennsylvania Threatened - Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent further decline in this Commonwealth, or if the species is greatly exploited by man.
- PR** - Pennsylvania Rare - Plant species which are uncommon within this Commonwealth. All species of native wild plants classified as Disjunct, Endemic, Limit of Range, and Restricted are included within the Pennsylvania Rare classification.
- PX** - Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plant species may or may not be in existence outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.
- PV** - Pennsylvania Vulnerable - Plant species which are in danger of population decline within Pennsylvania because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.
- TU** - Tentatively Undetermined - Plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.
- WATCH** Watch Listed- Plant species that do not have an official PABS/DCNR rarity status, but which are tracked on an unofficial basis because of the possibility of being assigned a rarity status in the future, or for other conservation-related reasons.
- N** - None - Plant species which are believed to be endangered, rare, or threatened, but which are being considered by the required regulatory review processes for future listing

APPENDIX III (continued)

STATE STATUS-ANIMALS

The following state statuses are used by the Pennsylvania Game Commission for (1990, Title 34, Chapter 133 pertaining to wild birds and mammals) and by the Pennsylvania Fish and Boat Commission (1991, Title 30, Chapter 75 pertaining to fish, amphibians, reptiles, and aquatic organisms):

PE - Pennsylvania Endangered

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

Fish and Boat Commission - Endangered Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species list published in the Federal Register; or, (2) declared by the Executive Director (PaFC) to be threatened with extinction and appear on the Pennsylvania Endangered Species List published in the Pennsylvania Bulletin.

PT - Pennsylvania Threatened

Game Commission - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the causal factors affecting the organism are abated. These are: 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered, are still in critical condition; or 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87-Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

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

PNHP GLOBAL ELEMENT RANKS

- G1 =** Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- G2 =** Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- G3 =** Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

PNHP GLOBAL ELEMENT RANKS (continued)

- G4 =** Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 =** Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GH =** Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's Warbler).
- GU =** Possibly in peril range wide but status uncertain; need more information.
- GX =** Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered.
- GNR =** Global rank has yet to be assessed. A GNR rank indicates neither commonness nor

APPENDIX III (continued)

PNHP STATE ELEMENT RANKS

- S1** = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2** = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
- S3** = Rare or uncommon in state (on the order of 21 to 100 occurrences).
- S4** = Apparently secure in state, with many occurrences.
- S5** = Demonstrably secure in state and essentially ineradicable under present conditions.
- SA** = Accidental in state, including species which only sporadically breed in the state.
- SE** = An exotic established in state; may be native elsewhere in North America (e.g., house finch).
- SH** = Of historical occurrence in the state with the expectation that it may be rediscovered.
- SN** = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state.
- SR** = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.
- SRF** = Reported falsely (in error) from the state but this error persisting in the literature.
- SU** = Possibly in peril in state but status uncertain; need more information.
- SX** = Apparently extirpated from the state.
- DL** = Recently removed from the list of species of concern.

APPENDIX IV: Pennsylvania Element Occurrence Quality Ranks

<u>Quality Rank*</u>	<u>Explanation</u>
A	Excellent occurrence: all A-rank occurrences of an element merit quick, strong protection. An A-rank community is nearly undisturbed by humans or has nearly recovered from early human disturbance; further distinguished by being an extensive, well-buffered occurrence. An A-rank population of a sensitive species is large in area and number of individuals, stable, if not growing, shows good reproduction, and exists in natural habitat.
B	Good occurrence: protection of the occurrence is important to the survival of the element in Pennsylvania, especially if very few or no A-rank occurrences exist. A B-rank community is still recovering from early disturbance or recent light disturbance, or is nearly undisturbed but is less than A-rank because of significantly smaller size, poorer buffer, etc. A B-rank population of a sensitive species is at least stable, in a minimally disturbed habitat, and of moderate size and number.
C	Fair occurrence: protection of the occurrence helps conserve the diversity of a region's or County's biota and is important to statewide conservation if no higher-ranked occurrences exist. A C-rank community is in an early stage of recovery from disturbance, or its structure and composition have been altered such that the original vegetation of the site will never rejuvenate, yet with management and time partial restoration of the community is possible. A C-rank population of a sensitive species is in a clearly disturbed habitat, small in size and/or number, and possibly declining.
D	Small occurrence: protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrences exist. A D-rank community is severely disturbed, its structure and composition been greatly altered, and recovery to original conditions, despite management and time, essentially will not take place. A D-rank population of a sensitive species is very small with a high likelihood of dying out or being destroyed, and exists in a highly disturbed and vulnerable habitat.
E	Verified as extant, but has not been given a rank: additional information is needed before an appropriate quality rank can be assigned to an occurrence of a sensitive species.
F	Failed to find: while know from the site, the last survey failed to find sufficient evidence to verify the element still occurred at the site, but did not conclude that the site could no longer sustain a population of the sensitive species.
X	Presumed extirpated: while a sensitive species was documented on the site in the past, the site has been degraded beyond the point where it can sustain the species. An X-rank is generally used when the habitat necessary to maintain a population of a sensitive species has been destroyed or degraded to the point of being unsuitable for the species.

* Intermediate ranks may also be assigned.

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

Plants

Scientific Name	Common Name	Scientific Name	Common Name
<i>Amaranthus cannabinus</i>	Salt-marsh water-hemp	<i>Lycopus rubellus</i>	Bugleweed
<i>Bidens bidentoides</i>	Swamp beggar-ticks	<i>Matelea obliqua</i>	Oblique milkvine
<i>Bidens laevis</i>	Beggar-ticks	<i>Orontium aquaticum</i>	Golden club
<i>Cuscuta pentagona</i>	Field dodder	<i>Panicum scoparium</i>	Velvety panic-grass
<i>Cyperus refractus</i>	Reflexed flatsedge	<i>Pluchea odorata</i>	Shrubby camphor-weed
<i>Echinochloa walteri</i>	Walter's barnyard-grass	<i>Poa autumnalis</i>	Autumn bluegrass
<i>Eleocharis obtusa</i> var. <i>peasei</i>	Wrights spike rush	<i>Sagittaria calycina</i> var. <i>spongiosa</i>	Long-lobed arrow-head
<i>Eleocharis parvula</i>	Little-spike spike-rush	<i>Sagittaria subulata</i>	Subulate arrowhead
<i>Elephantopus carolinianus</i>	Elephant's foot	<i>Schoenoplectus fluviatilis</i>	River bulrush
<i>Eupatorium rotundifolium</i>	Round-leaved thoroughwort	<i>Schoenoplectus smithii</i>	Smith's bulrush
<i>Heteranthera multiflora</i>	Multiflowered mud-plantain	<i>Senna marilandica</i>	Wild senna
<i>Juncus dichotomus</i>	Forked rush	<i>Zizania aquatica</i>	Annual wild rice

Animals

Scientific Name	Common Name	Scientific Name	Common Name
Birds			
<i>Asio flammeus</i>	Short-eared owl*	<i>Ixobrychus exilis</i>	Least bittern
<i>Ardea (Casmerodius) albus</i>	Great egret	<i>Nycticorax nycticorax</i>	Black-crowned night-heron*
<i>Botaurus lentiginosus</i>	American bittern	<i>Pandion haliaetus</i>	Osprey
<i>Circus cyaneus</i>	Northern harrier	<i>Podilymbus podiceps</i>	Pied-billed grebe
<i>Cistothorus palustris</i>	Marsh wren	<i>Rallus elegans</i>	King rail*
<i>Falco peregrinus</i>	Peregrine falcon	<i>Rallus limicola</i>	Virginia rail
<i>Haliaeetus leucocephalus</i>	Bald eagle*	<i>Tyto alba</i>	Barn owl*
Amphibians and Reptiles			
<i>Pseudemys rubriventris</i>	Redbelly turtle*	<i>Kinosternon subrubrum subrubrum</i>	Eastern mud turtle*
<i>Lithobates sphenoccephalus</i>	Southern leopard frog*		
Fish			
<i>Umbra pygmaea</i>	Eastern mudminnow		
Invertebrates			
<i>Celithemis eponina</i>	Halloween pennant	<i>Libellula needhami</i>	Needham's skimmer
<i>Enallagma durum</i>	Big bluet	<i>Nastra lherminier</i>	Swarthy skipper
<i>Libellula incesta</i>	Slaty skimmer		

*Denotes sensitive species of concern

Natural Communities and Geologic Features

Freshwater intertidal marsh

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

<i>Scientific Name</i>	<i>Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>	<i>Scientific Name</i>	<i>Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>
<i>Abaeis nicippe</i>	Sleepy Orange	G5	SNA	<i>Erynnis baptisiae</i>	Wild Indigo Duskywing	G5	S5
<i>Achalarus lyciades</i>	Hoary Edge	G5	S4	<i>Erynnis brizo</i>	Sleepy Duskywing	G5	S4
<i>Aglaia milberti</i>	Milbert's Tortoiseshell	G5	S4	<i>Erynnis horatius</i>	Horace's Duskywing	G5	S4
<i>Agraulis vanillae</i>	Gulf Fritillary	G5	SNA	<i>Erynnis icelus</i>	Dreamy Duskywing	G5	S4
<i>Amblyscirtes vialis</i>	Common Roadside Skipper	G5	S2	<i>Erynnis juvenalis</i>	Juvenal's Duskywing	G5	S5
<i>Anatrytone logan</i>	Delaware Skipper	G5	S4	<i>Erynnis lucilius</i>	Columbine Duskywing	G4	S1
<i>Ancyloxypha numitor</i>	Least Skipper	G5	S5	<i>Erynnis martialis</i>	Mottled Duskywing	G3G4	SH
<i>Anthocharis midea</i>	Falcate Orangetip	G4G5	S3	<i>Erynnis zarucco</i>	Zarucco Duskywing	G5	SNA
<i>Asterocampa celtis</i>	Hackberry Emperor	G5	S4	<i>Euphydryas phaeton</i>	Baltimore	G4	S3
<i>Asterocampa clyton</i>	Tawny Emperor	G5	S4	<i>Euphyes bimacula</i>	Two-spotted Skipper	G4	S2
<i>Atalopedes campestris</i>	Sachem	G5	SNA	<i>Euphyes conspicuus</i>	Black Dash	G4	S3
<i>Atrytonopsis hianna</i>	Dusted Skipper	G4G5	S2	<i>Euphyes vestris</i>	Dun Skipper	G5	S5
<i>Battus philenor</i>	Pipevine Swallowtail	G5	S3	<i>Euptoieta claudia</i>	Variegated Fritillary	G5	SNA
<i>Boloria bellona</i>	Meadow Fritillary	G5	S5	<i>Eurytides marcellus</i>	Zebra Swallowtail	G5	S3
<i>Boloria selene - parent species</i>	Silver-bordered Fritillary	G5	S3	<i>Feniseca tarquinius</i>	Harvester	G4	S3
<i>Callophrys augustinus</i>	Brown Elfin	G5	S3	<i>Hesperia metea</i>	Cobweb Skipper	G4G5	S2
<i>Callophrys henrici</i>	Henry's Elfin	G5	S3	<i>Hesperia sassacus</i>	Indian Skipper	G5	S3
<i>Callophrys irus</i>	Frosted Elfin	G3	S2	<i>Hylephila phyleus</i>	Fiery Skipper	G5	SNA
<i>Callophrys niphon</i>	Eastern Pine Elfin	G5	S4	<i>Junonia coenia</i>	Common Buckeye	G5	SNA
<i>Calycopis cecrops</i>	Red-banded Hairstreak	G5	S4	<i>Lerema accius</i>	Clouded Skipper	G5	SNA
<i>Celastrina ladon</i>	Spring Azure	G5	S5	<i>Libytheana carinenta</i>	American Snout	G5	SNA
<i>Celastrina neglecta</i>	Summer Azure	G5	S5	<i>Limenitis archippus</i>	Viceroy	G5	S5
<i>Celastrina neglectamajor</i>	Appalachian Azure	G4	S3	<i>Limenitis arthemis</i>	White Admiral / Red-spotted Purple	G5	S5
<i>Cercyonis pegala</i>	Common Wood Nymph	G5	S5	<i>Limenitis arthemis arthemis</i>	White Admiral	G5	S5
<i>Chlosyne nycteis</i>	Silvery Checkerspot	G5	S3S4	<i>Limenitis arthemis astyanax</i>	Red-Spotted Purple	G5	S5
<i>Colias eurytheme</i>	Orange Sulphur	G5	S5	<i>Lycaena hyllus</i>	Bronze Copper	G5	S3
<i>Colias philodice</i>	Clouded Sulphur	G5	S5	<i>Lycaena phlaeas</i>	American Copper	G5	S5
<i>Cupido comyntas</i>	Eastern Tailed Blue	G5	S5	<i>Megisto cymela</i>	Little Wood Satyr	G5	S5
<i>Danaus gilippus</i>	Queen	G5	SNA	<i>Nastra lherminier</i>	Swarthy Skipper	G5	S3
<i>Danaus plexippus</i>	Monarch	G5	S5B	<i>Nymphalis antiopa</i>	Mourning Cloak	G5	S5
<i>Enodia anthedon</i>	Northern Pearly Eye	G5	S4	<i>Nymphalis vaualbum jalbum</i>	Compton Tortoiseshell	G5	S3
<i>Epargyreus clarus</i>	Silver-spotted Skipper	G5	S5	<i>Panoquina ocola</i>	Ocola Skipper	G5	SNA

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

<i>Scientific Name</i>	<i>Common Name</i>	Global Rank	State Rank	<i>Scientific Name</i>	<i>Common Name</i>	Global Rank	State Rank
<i>Panoquina panoquin</i>	Salt Marsh Skipper	G5	SH	<i>Pyrgus communis</i>	Common Checkered Skipper	G5	SNA
<i>Papilio cresphontes</i>	Giant Swallowtail	G5	S2	<i>Pyrisitia lisa</i>	Little Yellow	G5	SNA
<i>Papilio glaucus</i>	Eastern Tiger Swallowtail	G5	S5	<i>Satyrrium acadicum</i>	Acadian Hairstreak	G5	S3
<i>Papilio palamedes</i>	Palamedes Swallowtail	G5	SNA	<i>Satyrrium calanus</i>	Banded Hairstreak	G5	S5
<i>Papilio polyxenes</i>	Black Swallowtail	G5	S5	<i>Satyrrium caryaevorus</i>	Hickory Hairstreak	G4	S4
<i>Papilio troilus</i>	Spicebush Swallowtail	G5	S5	<i>Satyrrium edwardsii</i>	Edwards' Hairstreak	G4	S3
<i>Parrhasius m-album</i>	White M Hairstreak	G5	S4	<i>Satyrrium favonius</i>	Northern Hairstreak	G4	S3
<i>Phoebis sennae</i>	Cloudless Sulphur	G5	SNA	<i>Satyrrium liparops</i>	Striped Hairstreak	G5	S4
<i>Pholisora catullus</i>	Common Sootywing	G5	S4	<i>Satyrrium titus</i>	Coral Hairstreak	G5	S3
<i>Phyciodes batesii</i> - parent species	Tawny Crescent	G4	SX	<i>Satyrodes appalachia</i>	Appalachian Brown	G4	S4
<i>Phyciodes tharos</i>	Pearl Crescent	G5	S5	<i>Satyrodes eurydice</i>	Eyed Brown	G4	S3
<i>Pieris rapae</i>	Cabbage White	G5	SNA	<i>Speyeria aphrodite</i>	Aphrodite Fritillary	G5	S4
<i>Poanes hobomok</i>	Hobomok Skipper	G5	S5	<i>Speyeria cybele</i>	Great Spangled Fritillary	G5	S5
<i>Poanes massasoit</i>	Mulberry Wing	G4	S2	<i>Speyeria idalia</i>	Regal Fritillary	G3	S1
<i>Poanes viator</i>	Broad-winged Skipper	G5	S4	<i>Strymon melinus</i>	Gray Hairstreak	G5	S5
<i>Poanes zabulon</i>	Zabulon Skipper	G5	S5	<i>Thorybes bathyllus</i>	Southern Cloudywing	G5	S4
<i>Polites mystic</i>	Long Dash	G5	S4	<i>Thorybes confusus</i>	Confused Cloudywing	G4	SNA
<i>Polites origenes</i>	Crossline Skipper	G5	S4	<i>Thorybes pylades</i>	Northern Cloudywing	G5	S4
<i>Polites peckius</i>	Peck's Skipper	G5	S5	<i>Thymelicus lineola</i>	European Skipper	G5	SNA
<i>Polites themistocles</i>	Tawny-edged Skipper	G5	S5	<i>Urbanus proteus</i>	Long-tailed Skipper	G5	SNA
<i>Polites vibex</i>	Whirlabout	G5	SNA	<i>Vanessa atalanta</i>	Red Admiral	G5	SNA
<i>Polygonia comma</i>	Comma	G5	S5	<i>Vanessa cardui</i>	Painted Lady	G5	SNA
<i>Polygonia interrogationis</i>	Question Mark	G5	S5	<i>Vanessa virginiensis</i>	American Lady	G5	SNA
<i>Polygonia progne</i>	Gray Comma	G5	S3	<i>Wallengrenia egeremet</i>	Northern Broken Dash	G5	S4
<i>Pompeius verna</i>	Little Glassywing	G5	S5	<i>Zerene cesonia</i>	Southern Dogface	G5	SNA
<i>Pontia protodice</i>	Checkered White	G4	SNA				

APPENDIX VII: Odonates collected during Philadelphia County field surveys or other collections

<i>Scientific Name</i>	<i>Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>	<i>Scientific Name</i>	<i>Common Name</i>	<i>Global Rank</i>	<i>State Rank</i>
<i>Aeshna umbrosa umbrosa</i>	Shadow darner	G5	S5	<i>Hetaerina titia</i>	Smoky rubyspot	G5	S2
<i>Amphiagrion saucium</i>	Eastern red damsel	G5	S4	<i>Ischnura hastata</i>	Citrine forktail	G5	S5
<i>Anax junius</i>	Common green darner	G5	S5	<i>Ischnura posita</i>	Fragile forktail	G5	S5
<i>Archilestes grandis</i>	Great spreadwing	G5	S4	<i>Ischnura ramburii</i>	Rambur's forktail	G5	S1
<i>Argia apicalis</i>	Blue-fronted dancer	G5	S4	<i>Ischnura verticalis</i>	Eastern forktail	G5	S5
<i>Argia fumipennis violacea</i>	Violet darner	G5	S5	<i>Lestes rectangularis</i>	Slender spreadwing	G5	S5
<i>Argia moesta</i>	Powdered dancer	G5	S5	<i>Lestes vigilax</i>	Swamp spreadwing	G5	S5
<i>Argia translata</i>	Dusky dancer	G5	S4	<i>Leucorrhinia intacta</i>	Dot-tailed whiteface	G5	S5
<i>Boyeria vinosa</i>	Fawn darner	G5	S5	<i>Libellula cyanea</i>	Spangled skimmer	G5	S4S5
<i>Calopteryx dimidiata</i>	Sparkling jewelwing	G5	SH	<i>Libellula incesta</i>	Slaty skimmer	G5	S3S4
<i>Calopteryx maculata</i>	Ebony jewelwing	G5	S5	<i>Libellula luctuosa</i>	Widow skimmer	G5	S5
<i>Celithemis elisa</i>	Calico pennant	G5	S5	<i>Libellula (Plathemis) lydia</i>	Common whitetail	G5	S5
<i>Celithemis eponina</i>	Halloween pennant	G5	S2S3	<i>Libellula needhami</i>	Needham's skimmer	G5	SH
<i>Didymops transversa</i>	Stream cruiser	G5	S5	<i>Libellula pulchella</i>	Twelve-spotted skimmer	G5	S5
<i>Dromogomphus spinosus</i>	Black-shouldered spinyleg	G5	S5	<i>Libellula semifasciata</i>	Painted skimmer	G5	S4S5
<i>Enallagma aspersum</i>	Azure bluet	G5	S3S4	<i>Libellula vibrans</i>	Great Blue skimmer	G5	S2N
<i>Enallagma civile</i>	Familiar bluet	G5	S5	<i>Macromia illinoensis</i>	Illinois river cruiser	G5	S5
<i>Enallagma durum</i>	Big bluet	G5	S3	<i>Macromia taeniolata</i>	Royal river cruiser	G5	SNA
<i>Enallagma exulans</i>	Stream bluet	G5	S5	<i>Nannothemis bella</i>	Elfin skimmer	G4	S1
<i>Enallagma geminatum</i>	Skimming bluet	G5	S5	<i>Pachydiplax longipennis</i>	Blue dasher	G5	S5
<i>Enallagma signatum</i>	Orange bluet	G5	S5	<i>Pantala flavescens</i>	Wandering glider	G5	S5
<i>Epiaeschna heros</i>	Swamp darner	G5	S4	<i>Pantala hymenaea</i>	Spot-winged glider	G5	S4S5
<i>Epithea cynosura</i>	Common baskettail	G5	S5	<i>Perithemis tenera</i>	Eastern amberwings	G5	S5
<i>Epithea princeps</i>	Prince baskettail	G5	S5	<i>Somatochlora tenebrosa</i>	Clamp-tipped emerald	G5	S5
<i>Erythemis simplicicollis</i>	Eastern pondhawk	G5	S5	<i>Stylurus plagiatas</i>	Russet-tipped clubtail	G5	S1
<i>Erythrodiplax berenice</i>	Seaside dragonlet	G5	S1	<i>Stylurus spiniceps</i>	Arrow clubtail	G5	S4S5
<i>Gomphaeschna antilope</i>	Taper-tailed darner	G4	SH	<i>Sympetrum ambiguum</i>	Blue-faced meadowhawk	G5	S1
<i>Gomphaeschna fuscillata</i>	Harlequin darner	G5	S2	<i>Sympetrum obtrusum</i>	White-faced meadowhawk	G5	S3
<i>Gomphus exilis</i>	Lancet clubtail	G5	S5	<i>Sympetrum rubicundulum</i>	Ruby meadowhawk	G5	S5
<i>Gomphus lividus</i>	Ashy clubtail	G5	S5	<i>Sympetrum semicinctum</i>	Band-winged meadowhawk	G5	S3S4
<i>Gomphus vastus</i>	Cobra clubtail	G5	S3S4	<i>Sympetrum vicinum</i>	Yellow-legged meadowhawk	G5	S5
<i>Hagenius brevistylus</i>	Dragonhunter	G5	S5	<i>Tramea carolina</i>	Carolina saddlebags	G5	S4S5
<i>Hetaerina americana</i>	American rubyspot	G5	S5	<i>Tramea lacerata</i>	Black saddlebags	G5	S5

**APPENDIX IIX: Facts Sheets for Species and Communities of Special Concern
in Philadelphia County**

Short-eared Owl (*Asio flammeus*)

Pennsylvania Endangered Bird Species

State Rank: S1B (critically imperiled breeding), **S3N** (vulnerable non-breeding) **Global Rank: G5** (secure)

Identification

The short-eared owl received its name from its lack of "ear" tufts. It is about the size of a crow, 13 to 17 inches high, and has a 38- to 44-inch wingspan. Their color varies from light to dark brown with darker patches on the undersides of their wings, and large buff-color patches on the upper sides being distinctive. Short-eared owls are grassland birds that nest on the open ground, sometimes in loose colonies. The nest is a slight depression, which is lined with grass and feathers and is often invisible within the matrix of grassland plants. Unlike most other owls, the short-eared is active at dusk, dawn and – at times – even in mid-day; therefore, they are seen more often than many other owl species.

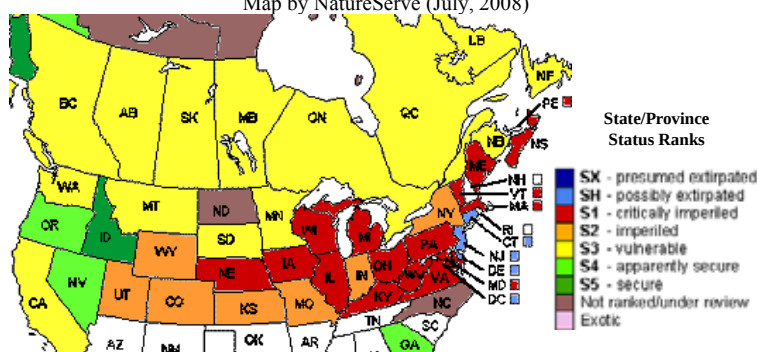


photo source: Rita Hawrot, PNHP

Short-eared Owl (*Asio flammeus*) chick in nest

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

Short-eared Owls occur in grasslands in many part of the world including North and South America, Eurasia, and even isolated islands such as Iceland and Hawaii. They both breed and winter in the Commonwealth allowing them to be found in the state year-round.

Habitat

This owl is found in grasslands and shrublands. Generally preferring large to expansive areas of contiguous habitat during the breeding season, Short-eared Owls can be found in a wider range of habitats during the winter. They are commonly observed during the winter in fallow farm fields and similar habitat.

Management Practices

Suitable nesting habitat for the Short-eared Owl is extremely limited in Pennsylvania, and intensive agricultural practices make many potential habitats unsuitable. Most substantial areas of open lands are farmlands and, therefore, subject to repeated disturbance. Accordingly, the welfare of grassland nesting birds is threatened. This may be why the only known nests of

<http://www.dcnr.state.pa.us/wrcf/define1.aspx> short-eared owls are found in extensive, low-disturbance open lands, e.g. reclaimed strip mines and wildlife refuges. Future management should include the creation and maintenance of large, herbaceous preserves suitable for all grassland nesters. Primary management of these areas must assure minimal disturbance during nesting and prevention development or succession to an unusable habitat.

References:

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Great Egret (*Ardea alba*)

Pennsylvania Endangered Bird Species

State Rank: S1B (Critically Imperiled, Breeding) Global Rank: G5 (Secure)

Identification

The Great Egret (*Ardea alba*, formerly *Casmerodius albus*) is a large brilliant white heron slightly smaller than a Great Blue Heron (*Ardea herodias*) standing about 3 feet (1m) tall with a 4.5-foot (1.4m) wingspan. This species is easily told from Pennsylvania's other white herons by its large size and the combination of a yellow bill with black legs.

Hunted to near extinction for the feather trade in the early 1900's, the persecution of this species is a primary reason for the founding of the Audubon Society and the creation of Pelican Island National Wildlife Refuge, the nation's first National Wildlife Refuge. Since its protection the Great Egret has been slowly reclaiming its former range including numerous colonies in the Commonwealth. Today, the main threats faced by the Great Egret are wetland habitat loss, water pollution, and disturbance of nesting colonies.

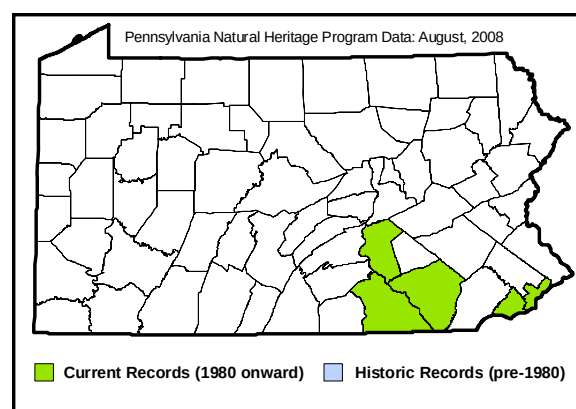
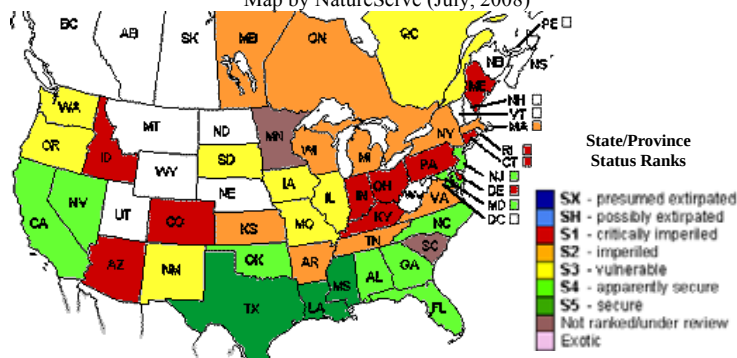


photo source: C. Singletary, Cornell Lab of Ornithology

A Great Egret (*Ardea alba*) stalking prey.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

The majority of this species population is found south of Pennsylvania in large wetland and estuary complexes with the Mid-Atlantic portion of the population mainly concentrated along the coastline and the major connected rivers including the Delaware and Susquehanna.

Habitat

This egret is typically found feeding in shallow rivers, streams, ponds, lakes and marshes. Nests are found in adjacent trees or shrubby growth, preferable on islands or in trees surrounded by standing water. The birds usually nest in colonies that may include other colonial nesting species.

Conservation Status

Colonial nesting birds are vulnerable to disturbance and direct persecution. Additionally, nesting colonies are susceptible to invasion by predatory animals, which can result in the abandonment of the site. All known nesting colonies should be closed to public intrusion and preserved and buffered from developmental pressures. Additionally, the maintenance, preservation, and restoration of riparian buffers and the few remaining large wetland complexes is essential for this species continued survival.

References

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- Pennsylvania Natural Heritage Program. 2008.



American Bittern (*Botaurus lentiginosus*)

Pennsylvania Endangered Bird Species

State Rank: S1B (Critically Imperiled, Breeding) **Global Rank: G4** (Apparently Secure)

Identification

This large, cryptically-colored heron is most often seen when flushed from marshes, but instantly identified by its unique water-pump-like “oong-ka” choonk” call. A large compact heron up to 34 inches tall and with a 50-inch wingspan, its streaked brown plumage, and black moustache-like cheek markings are diagnostic. When threatened, individuals stand upright with their bill pointing upward causing them to blend into the surrounding vegetation. At times they even sway from side to side, moving like the tall reeds and grasses surrounding it.

Occasionally seen stalking along shorelines and marsh edges, American Bitterns prey on amphibians, fish, snakes, crayfish, insects, and even small mammals. Nesting singly rather than colonially like many herons, this bittern defends a hunting territory around its nest. Generally, American Bitterns build platform nests of woven reeds and grasses above the water’s surface, but are known to occasionally nest in thick tall grassy uplands next to large wetlands.

Range

American Bitterns nest in large marsh complexes across the central and northern United States and southern Canada and are rarely found in smaller wetlands. Wintering across the southern United States and into Mexico and Central America, they are limited by the need for open water. This allows bitterns to stay in southwestern Pennsylvania year round, but generally they are most commonly seen during the spring and fall migrations.

Habitat

American Bitterns require wetland habitats and prefer large, extensive wetlands complexes composed of a mixture of different vegetation types and water depths.

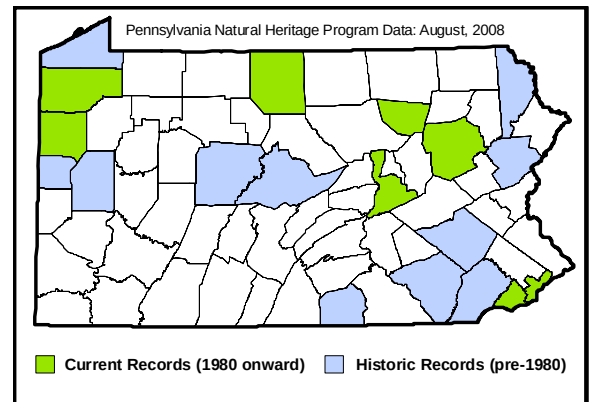
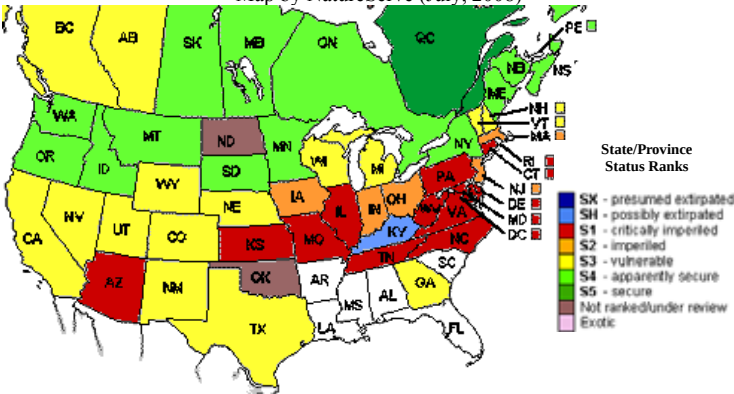


photo source: Mary Tremaine, Cornell Lab of Ornithology

American Bittern (*Botaurus lentiginosus*) in a frozen defensive stance imitating vegetation.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Conservation Status

The continuing degradation and disappearance of the wetland habitats across the continent has resulted in American Bittern showing continent-wide population decreases since 1986. Additional concerns include the invasion of wetlands by non-native plant species, increased runoff from high-input agriculture, and incidental take during game-bird hunting. Measures necessary for the conservation of this species include the protection and restoration of large marsh complexes in both the breeding and wintering range of this species along with islands of suitable and sufficient wetland habitat along the species migratory route.

References

- Felbaum, Mitchell, et al. Endangered and Threatened Species of Pennsylvania. Harrisburg, PA: Wildlife Conservation Resource Fund, 1995.
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- Pennsylvania Natural Heritage Program. 2008.



Northern Harrier (*Circus cyaneus*)

Pennsylvania at Risk Bird Species

State Rank: S3B; S4N (Vulnerable, Breeding; Apparently Secure, Non-Breeding) Global Rank: G5 (Secure)

Identification

Northern Harriers are medium-sized, long-winged, long-tailed hawks with rounded wings that can appear pointed while gliding. This species is typically 16.5 inches long with a wingspan of 42 inches, with the females averaging a bit larger than the males. Field marks include a white rump, short, dark, hooked beak, and flat face with an owl-like facial disk. This species has the behavior of flying low over marshes and fields harrying the ground in a constant back and forth flight. The male is pale gray above and even paler on the underside with a dark gray head, with dark tips on the flight feathers, and narrow dark bars on the tail. The female and juveniles are dark brown above, with buff underparts and dark streaks on their breast, belly, and under wing coverts, dark barring on the tail, and dark patch on inner wing created by dark secondaries and secondary coverts.

Range

This species breeds widely across North America, but is limited to areas with extensive grassland and marshland habitat.

Habitat

Northern Harriers use areas with extensive and interconnected wetland, marshland, and grassland habitat. open wetlands, including marshy meadows, wet lightly grazed pastures, old fields, freshwater and brackish marshes, and dry uplands composed of open habitat. In Pennsylvania, this species also uses reclaimed strip mines for nesting in some areas.

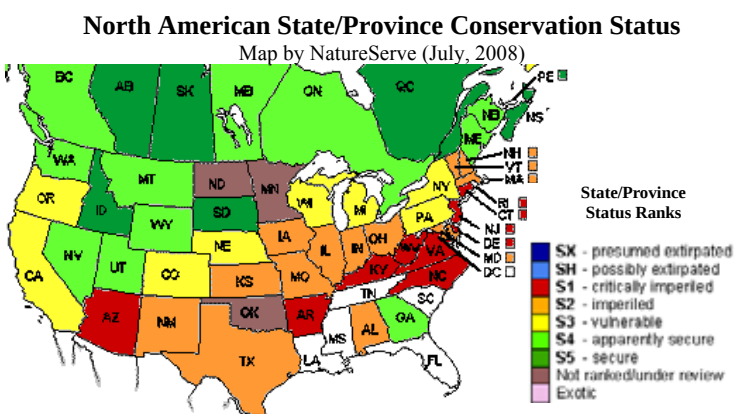
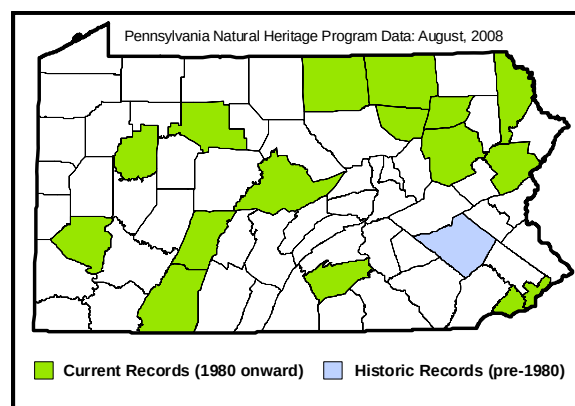


photo source: Ron Austing

Adult male Northern Harrier (*Circus cyaneus*)



Conservation Status

Northern Harriers declined slowly from 1966 to 1987 throughout North America, including Pennsylvania. Loss of wetlands and suitable field habitat are the primary causes of the widespread decline. Other reasons for decline may include suburban development, reforestation of abandoned fields, the conversion of hay fields to row crops and increasingly intense farming practices, and use of

organochlorine pesticides such as DDT. This species is listed as an endangered or threatened species in numerous states with the protection of large, open wetland and grassland complexes across its range needed to secure the future for the Northern Harrier.

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- Pennsylvania Natural Heritage Program. 2008.



Marsh Wren (*Cistothorus palustris*)

Pennsylvania Candidate Rare Bird Species

State Rank: S2S3B (Imperiled/Vulnerable, Breeding) Global Rank: G5 (Secure)

Identification

A secretive little bird often confused with the Sedge Wren (*Cistothorus platensis*), Marsh Wrens are uncommon, but regular residents of wetlands dominated by rank vegetation such as cattails (*Typha* spp.) and common reed (*Phragmites australis*). Often first identified by its distinctive, complex, and varied song, this wren is easily identified when heard calling within a wetland. Some males are recorded as having up to 200 unique songs that they use in vocal duels with neighboring males. Noted for the strong white eyebrow, rufous wings, and black-and-white striped shoulder, this species rarely sits still long enough to be positively identified in one look as it scrambles through the vegetation.

Marsh Wrens lead interesting family lives with one male defending a territory that can contain several nesting females. Within this territory will be numerous “dummy” nests built by the male to exhibit his nest-building and territory defense skills. On average, a male will build six nests for every female nesting within his territory.



photo source: <http://www.naturespicsonline.com/>

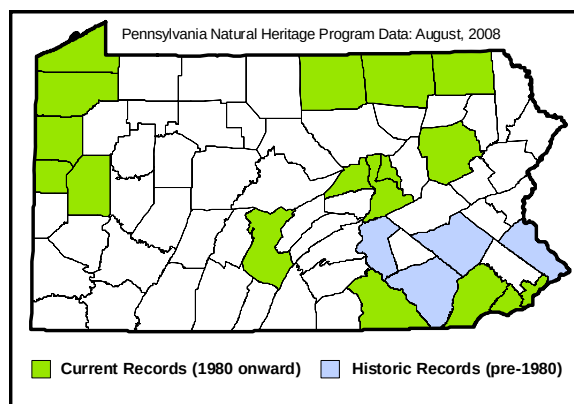
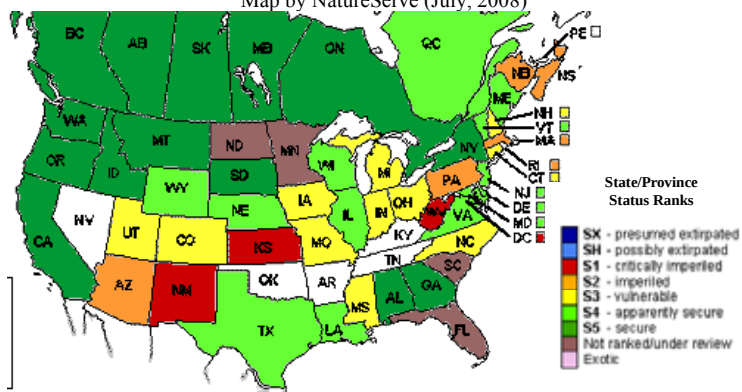
Singing Marsh Wren (*Cistothorus palustris*)

Range

The Marsh Wren is found in two distinct populations that overlap along a line running through the Great Plains, but otherwise do not overlap during the breeding season. They are found breeding in appropriate habitat along the coast lines of the Atlantic, Pacific, and Gulf of Mexico in North America north to Maine and British Columbia and south to approximately Mexico with a band colonizing the central US and southern Canada. Wintering in the southern US and Mexico, Marsh Wrens are also known to reside year-round in southeastern Pennsylvania.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

A resident of marshland and wetlands with emergent vegetation, Marsh Wrens tend to build their nests over shallow water near the edge of the wetland. As the summer progresses or during dry years, nests will be built further into the marsh where it is less likely to dry out. Wintering habitat is generally similar to breeding habitat, but may extend into upland grassy and low shrubby areas.

Conservation Status

This species, like all species dependent on large complex marsh systems, is suffering from a severe reduction in marsh systems. Additionally, hydrology altering practices and the invasion of non-native species is also reducing existing habitat further endangering this species. Key conservation actions for this species are the preservation of existing large marshes and the management of the marshes to preserve the quality of the habitat they provide.

References

- McWilliams, G.M. and Brauning, D.W. 2000. The Birds of Pennsylvania. Cornell University Press, Ithaca, NY. 479pp.
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Peregrine Falcon (*Falco peregrinus*)

Pennsylvania Endangered Bird Species

State Rank: S1B;S1N (Critically Imperiled Breeding and Non-breeding) **Global Rank: G4** (Apparently Secure)

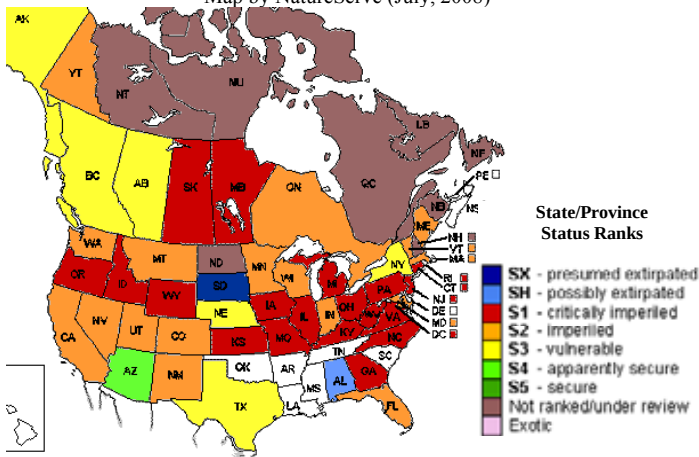
Identification

A larger 15- to 22-inch falcon, adults have dark-bluish gray upperparts and wings contrasted against a dark-barred buff breast. The head has a nearly black helmet-like appearance against the buff cheeks. Like all falcons, the Peregrine has long pointed wings, rapid steady wing beats, and can fly exceptionally fast.

Peregrine historically nested across the planet utilizing cliff-faces along rivers as their preferred nesting location. However, by 1961 there were no Peregrines left in Pennsylvania. Their decline and extirpation has been attributed to egg collecting, falconry and shooting, but chiefly to organochlorine pesticides such as DDT. Today some cliff nests are being recolonized, but Peregrine Falcons have adapted amazingly well to the urban cliff-faces of skyscrapers and bridges enjoying the easy dining of city-dwelling Pigeons (*Columba livia*).

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

Per its name, the Peregrine Falcon is found almost everywhere on the planet where sufficient prey and habitat exist. Well adapted to the human environment, this species is known from most major urban areas around the globe with nests in some of the Commonwealth's major cities including Philadelphia, Pittsburgh, Reading, and at the Three Mile Island power plant.



Peregrine Falcon (*Falco peregrinus*)

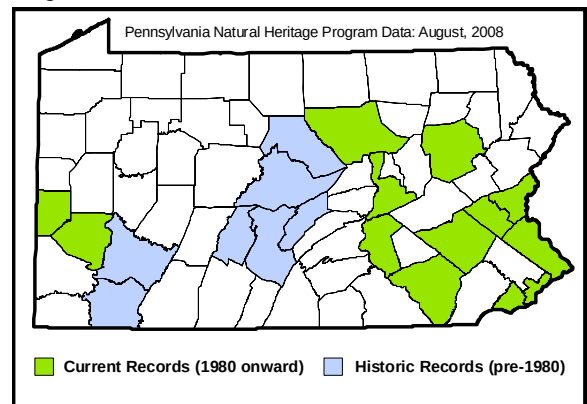
photo source: Joe Kosack, PA Game Commission

Habitat

The combination of a sufficient prey base and a safe nesting location seem to be the limitations to where this species can nest including riparian, grassland, forested, desert, tundra, and urban environments.

Conservation Status

The plan to restore this species includes annual surveys for new nest sites; protection of known nest sites, including hazard reduction to increase survival of young peregrines; restoration of peregrines at suitable historic sites; and promotion of public support. A successful reintroduction program has released birds in Harrisburg, Reading, and Williamsport, PA.



References

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Bald Eagle (*Haliaeetus leucocephalus*)

Pennsylvania Threatened Bird Species

State Rank: S2B (impaired, breeding) Global Rank: G5 (secure)

Identification

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

Range

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

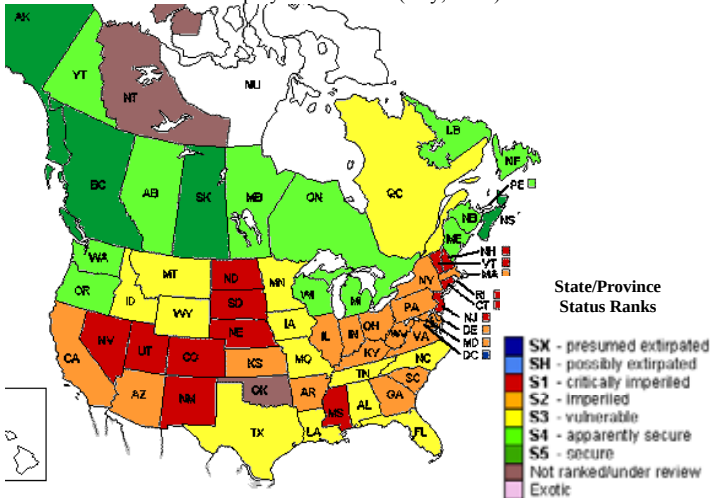


Adult Bald Eagle (*Haliaeetus leucocephalus*)

photo source: Ron Austing

North American State/Province Conservation Status

Map by NatureServe (July, 2008)

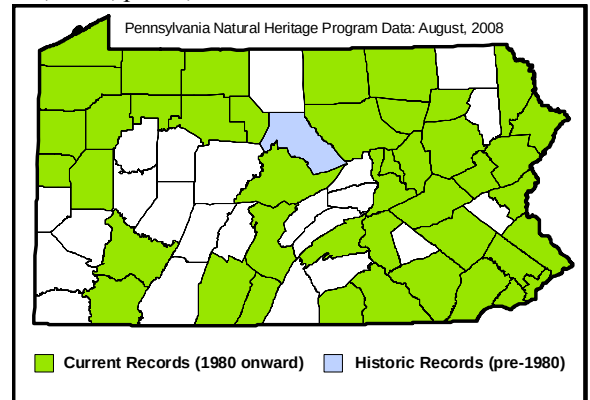


Habitat

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

Conservation Status

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



References

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Least Bittern (*Ixobrychus exilis*)

Pennsylvania Endangered Bird Species

State Rank: S1B (Critically Imperiled, Breeding) Global Rank: G5 (Secure)

Identification

The Least Bittern (*Ixobrychus exilis*) is an inconspicuous 11 to 14 inches in length with a wingspan of only 16 to 18 inches making it the smallest member of the heron family. The plumage of this species is evolved to blend in; its black and tan body, blackish-green cap and back, and white and brown streaked throat make the bird very difficult to pick out in wetlands. When disturbed, the least bittern is more likely to run than fly, and like its relative, the American Bittern (*Botaurus lentiginosus*), it also has the habit of freezing with its bill pointed straight up when alarmed allowing it to readily blend in with the marsh vegetation.

Hunting where the marsh transitions from vegetation to open-water, this species is known to build hunting platforms from the vegetation and is able to catch fast moving prey including small fish and dragonflies. The least bittern arrives in Pennsylvania in April and both parents help build a nest platform of reeds and grasses near open water. Four or five pale blue or green eggs are laid in the 6-inch nest in mid or late May with hatching in slightly less than three weeks. Hatchlings leave the nest at two weeks and fledge in only four to six weeks from hatching.



photo source: A. & E. Morris, VIREO

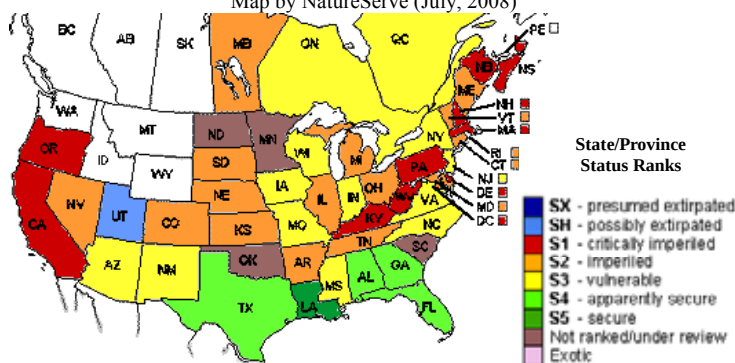
Least Bittern (*Ixobrychus exilis*)

Range

The Least Bittern nests in wetland areas throughout the eastern United States and along the Pacific coast with resident populations throughout Mexico and South America. This species winters along the Gulf of Mexico coast, and down through Mexico into South America. A regular migrant through the state, it generally nests in the Commonwealth's northwest and southeast corners, with possibly a few other central locations in the larger marshes.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)

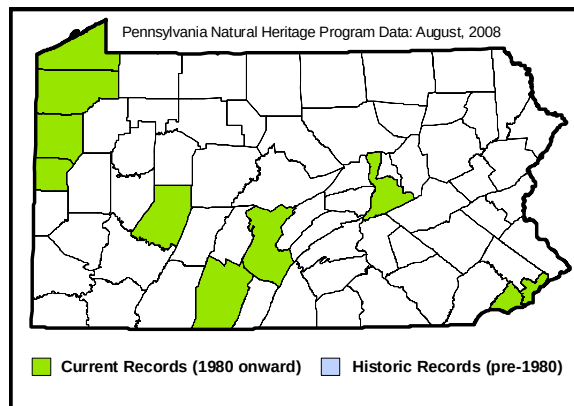


Habitat

Least Bitterns thrive in dense extensive marshland environments containing cattails and reeds, along the coast and inland, where they feed primarily on small fish, amphibians, and both aquatic and terrestrial insects. In exceptional habitat as many as 6 nests per acre (15 per hectare) have been documented.

Conservation Status

Nesting opportunities for this species in Pennsylvania are limited and decreasing as the wetland habitat it needs have been extensively drained or impounded. Areas where this species is known to nest must be protected. Surveys are being conducted to determine where it does actually nest, and marshland habitats can be managed to provide additional nesting habitat.



References

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- Pennsylvania Natural Heritage Program. 2008.



Black-crowned Night-heron (*Nycticorax nycticorax*)

Pennsylvania Endangered Bird Species

State Rank: S2S3B (Imperiled/ Vulnerable, Breeding) Global Rank: G5 (Secure)

Identification

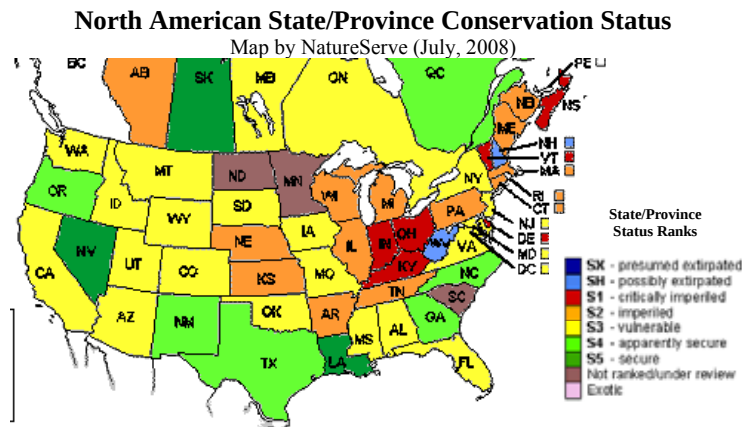
A common though secretive species, Black-crowned Night-herons (*Nycticorax nycticorax*) are becoming common resident in urban areas as their populations once again increase. Experiencing significant population declines in the 1960's, this species and many others were adversely affected by the use of DDT. Crepuscular to nocturnal, Black-crowned Night-herons are most often seen along ponds and river near dusk. Very distinctive when seen, adults are noted for their black back and crown, grey wings, and white breast they also have a blood-red eye and a thin white plume on their crown.

Nesting in trees usually in groups and often with other heron species, some nesting colonies on islands have been noted to host several 1,000 pairs. During the day these colonies are home to the Black-crowned Night-heron, which leave at dusk to hunt for fish, crustaceans, amphibians, and even small mammals, the parents return to the nest over the night to feed the young and return to roost at dawn.



photo source: Andrew Straussman

Black-crowned Night-heron (*Nycticorax nycticorax*)



Range

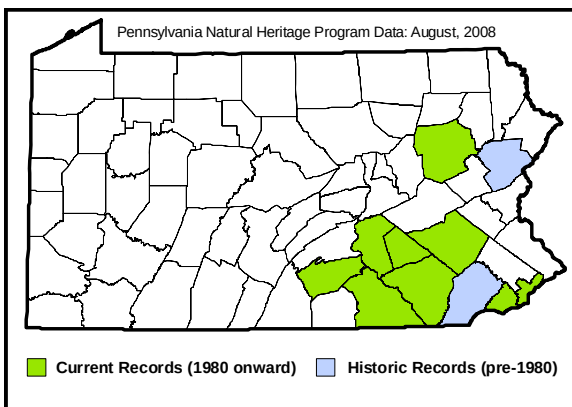
Breeding range extends across the continental US with population density related to the presence of quality nesting and foraging habitat. Winter range includes is limited by the presence of open water with birds noted in southeastern Pennsylvania year round.

Habitat

Mostly associated with large wetland complexes, but also along large riparian systems with adequate hunting locations. Nesting colonies generally found in trees on islands or otherwise protected from predation.

Conservation Status

The protection and expansion of large, healthy wetland complexes is important for this species survival. Additionally, as nesting colonies expand into urban areas there is the potential for intentional disturbance by humans given the "noise and mess" associated with colonies.



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Osprey (*Pandion haliaetus*)

Pennsylvania Threatened Bird Species

State Rank: S2B (Imperiled, Breeding) Global Rank: G5 (Secure)

Identification

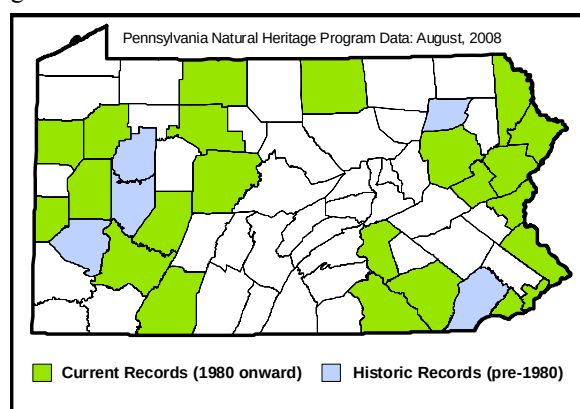
The Osprey is a distinctive bird of prey most often seen around open water. With white underparts, a brown back and wings, and a white head with a small crest, Osprey are known for their striking yellow eyes and brown eye stripe. Fish make up the vast majority of the Osprey's diet with hunting Osprey commonly attacked by gulls, crows, and eagles intent on stealing their catch.

Like the Bald Eagle (*Haliaeetus leucocephalus*), the Osprey suffered a significant population decline linked to the use of organochlorine pesticides. These toxins bioaccumulated in the environment with the Osprey, a top predator, ingesting large quantities of the chemical from the fish they ate. This chemical interfered with the creation of the shell on their eggs causing the eggs to crack as the adults incubated them. Several generations of Osprey chicks were lost as a result and Osprey populations began to plummet. With the cessation of DDT use in the US Osprey populations have begun to recover.



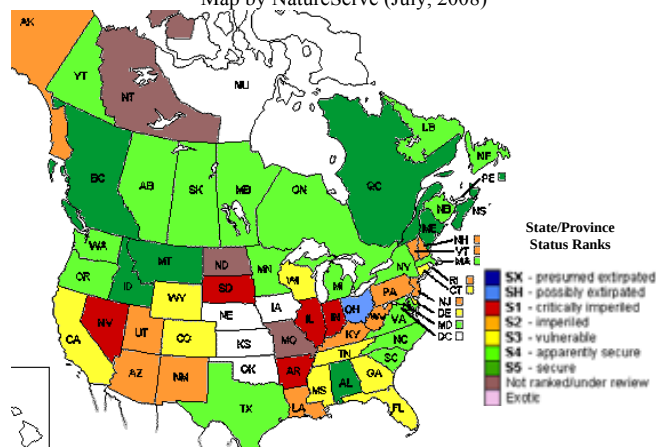
Young Osprey (*Pandion haliaetus*) on nest

photo source: Kirk Piehler, US Army Corps of Engineers



North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

Ospreys inhabit every continent but Antarctica, nesting in trees, snags, and ever-increasing man-made structures located near high quality fresh- or saltwater fishing grounds.

Habitat

Nesting in both "wild" and highly urban environments, the habitat requirements for Osprey seem to be quality fishing grounds near a suitable nesting platform.

Conservation Status

Osprey populations can be supported by the construction of nesting platforms, protection of breeding and fishing habitat, and monitoring the environment for possible sources of bioaccumulating toxins. Continued reduction and monitoring of pollutants including pesticides and heavy metals will also be necessary, since top predators such as the Osprey are particularly vulnerable to these poisons. Reduction of organochlorine pesticide use in the species' South American range, where DDT is still commonly used, is a high priority.

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- Poole, Alan F., Rob O. Bierregaard and Mark S. Martell. 2002. Osprey (*Pandion haliaetus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/683>



non-breeding) **Global Bank: G5** (summer)

The Pied-billed Grebe is a small water bird, about 12-15 inches, with a blunt ivory-colored beak that bears a single distinctive dark stripe in the mating season. Male and female adults are both drab brown with white rumps and diagnostic black patches on the throat and forehead; the chicks are striped in sharp black and white. Because Pied-billed Grebes are secretive, especially during their breeding season, their population size and distribution are not well known.



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Pied-billed Grebes are year-round residents of the North American southeast and west, as well as southern South America; and breeding residents from the midwestern and eastern United States north into Canada.

Map by NatureServe (October, 2008)



The Pied-billed Grebe is most vulnerable to human alteration of its wetland habitats: draining, filling, or other interference with natural hydrology. However, Ickes (in Brauning 1992) suggests that this danger may be offset by the grebe's willingness to nest in artificial ponds. Recreational activities such as boating and fishing may also disturb the birds. They can benefit most from preservation and restoration of wetland habitats and from control of disruptive human activities near its breeding grounds. Preserving wetlands larger than 10 hectares with a healthy population of emergent and submerged vegetation is needed to assure the future of this species. Additionally, breeding grounds need to be protected from chemical pollution, siltation, and eutrophication. Maintenance of stable water levels in managed wetlands can also greatly improve the grebes' reproductive success by reducing the chances of flooding nests.

Pied-billed Grebes inhabit wetlands near open water, including farm ponds, marshes, artificial lakes, and flooded quarries. They require thick vegetation of some sort – rushes, reeds, or cattails – to provide cover and anchorage for their floating nests.



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King Rail (*Rallus elegans*)

Pennsylvania Endangered Bird Species

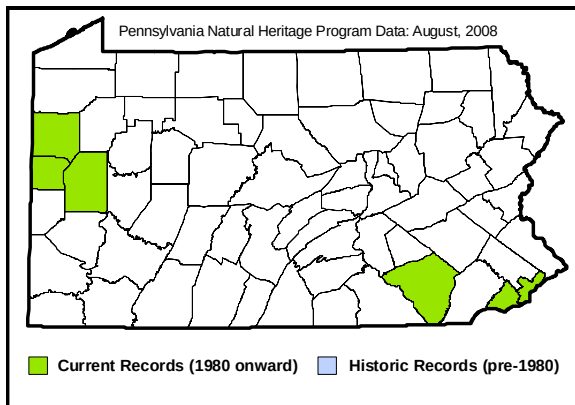
State Rank: S1B (Critically Imperiled, Breeding) **Global Rank: G4** (Apparently Secure)

Identification

The King Rail (*Rallus elegans*) is so named because of its large size and bright coloration. Approximately chicken-sized, this species is a bright rusty color with a brown-tipped yellow bill. With a wingspan of up to 25 inches (63cm), males of this species are larger than females. Nesting on platforms built on hummocks, nests are generally built 12-inches above the water to prevent flooding during rains. Wading in shallow water, King Rails feed on crustaceans, small fish, frogs, and insects.

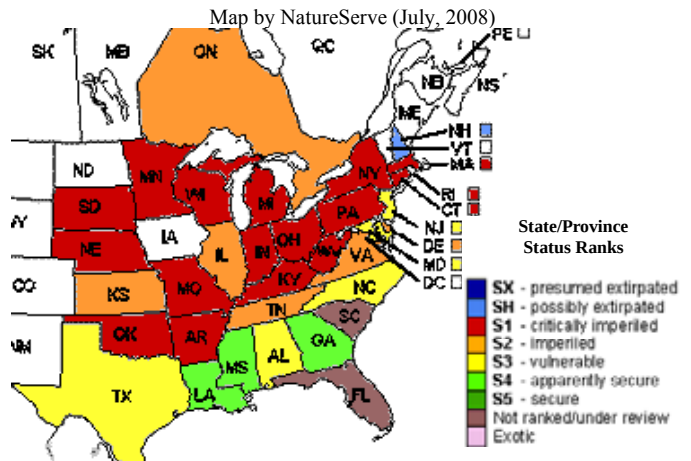
This species is extremely secretive and will generally run through the vegetation rather than fly to escape detection. They are rarely seen, therefore, and are most often located by their loud calls, a resonant grunting bup-bup, bup, bup, bup, more rapid at the end.

King Rails, never common in Pennsylvania, have shown persistent population declines in recent decades. This apparent decline is considered to be due primarily to the loss of wetland habitat.



King Rail (*Rallus elegans*) hunting for invertebrates

North American State/Province Conservation Status



Range

Found year-round in the coastal marshes from Florida to Texas, northern population, including those in Pennsylvania, are migratory. The northern extent of this species is near Canada in the Great Plains and southern New York along the Atlantic coast.

Habitat

This rail lives in freshwater and brackish marshes and occasionally roadside ditches in eastern North America. It is a very rare breeder in the few larger marshes remaining in Pennsylvania.

Conservation Status

As with many other endangered and threatened species, the King Rail needs wetlands in order to exist. Maintaining healthy, large, functional wetlands is the only way to maintain population of this species within the Commonwealth.

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- Poole, Alan F., L. R. Bevier, C. A. Marantz and Brooke Meanley. 2005. King Rail (*Rallus elegans*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/003>



Virginia Rail (*Rallus limicola*)

Pennsylvania Bird Species of Concern

State Rank: S3B (Vulnerable, Breeding) Global Rank: G5 (Secure)

Identification

A denizen of the cattail edges of large marsh complexes and small isolated wetlands, the Virginia Rail (*Rallus limicola*) is probably the most common rail species in the Commonwealth. Distinguished from similar species by the combination of smaller size (9-inches) and a long bill (1.5-inches), this species is a rusty brown with a grey cheek patch. The bill and legs, a noticeable red to orange-brown, are also easily picked out among the marsh vegetation.

Migrating into Pennsylvania as wetlands re-green in the spring, nesting begins in May with the chicks hatching in June and fledging in July. Fall migration may begin as early as mid-August and generally most birds have left by mid-October, but individuals have been recorded in marshes until freezes force them south.

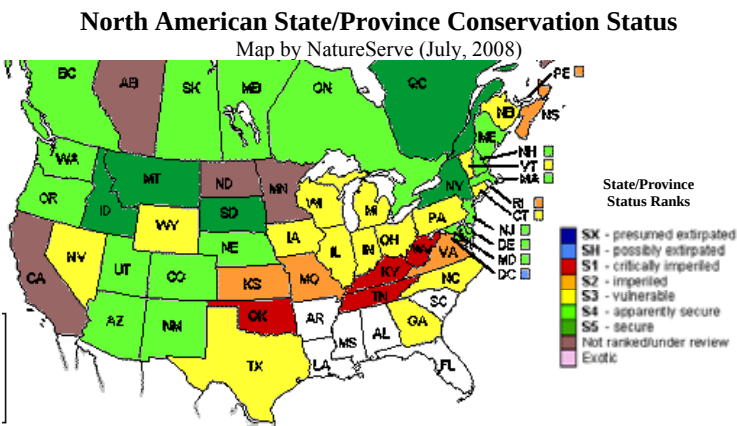


photo source: Denis Kania

Virginia Rail (*Rallus limicola*)

Range

Found breeding in suitable habitat throughout northern North America with wintering grounds composed by wetlands along the Gulf Coast and into Mexico.



Habitat

Prefers early-successional marshlands with little standing-dead vegetation to impede movement and foraging. Nests in similar habitat over water in a woven nest concealed by marsh vegetation. Utilizes mudflats and shallow water (<6 in deep) in emergent wetlands for foraging with a vegetative canopy seeming to be an important component. Areas of open water near foraging habitat are important for increased invertebrate production.

Conservation Status

This species faces to different threats to its continued presence and prevalence in the Commonwealth. The first is the destruction of existing marsh habitat through draining, filling, flooding, development, and invasion by non-native invasive species. The second is the succession of existing wetland habitat into an unsuitable tangle of standing-dead vegetation that the Virginia Rail cannot use. To maintain this species in the Commonwealth existing marshlands must be protected from modification or destruction. Additionally, early-successional marsh habitat composed of native wetland species must be created on a regular basis to provide for adequate nesting and foraging habitat.

References

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Barn Owl (*Tyto alba*)

Pennsylvania Candidate Rare Bird Species

State Rank: S3B; S3N (Vulnerable, Breeding and Non-breeding), Global Rank: G5 (secure)

Identification

The Barn Owl (*Tyto alba*) is a member of the family Tytonidae, the only representative of that family occurring in the United States. Barn Owls are on average 14 inches long with a wingspan of 44 inches. It is a large, nocturnal, and predatory bird with a large rounded head. It has pale facial disks with a dark frame. This species has tawny and gray upperparts with small black and white spots, and white underparts with scattered dark spots. The two sexes are similar to each other. The Barn Owl is easily distinguished from other owls by its face pattern. Flight patterns are similar to Long-eared and Short-eared Owls but lacks dark wrist marks.

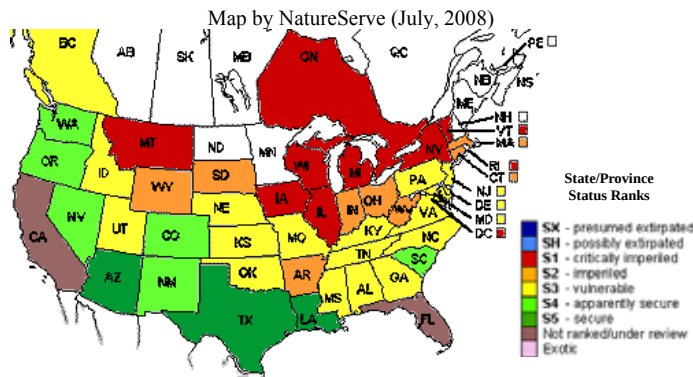
Range

Barn Owls have a nearly worldwide distribution, being absent from only the high latitudes. It is found throughout most of the United States and it frequents open areas with suitable nesting areas in Pennsylvania.

Habitat

Barn Owls require open areas with cavities for nesting. These cavities can be natural tree cavities or human-made structures such as church steeples, barns, abandoned buildings, or even nest boxes. This species needs a good population of small rodents, especially meadow voles (*Microtus pennsylvanicus*). In winter, Barn Owls will sometimes roost in dense conifer trees, even plantations.

North American State/Province Conservation Status



Conservation/Status

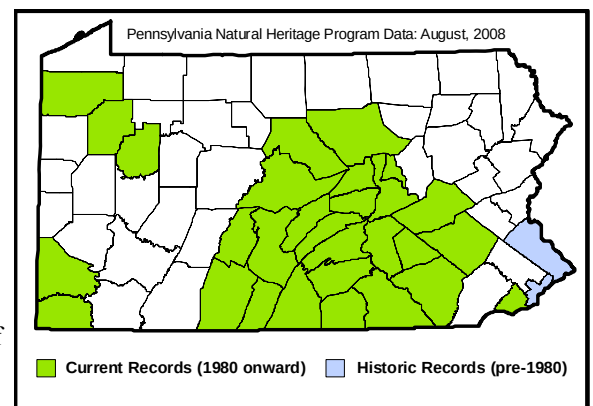
Barn Owls were undoubtedly rare in Pennsylvania before the cutting of the primeval forests. This species became common in the early 20th century, with many open farmlands containing optimum habitat for this species and their major prey, meadow voles. Changing land use and agricultural practices have led to a decline in Barn Owl populations. Shifting from pasture to row crops and a loss of nesting sites are the most serious problems for this species, which also result in lower meadow vole populations. This species, despite populations being secure globally, should be monitored to ensure that the Barn Owl continues to be a breeder in Pennsylvania.

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Barn Owl (*Tyto alba*) owlets in nest box and adult perched in a barn.



Eastern Mud Turtle (*Kinosternon subrubrum subrubrum*)

Pennsylvania Turtle Species of Concern

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

The Eastern Mud Turtle is one of North America's smallest turtles, rarely exceeding 95mm (approximately 4") in length. The unpatterned shell of the Eastern Mud Turtle may vary from light brown, to olive, to nearly black. The plastron, or undershell, is usually yellowish with hints of brown. This is the only species in the Commonwealth that has two hinges on the plastron, which can be drawn upward to conceal its head and appendages from predators. The tail of the Eastern Mud Turtle is greatly developed, especially in males, and is tipped by a sharp "nail". The chin and neck of the species may be striped and stippled with yellow. The Eastern Mud Turtle may easily be confused with the much more common Eastern Musk Turtle, also known as the Stinkpot Turtle (*Sternotherus odoratus*). These species are most easily distinguished from the size and shape of the plate-like scutes on the plastron.



photo source: Charlie Eichelberger

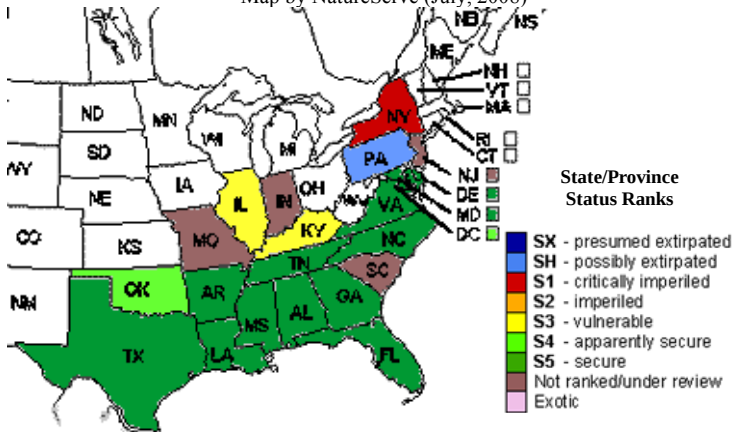
Eastern Mud Turtle (*Kinosternon subrubrum subrubrum*)

Range

Eastern Mud Turtles are found along the Coastal regions of New York State, southward to Florida, along the Gulf Coast states and north along the Mississippi River drainage to Illinois and Indiana. In Pennsylvania, the species is confined to the coastal plain, and has been known from Delaware, Bucks, Montgomery, and Philadelphia Counties. Today, only two extant populations are known from the Commonwealth. Years have gone between sightings of this species in the state, and it has never been common in Pennsylvania. The recent "rediscovery" of the Eastern Mud Turtle in the state has led the Pennsylvania Biological Survey to move the status from "historic" to "critically imperiled".

North American State/Province Conservation Status

Map by NatureServe (July, 2008)

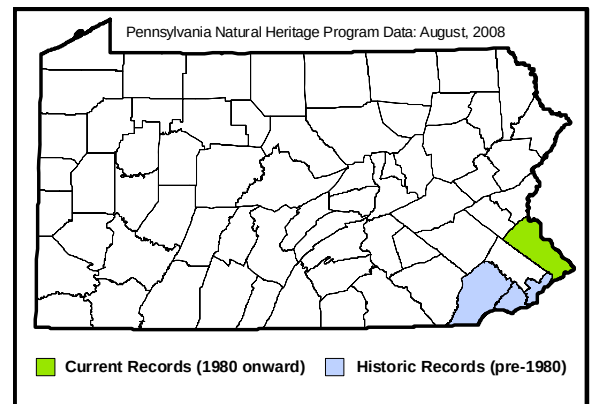


Habitat

Eastern Mud Turtles are primarily an aquatic species, though overland travel for males is quite common during the late spring. The aquatic habitats used by this turtle are mixed, from shallow ephemeral depressions that may only be wet for a few days following a rain event, or wetlands over a meter (approximately 3') deep. Eastern Mud Turtle wetlands are typified by soft muddy bottoms, and abundant vegetation. Both fresh and brackish waters may be inhabited by the Eastern Mud Turtle. Though the turtle may exist in high densities in certain parts of the range, it is largely secretive, and usually only encountered if specifically searching for it.

Conservation Status

Unfortunately, the Eastern Mud Turtles range in Pennsylvania overlaps those areas which have been drastically altered by development, and encroachment on the remaining habitat for this species continues. Pockets of habitat still exist in the Commonwealth on both private and public lands, and these remaining wetlands may be extensive enough to keep this rare turtle as a member of Pennsylvania's herpetofauna. Due to its secretive nature, intensive surveys for this species are needed to adequately establish its status in the remaining patches of habitat.



References

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- Pennsylvania Natural Heritage Program. 2008.



Red-bellied Turtle (*Pseudemys rubriventris*)

Pennsylvania Threatened Turtle Species

State Rank: S2 (Imperiled) Global Rank: G5 (Secure)

Identification

The Red-bellied Turtle (*Pseudemys rubriventris*) is one of Pennsylvania's largest turtles. The carapace, or upper shell, is brown to black with reddish bars on some of the plate-like scutes. The plastron, or under shell, varies from pink to red and the head, neck and legs are covered with bright yellow lines in younger individuals. Markings may become less obvious with age and some older turtles are almost completely black above with few distinguishing characteristics. Confusing species are Painted Turtles (*Chrysemys picta*) and the introduced Red-eared Slider (*Trachemys scripta*). Painted Turtles can be distinguished by the light borders along the carapace seams and smaller size in adults. Red-eared Sliders are similar in size and coloration; however the presence of a red "ear patch" can sometimes be used to identify this species. Like the Red-bellied Turtle, Painted Turtles and Sliders may darken with age making it difficult to differentiate between the species.



An adult Red-bellied Turtle (*Pseudemys rubriventris*) showing the distinctive reddish bars on its scutes.

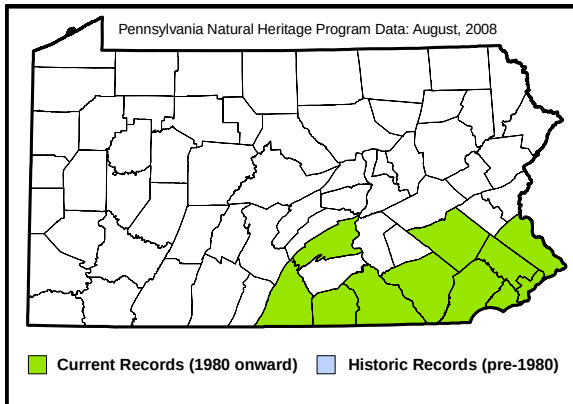
photo source: Jay Drashner

Range

Red-bellied Turtles range from New York to North Carolina and has been introduced into some areas around the United States.

Habitat

This aquatic species is primarily found in large water bodies including lakes, ponds, marshes, slow-moving rivers and creeks. Red-bellied Turtles prefer deeper water with sandy or muddy substrate and require aquatic vegetation. This species also depends on abundant basking sites and spend a great deal of time perched on logs and downed trees. Nesting sites are in upland habitat and usually within 100 meters of the water, though they have been known to nest up to 250m from water. Eggs are laid in sandy or loamy soil, in clutches of 10 to 12.

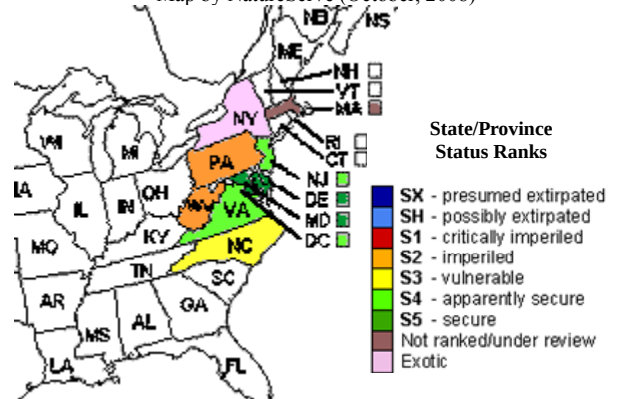


Conservation Status

The Red-bellied Turtle is listed as a threatened species in our state. Though we are on the edge of its range, many factors contribute to the threatened status of this species in Pennsylvania. In the late 1800's, this species was captured and sold as a food item in large metropolitan markets. The population in the east was significantly reduced through collection. Currently, threats to this species include loss of habitat through development, reductions in site and water quality, and threats from exotic species. The range of the Red-eared Slider is expanding and the Red-bellied Turtle may have to compete with the exotic Slider in some areas. Road mortality is an issue for females traveling away from water to lay eggs. Also, nest predators such as raccoon, opossum, skunk and fox can significantly decrease nesting success of this species. More information is needed on the life history of this species and factors affecting populations in the state.

North American State/Province Conservation Status

Map by NatureServe (October, 2008)



References

- Hulse, A.C., C.J. McCoy and E.J. Censky. 2001. Amphibians and Reptiles of Pennsylvania and the Northeast. Cornell University Press, New York. 419pp.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- PA Department of Conservation and Natural Resources Website. Wild Resource Conservation Fund, Endangered and Threatened Species in Pennsylvania. Redbelly Turtle: www.dcnr.state.pa.us/wrcf/rbturt.htm.
- Pennsylvania Natural Heritage Program. 2008.



Southern Leopard Frog (*Lithobates sphenoccephala*)

Pennsylvania Endangered Frog Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

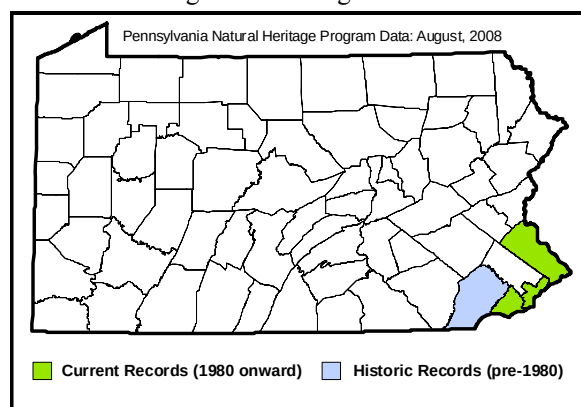
Identification

The Southern Leopard Frog is typically 50-80mm (2" to 3¼") long, and has a narrow snout. The color of the Southern Leopard Frog is quite variable, with some individuals being green, some dark brown, and every shade in between. The belly of the frog is white. A conspicuous white spot can be found in the center of the tympanum, or ear spot. Breeding calls of this species has been likened to the sound of muffled laughter, and this species is known to only call after dark. The Southern Leopard Frog may be confused with the Northern Leopard Frog (*Lithobates pipiens*) or the Pickerel Frog (*Lithobates palustris*). The Northern Leopard Frog has been found nearly statewide, but does not tolerate the brackish waters often inhabited by its southern cousin. Lacking the Southern Leopard Frog's tympanic white spot, the Northern Leopard Frog has suffered declines and is also considered a species of concern in the Commonwealth. The Pickerel Frog is a very common species, and while spotted like the Leopard Frogs, the Pickerel Frog has squarish spots and a yellow tinge between the hind legs and on the lower portion of the belly. The Pickerel Frog can be found statewide, and is typically associated with vegetated flowing streams and creeks.



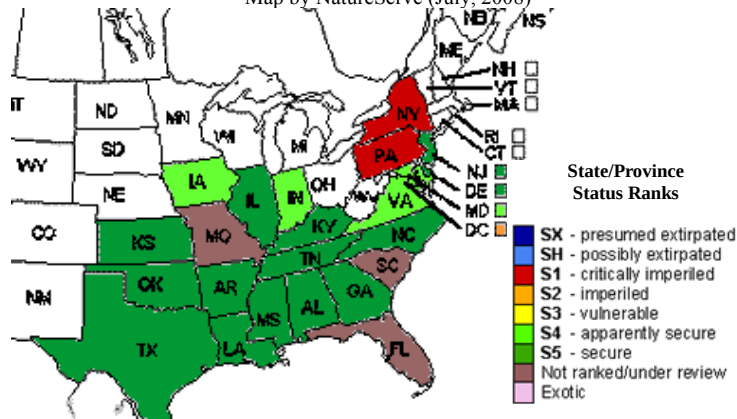
photo source: Tom Diez

Southern Leopard Frog (*Lithobates sphenoccephala*) with prominent white spot on the tympanum.



North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

The Southern Leopard Frog's range in the Commonwealth is limited to the southeastern corner. Outside of Pennsylvania this species' range extend from coastal New York south along the seaboard to Texas.

Habitat

Southern Leopard Frogs frequent vegetated edges of shallow wetlands, along the Coastal Plain Province of Pennsylvania. The species is very skittish, and will flee into water, or into thick vegetation at the slightest sign of alarm. Breeding typically occurs in April, with tadpoles transforming into froglets and becoming terrestrial in June. While the breeding wetlands are typically open habitats, outside of the breeding season, Southern Leopard Frogs are known to frequent shaded areas with large areas of grass, rush, and sedge cover. Adults may travel quite a ways from the breeding wetlands.

Conservation Status

The Southern Leopard Frog has always been rare in Pennsylvania. Limited Coastal Plain habitat exists in the state, and the remaining areas were habitat for these frogs exists are under continual developmental pressure. Populations of Southern Leopard Frogs have declined due to habitat destruction and many historic locations are now developed and will never be suitable for Southern Leopard Frogs. The apparent population decline, and the widespread destruction and modifications of habitat for these frogs has led the Pennsylvania Fish and Boat Commission to list the Southern Leopard Frog as an endangered species.

References

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- Pennsylvania Natural Heritage Program. 2008.



Eastern Mudminnow (*Umbra pygmaea*)

Pennsylvania Proposed Freshwater Fish Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

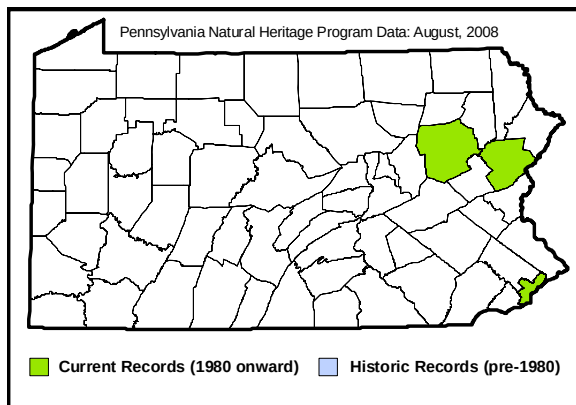
The eastern mudminnow is a small fish that grow up to 15 cm in total length, but is generally much smaller. This small fish may be confused with a darter (family Cyprinodontidae), but it is actually in the same order as trout and salmon (Salmoniformes). It has cycloid (round) scales, one dorsal fin, small abdominal pelvic fins, and no fin spines. A black bar is present at the base of the tailfin. The back and sides have 10-14 dark brown stripes noticeable on the paler body.

Spawning in spring, the eastern mudminnow deposits adhesive eggs singly on aquatic plants or in a hollowed out nest in algae, which it guards. The eastern mudminnow is able to tolerate extremely low levels of oxygen and hides by burrowing beneath debris. Feeding opportunistically, their diet is noted for containing insects, crustaceans, gastropods, and many other small aquatic fauna and they are noted for occasionally leaping from the water while feeding.

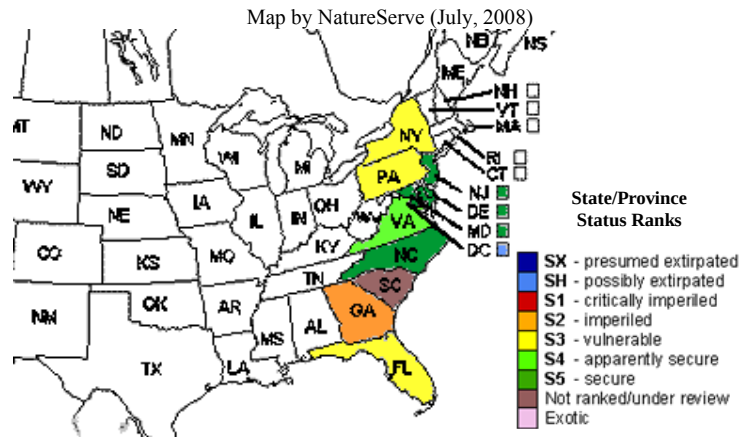


Eastern mudminnow (*Umbra pygmaea*) collected in the Philadelphia area.

photo source: Paul Overbeck, ANSP



North American State/Province Conservation Status



Range

Found only within the lower Delaware River watershed in Pennsylvania, eastern mudminnows occur along the Atlantic and Gulf slopes from New York to Florida.

Habitat

Found in quiet, mud-bottomed, often heavily vegetated streams, sloughs, swamps, and ponds, eastern mudminnows prefer the margins of their habitat and areas over sand, mud, and debris where there is the potential to quickly burrow into the substrate and escape from predators.

Conservation Status

The eastern mudminnow is common over most of its wide U.S. Atlantic slope range, but at the extremes of its range it is relatively uncommon. In Pennsylvania the species is uncommon with its primary habitat, backwater wetland in the lower Delaware River watershed, highly degraded where they still exist.

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- Pennsylvania Natural Heritage Program. 2008.



Green Floater (*Lasmigona subviridis*)

Freshwater Mussel Species of Concern

State Rank: S2 (imperiled), Global Rank: G3 (vulnerable)

Identification

The green floater (*Lasmigona subviridis*) is a small mussel, usually less than 55 mm in length. The shell is thin and the mussel has a subovate or trapezoidal shape. The color varies from a dull yellow to green with many dark green rays visible, especially in young individuals. This species may be confused with the creek heelsplitter (*Lasmigona compressa*) (NatureServe 2005; Strayer and Jirka 1997). The creek heelsplitter is larger, thicker shelled, and less ovate. Also, the creek heelsplitter has only been found in the Ohio River Drainage in Pennsylvania while the green floater is also present in the Susquehanna and Delaware River Drainages.

Habitat

The green floater is often found in small creeks and large rivers and sometimes canals. This species is intolerant of strong currents and occurs in pools and other calm water areas (NatureServe 2005, North Carolina Mussel Atlas, Strayer and Jirka 1997). Preferred substrate is gravel and sand in water depths of one to four feet. This species is more likely to be found in hydrologically stable streams, not those prone to flooding and drying. Good water quality is also important for this mussel species (North Carolina Mussel Atlas).

Host Fish

Glochidial (larval) hosts for the green floater are not known (NatureServe 2005, Strayer and Jirka 1997).

Status

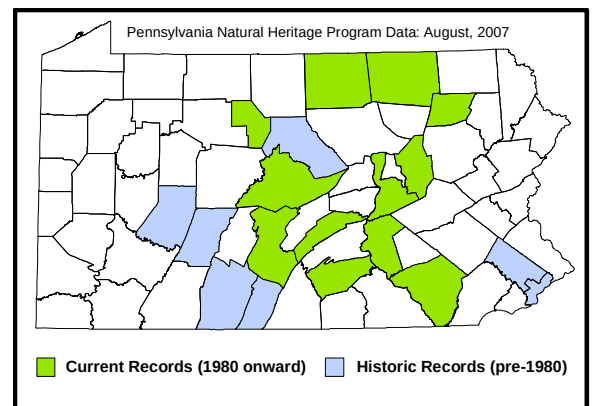
From New York south to Georgia and west to Tennessee the green floater is found. This species is not very common in Pennsylvania, but has been found in the Susquehanna, Delaware, and Ohio River Drainages (NatureServe 2005). The state status of the green floater is imperiled (S2), as it is not frequently encountered within its expected range (www.naturalheritage.state.pa.us/invertebrates.aspx). The small size of this species may make it difficult to locate live animals during surveys. Shells of dead green floaters tend to get buried in the surrounding habitat. More extensive surveys are necessary to determine the current status of this species in Pennsylvania and the United States.

The green floater was listed as threatened in an assessment of the conservation status of the freshwater mussels of the United States by the American Fisheries Society (Williams et al. 1993). The green floater has been historically widespread in the Susquehanna River drainage in New York; however, populations have declined since the early 1990s, probably due to pollution (Strayer and Jirka 1997). Decline in the abundance of this species in other places could be due to stream transport of their preferred habitat, as well as increases in pollutants. The introductions of zebra mussels and Asian clams have also negatively impacted abundance of this species in surveys. However, since this mussel species is hermaphroditic, small populations might survive slightly better than other mussel species in less than ideal conditions (NatureServe 2005).



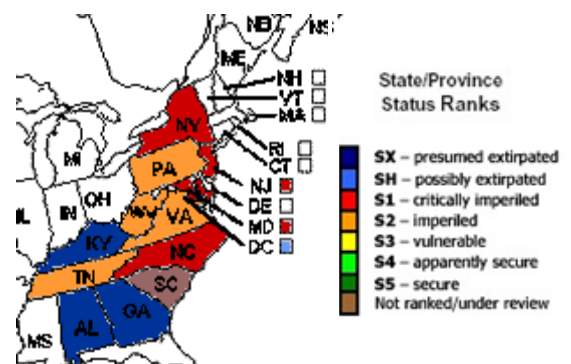
Green floater (*Lasmigona subviridis*)

photo source: PNHP



North American State/Province Conservation Status

Map by NatureServe (July, 2007)



References

- NatureServe Explorer: An online encyclopedia of life [web application]. 2005. Version 4.5. Arlington, VA. Website: www.natureserve.org/explorer.
- North Carolina Mussel Atlas, Species Information and Status. Website: www.ncwildlife.org/pg07_WildlifeSpeciesCon/pg7b1a1_9.htm
- Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx
- Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, NY 113pp and plates.
- Williams, J.D., M.L. Warren, K.S. Cummins, J.L. Harris, and R.J. Neves. 1993. Conservation Status of Freshwater Mussels. Fisheries 18(9): 6-22.



Halloween Pennant (*Celithemis eponina*)

Pennsylvania Dragonfly Species of Concern

State Rank: S2S3 (Imperiled/Vulnerable) **Global Rank: G5** (Secure)

Identification

One of the most easily identified dragonflies in Pennsylvania, the Halloween pennant (*Celithemis eponina*) displays a combination of black markings on otherwise orange-yellow wings, which distinguish it from other similarly marked pennants (*Celithemis* spp.). A mid-sized dragonfly, this species has a 2 to 3 inch wingspan and is around 1.5-inches long with a pale yellow to red body. A slower flyer than many other dragonfly species, the Halloween pennant will often flutter and float in a manner reminiscent of a butterfly.

Range

Found in a variety of wetlands across Pennsylvania, this species has an extensive range across the eastern United States and is known to fly year-round in Florida.

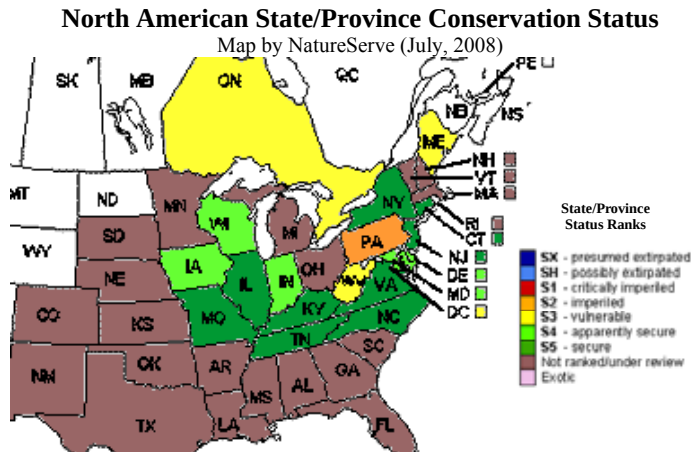


photo source: Andrew Strassman, PNHP

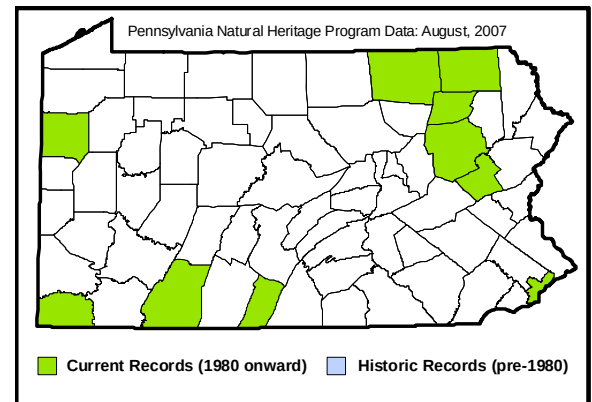
A Halloween Pennant (*Celithemis eponina*) on a hunting perch.

Habitat

Somewhat a generalist, this species is noted from many different types of wetlands. Adults are known to frequent upland meadows and grasslands where they will pick the top of a tall plant or bush to use as a hunting perch.

Conservation Status

Like many odonates (dragonflies and damselflies), this species utilizes very different habitats throughout its life cycle. As a nymph this species requires a healthy aquatic system in which to hunt, grow, and find shelter from predators. As an adult this species needs a vegetated wetland shoreline with safe connections to open meadows and grasslands in which it can hunt and mature before returning to the wetlands to lay eggs. If any of these habitats are missing, not connected, or very degraded, the species will be lost from the system.



References

- Dunkle, S. W. Dragonflies through Binoculars: A Field Guide to Dragonflies of North America. Oxford University Press; New York, 2000.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Nikula, B., Loose, J.L., and M.R. Burne. A Field Guide to the Dragonflies and Damselflies of Massachusetts. Massachusetts Division of Fisheries and Wildlife; Natural Heritage & Endangered Species Program, 2003.
- Pennsylvania Natural Heritage Program. 2008.



Big Bluet (*Enallagma durum*)

Pennsylvania Damselfly Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

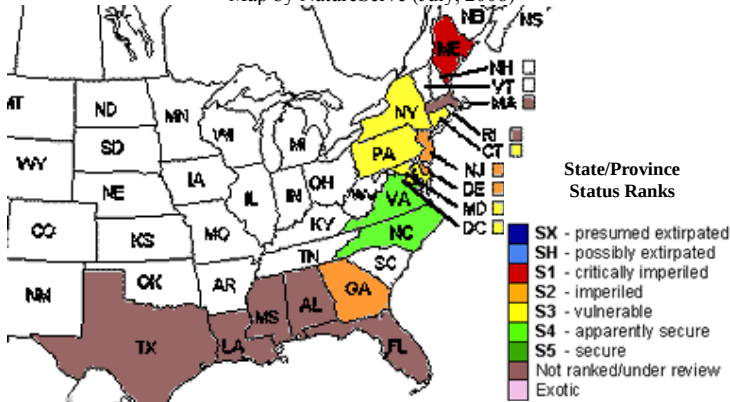
While all bluet damselflies are superficially similar in appearance, the big bluet (*Enallagma durum*) is relatively easily to distinguish from other bluets. One of the largest bluets in Pennsylvania at 1.3- to 1.7-inches the males of this species also have arrow-shaped black markings along the top of their abdomen. Females, which may have either a green or blue body, are distinguishable from other bluet females by their large size, but positive identification can only be accomplished by examining them under a microscope.

Range

Noted along the coastline of the Gulf of Mexico through Florida and northward to Maine.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Conservation Status

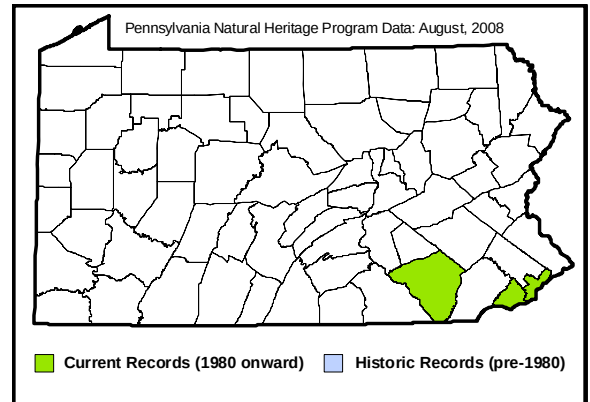
Preservation of this species in the Commonwealth will require the protection and restoration of the few areas of remaining tidal marsh along the Delaware River. Additionally, shade-providing vegetation along marsh and river edges appears to be important to maintaining populations of this species and will need to be restored in areas where it has been removed.



Adult male Big Bluet (*Enallagma durum*)

Habitat

This species is noted from coastal and tidal waters often favoring brackish wetlands. Also found near ponds and large, slow rivers near the shore, this species is noted from the lower Delaware and Susquehanna Rivers in the Commonwealth.



References

- Lam, E. Damselflies of the Northeast; A guide to the species of eastern Canada and the northeastern United States. Biodiversity Books; Forest Hill, NY, 2004.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Nikula, B., Loose, J.L., and M.R. Burne. A Field Guide to the Dragonflies and Damselflies of Massachusetts. Massachusetts Division of Fisheries and Wildlife; Natural Heritage & Endangered Species Program, 2003.
- Pennsylvania Natural Heritage Program. 2008.



Slaty Skimmer (*Libellula incesta*)

Pennsylvania Dragonfly Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Mature male slaty skimmers (*Libellula incesta*) have a unique coloration for dragonflies found in the Commonwealth. The slaty skimmer is unique with dark red-brown eyes on a black head and an unmarked blue-black body. Females are similar to many other species and are best identified by a dark face and dull brown body with cream-ivory marks on the sides from the thorax extending back along the abdomen. Both sexes have black stigmas (the colored wing cells at the tips of the wings) on otherwise clear wings with black veins. This can further distinguish them from species such as the great blue skimmer and bar-winged skimmer (*L. vibrans* and *L. axilena*).

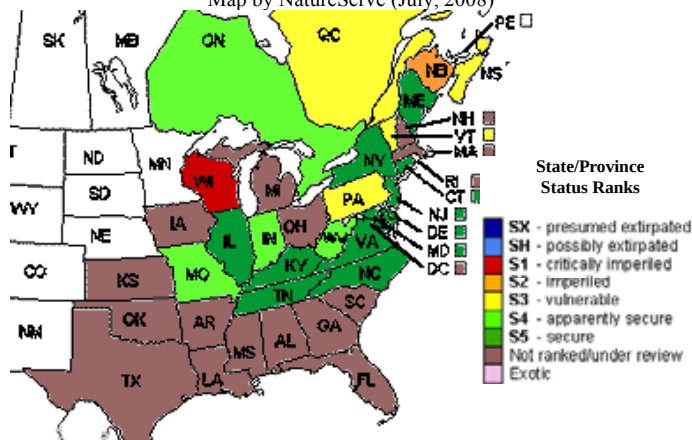


photo source: Andrew Strassman, PNHP

Slaty Skimmer (*Libellula incesta*)

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Range

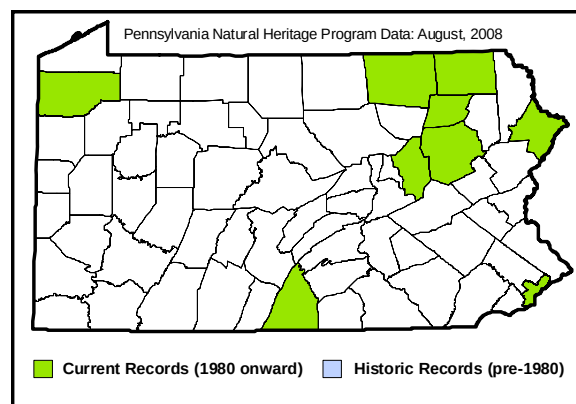
Wide-spread across the eastern United States and southern Canada south to the Gulf of Mexico and west to central Texas and Wisconsin.

Habitat

Prefers wetlands and slow moving rivers with mucky bottoms. Often associated with forested wetland edges and even found in bogs in northeastern and northwestern Pennsylvania.

Conservation Status

As with all Odonata (dragonflies and damselflies) the protection of wetlands and the connected supporting uplands is mandatory for the survival of this species. Utilizing very different habitats throughout its life cycle, this species relies upon intact wetland habitat as a nymph, but after emerging as an adult it needs adequate forested upland edge habitat where it can feed and mature before returning to the wetlands to reproduce. Removal of any portion of this habitat will result in the breaking of this species life cycle and its loss from the ecosystem.



References

- Dunkle, S. W. Dragonflies through Binoculars: A Field Guide to Dragonflies of North America. Oxford University Press; New York, 2000.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Nikula, B., Loose, J.L., and M.R. Burne. A Field Guide to the Dragonflies and Damselflies of Massachusetts. Massachusetts Division of Fisheries and Wildlife; Natural Heritage & Endangered Species Program, 2003.
- Pennsylvania Natural Heritage Program. 2008.



Needham's Skimmer (*Libellula needhami*)

Pennsylvania Dragonfly Species of Concern

State Rank: SH (Historic), proposed S1 (Critically Imperiled) **Global Rank:** G5 (Secure)

Identification

A coastal species common to the brackish backwaters and marshes along the Atlantic and Gulf of Mexico coastline, Needham's skimmer (*Libellula needhami*) has only recently been re-documented in the Commonwealth after a 50-year absence. A beautiful dragonfly with a 2-inches long golden-red body, this species is easily confused with several similar species. Two diagnostic characteristics are the brown vein on the inner leading edge of the wings and brown tibia on hind legs in contrast to the golden-winged skimmer (*Libellula auripennis*) which has entirely orange-yellow wing veins and black tibia on the hind legs. Both species are considered critically imperiled (S1) in Pennsylvania.



photo source: Andrew Strassman, PNHP

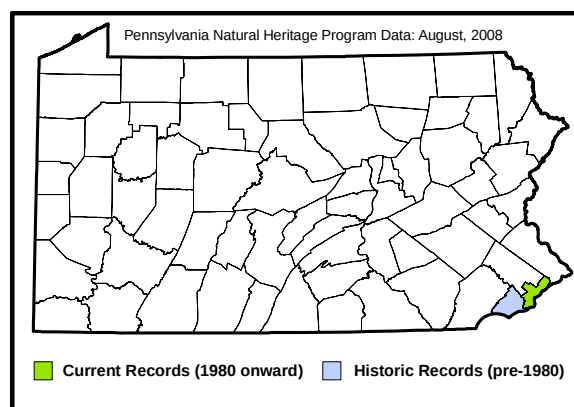
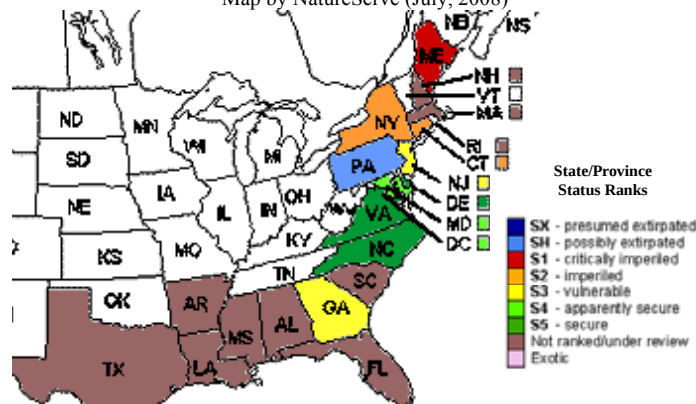
Needham's Skimmer (*Libellula needhami*)

Range

Found near coastal saltwater and brackish marshlands along the Atlantic and Gulf of Mexico shoreline from Texas north to Maine.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

Brackish marshlands, channels, backwaters, ponds, and eutrophied coastal farm ponds on occasion.

Conservation Status

Preservation of this species in the Commonwealth will require the protection and restoration of the few areas of remaining tidal marsh along the Delaware River. Like many odonates (dragonflies and damselflies), this species requires very different habitats throughout its life cycle. If any of these habitats are missing, not connected, or very degraded, the species will be lost from the system. As a nymph this species requires healthy aquatic system in which to hunt, grow, and find shelter from predators.

References

- Dunkle, S. W. Dragonflies through Binoculars: A Field Guide to Dragonflies of North America. Oxford University Press; New York, 2000.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Nikula, B., Loose, J.L., and M.R. Burne. A Field Guide to the Dragonflies and Damselflies of Massachusetts. Massachusetts Division of Fisheries and Wildlife; Natural Heritage & Endangered Species Program, 2003.
- Pennsylvania Natural Heritage Program. 2008.



Swarthy Skipper (*Nastra lherminier*)

Pennsylvania Butterfly Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Easily identified by its utter plainness, the Swarthy Skipper (*Nastra lherminier*) is noted for its total lack of distinguishing marks or coloration. The entire skipper is a dull brown above and below, but with obviously raised and lighter wing veins on close examination. Like most skippers, this species is small and easy to over look at only $\frac{3}{4}$ -inch. Possessing another of the tendencies of skippers, this species rarely sits still for very long even when feeding on nectar from flowers.

Adult Swarthy Skippers can be seen in the Commonwealth with two flights of adults during the summer.. The first brood flies in mid-summer with the second brood overwintering in the duff as pupa to emerge as adults the next spring.

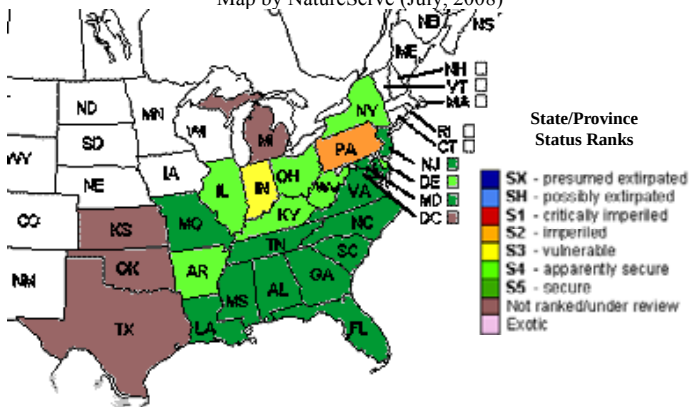


photo source: Andrew Strassman, PNHP

Swarthy Skipper (*Nastra lherminier*) on a bull thistle

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

The caterpillars of this species feed exclusively on little bluestem grass (*Schizachyrium scoparium*). Little bluestem is a shade-intolerant bunch grass that needs dry open areas such as roadsides, old meadows, and grasslands. A lack or loss of little bluestem precludes the continued presence of Swarthy Skippers in the ecosystem. Butterfly adults also require flowering plants for nectar food. The swarthy skipper appears to be a generalist that will nectar on most available flowers.

Conservation Status

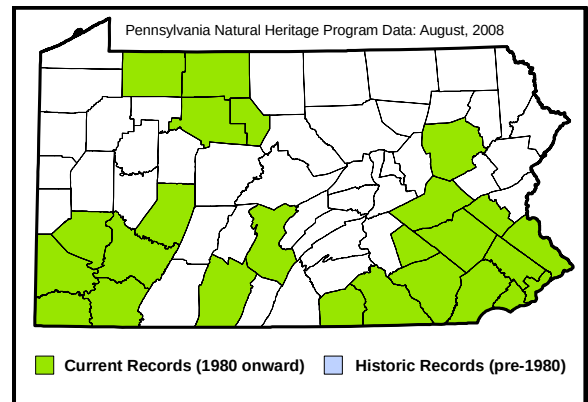
This species requires a simple combination of its host plant, little bluestem (*Schizachyrium scoparium*) and access to flowering plants. Suitable habitat for this species is common throughout the Commonwealth. It is very likely that the Swarthy Skipper is more common than is currently known. Nonetheless, it is important to preserve and maintain the early-successional habitat where this species occurs in order to assure its continued presence in the state.

References

- Glassburg, J. Butterflies through Binoculars, The East; A field guide to the Butterflies of Eastern North America. Oxford University Press; New York, 1999.
- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.

Range

Found across the eastern United States.



Pennsylvania Natural Heritage Program

Salt-marsh Water-hemp (*Amaranthus cannabinus*)

Pennsylvania Rare Plant Species

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Salt-marsh Water-hemp is a perennial herb with a hairless stem that may grow up to 8 feet (2.5 meters) in height. The leaves are alternately arranged, lance-shaped, not toothed on the margin, up to 6 inches (15 cm) in length and 1.5 inches (4 cm) in width, with a well developed stalk at the base and pointed at the tip. The flowers, appearing from July to September, lack petals and are greenish in color, and are arranged in elongate spikes at the top of the stem. The male and female flowers occur on separate plants. The individual fruit is sac-like, to about 4 mm in length, and contains a single seed.

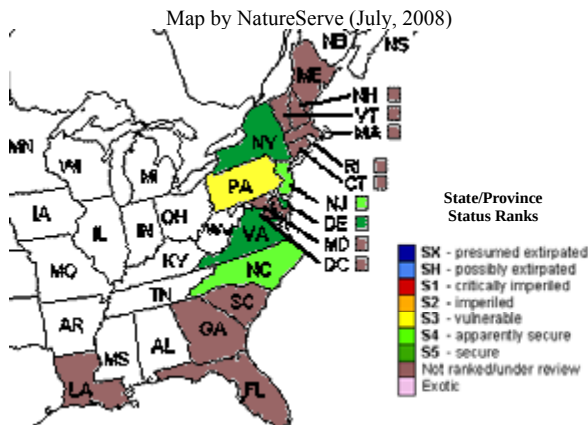
Distribution

Salt-marsh Water-hemp has a distribution from Maine south along the coast into Florida and west into Louisiana. In Pennsylvania, it has been documented in a few southeastern counties along the Delaware River.

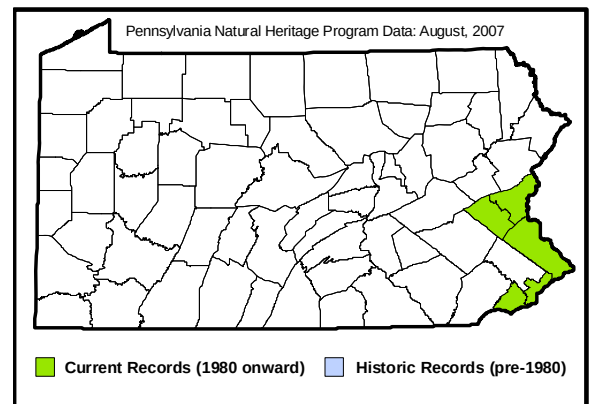


photo source: PNHP

North American State/Province Conservation Status



Salt-marsh water-hemp (*Amaranthus cannabinus*)



Habitat

Salt-marsh Water-hemp grows in intertidal marshes, mudflats, and river shores, where it is subjected to daily fluctuations in water levels.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Salt-marsh Water-hemp a rarity status of Rare. The species has a very limited state range and a specialized habitat, yet appears to be relatively successful in maintaining itself, and does not appear to be endangered or threatened with extirpation. The habitat of this species has threats from exotic species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Eastern Baccharis (*Baccharis halimifolia*)

Pennsylvania Rare Plant Species

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

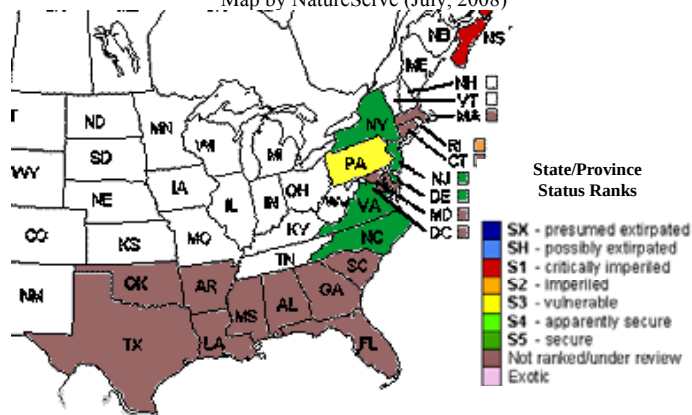
Eastern Baccharis is a slender shrub growing to 6 feet (2 meters) or more in height. The stems are hairless and angled. The leaves are alternately arranged, short-stalked, up to 2.5 inches (6 cm) in length and 1.5 inches (4 cm) in width, usually widest at or above the middle, coarsely toothed or less frequently not toothed on the margin, thickish in texture, and typically somewhat greasy or resinous to the touch. The flowers, appearing in September and October, are whitish and arranged in clusters at the top of the stem. Male and female flowers occur on separate plants, with the female plants being conspicuous when fruiting.



photo source: PNHP

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

Eastern Baccharis has primarily a coastal range from southeastern Canada south into Florida and west into Texas. In Pennsylvania, the species occurs at the edge of its range, and it has been documented historically in several southeastern counties. It also sometimes occurs farther inland, particularly along major highways.

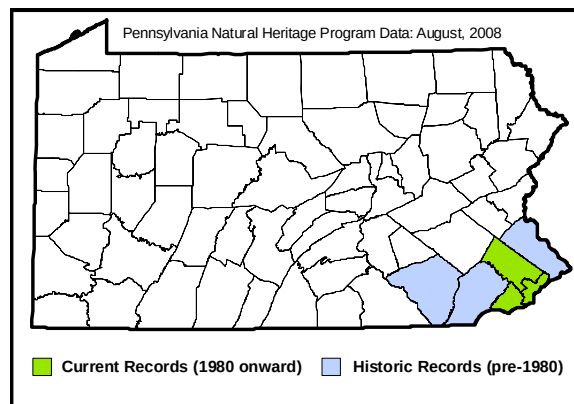
Habitat

Eastern Baccharis grows in natural coastal wetlands, but also thrives in certain types of drier disturbed ground, such as clearings, railroad grades, and along highways where there has been considerable road salt application.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Eastern Baccharis a rarity status of Rare, in order to balance the relatively few populations that have been documented and the small state range with the relative adaptability of the species in being able to colonize disturbed habitats and thus not appearing to be endangered or threatened with extirpation. The conservation of the species in Pennsylvania has concentrated on identifying populations that grow in more natural habitats as compared with those found in disturbed sites, with the natural habitats having threats from exotic species, dredging and filling, and water pollution.

Eastern baccharis (*Baccharis halimifolia*) flowers



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Swamp Beggar-ticks (*Bidens bidentoides*)

Pennsylvania Endangered Plant Species

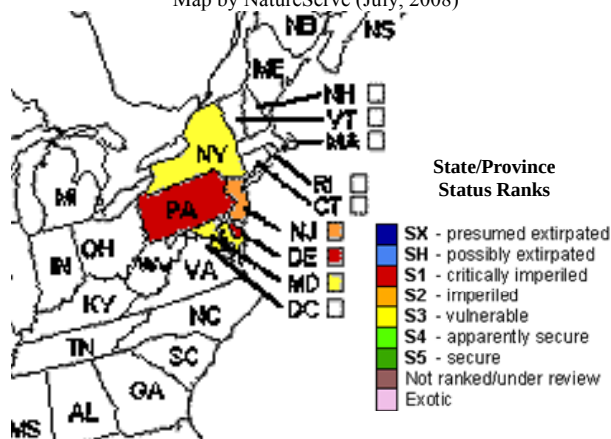
State Rank: S1 (Critically Imperiled) **Global Rank: G3G4** (Vulnerable/Apparently Secure)

Identification

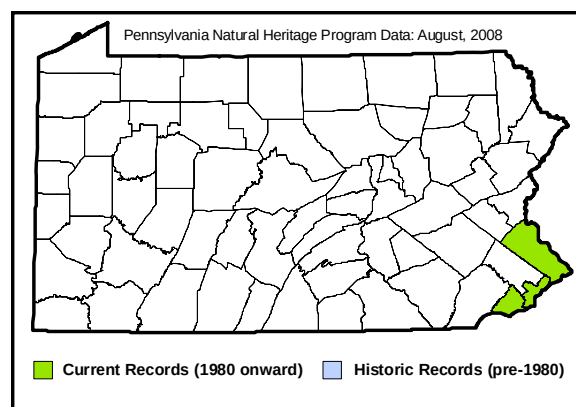
Swamp Beggar-ticks is an annual herb that can grow to 3 feet (1 meter) in height, but is often smaller. The leaves are oppositely arranged, lance-shaped, from 1.5 to 4 inches (4 to 10 cm) in length and to 0.75 inch (2 cm) in width, pointed at the tip, stalked at the base, and variably toothed on the margin. The flowers, appearing from August to October, have a yellow central disk and lack the conspicuous yellow ray flowers found in other species of the genus *Bidens*. The small individual fruits, less than ½ inch (about 1 cm) in length, have 2 slender barbed projections that aid in dispersal.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Blooming swamp beggar-ticks (*Bidens bidentoides*)



Distribution

Swamp Beggar-ticks has a relatively narrow range along the coast from New York south into Maryland. In Pennsylvania, it occurs on the edge of its range, and has been documented historically in a few southeastern counties along the Delaware River.

Habitat

Swamp Beggar-ticks grows in intertidal marshes, mudflats, and shores. The plants have a tendency to root on decaying wood, such as pieces of driftwood and old piers and boat docks.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Swamp Beggar-ticks a rarity status of Endangered, based on the limited global and state range, the relatively few populations that have been confirmed, the small population sizes, and the very specialized habitat. The known populations have threats from exotic species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Beggar-ticks (*Bidens laevis*)

Pennsylvania Plant Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Beggar-ticks is an annual or perennial herb with a hairless stem that may grow to 3 feet (1 meter) in height. The leaves are oppositely arranged, without a obvious stalk at the base, linear to lance-shaped, from 1.5 to 6 inches (4 to 15 cm) in length and to 1.5 inches (4 cm) in width, hairless on both surfaces, and toothed on the margin. The flowers, appearing from August to October, have conspicuous yellow ray flowers that are 0.5 to 1.25 inches (1.5 to 3 cm) in length. The individual fruits have slender barbed projections that aid in dispersal.

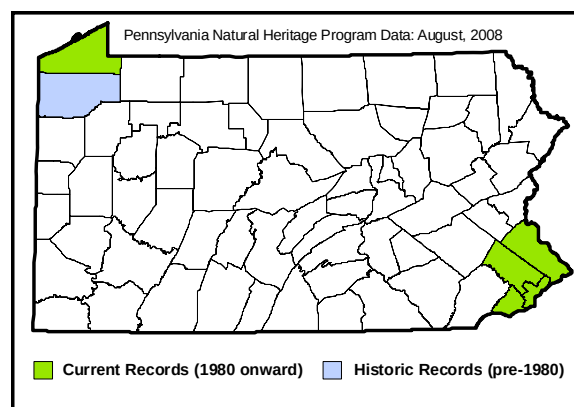


photo source: Ann Rhoads, Morris Arboretum

Beggar-ticks (*Bidens laevis*) in bloom

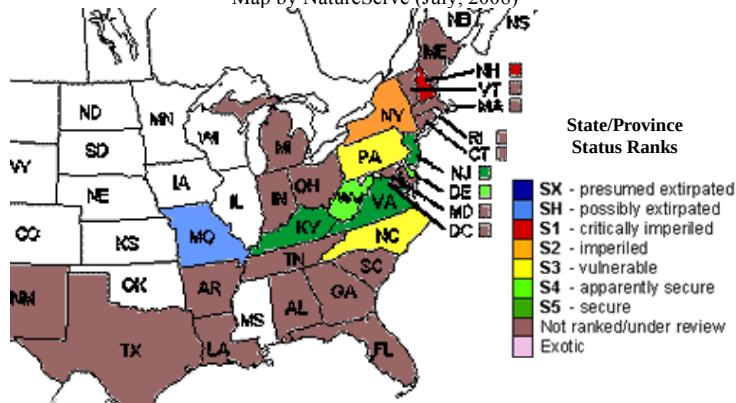
Distribution

Beggar-ticks has a range throughout much of the eastern and southern United States. In Pennsylvania, it has been documented historically in several southeastern and northwestern counties.



North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

Beggar-ticks grows in marshes, swamps, and on shorelines.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Beggar-ticks a rarity status of Undetermined until more field surveys are conducted in order to determine the current state status and conservation requirements of the species. The general habitat of this species has threats from exotic species and draining and filling.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



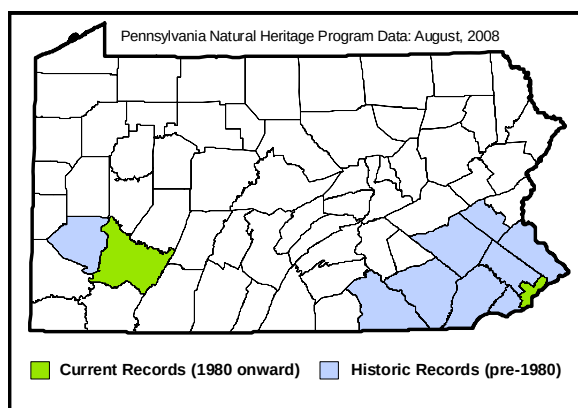
Field Dodder (*Cuscuta pentagona*)

Pennsylvania Plant Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

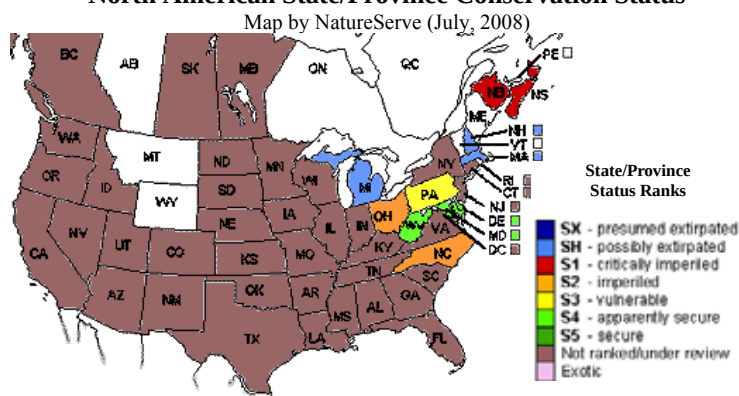
Identification

Field Dodder is an annual parasitic herbaceous vine, with the stems usually yellowish or orangish in color. The leaves are reduced to minute scales, which are scattered in an alternate arrangement along the stem. The flowers, appearing from June to September, are white and only 1 to 2 mm in length. The corolla lobes of individual flowers are about 1.0 mm in length, 5-parted and pointed in outline, distinguishing this species from numerous other species in the genus. The fruit is a many-seeded capsule.



One of the dodders (*Cuscuta* sp.) on a host plant.

North American State/Province Conservation Status



Distribution

Field Dodder has a range throughout North America. In Pennsylvania, it has been documented historically in numerous southern, especially southeastern, counties.

Habitat

Field Dodder grows in various types of open habitats, including old fields, clearings, thickets, and various sorts of open ground.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Field Dodder a rarity status of Undetermined, which means that more field surveys and analysis are required before a more permanent rarity status, if appropriate, can be designated.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
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Reflexed Flatsedge (*Cyperus refractus*)

Pennsylvania Endangered Plant Species

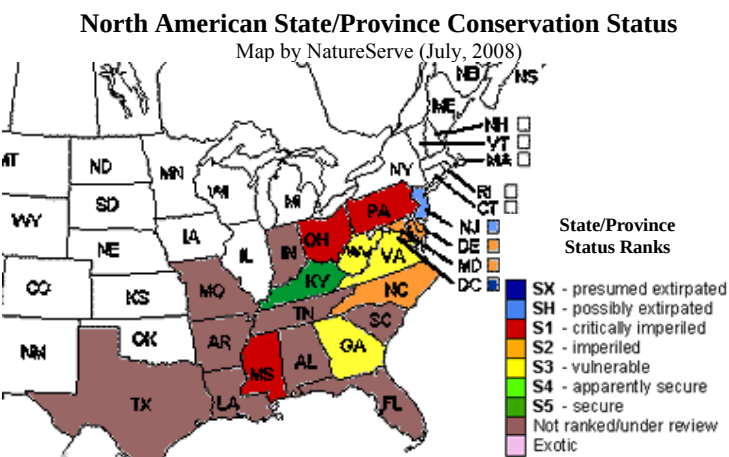
State Rank: S1 (Critically Imperiled) **Global Rank: G5** (Secure)

Identification

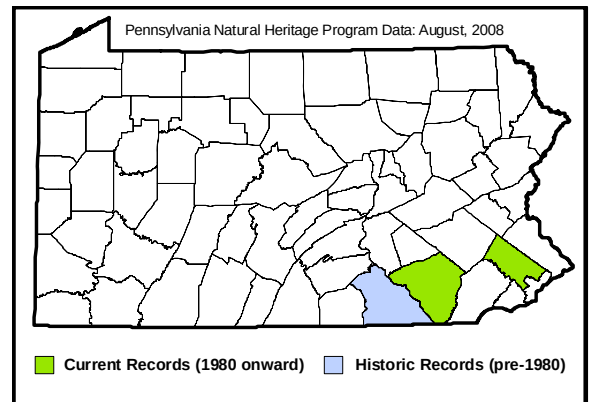
Reflexed flatsedge is a perennial herb with a triangular stem that grows from 1 to 2½ feet (3-8 dm) tall. The leaves are linear, V-shaped or flat, hairless, and up to 1/3 inch (8 mm) wide. The flowers, appearing from July to August, are grouped in loose, open spikes made up of 15 or more spikelets. Most of the spikelets extend horizontally or upward in a bottlebrush-like appearance, which helps to distinguish this species from similar species that have more downward-oriented spikelets. The spikelets are up to about 1 inch (2.5 cm) long and covered by several overlapping scales, which enclosed the small (1/8 inch, or 3 mm) fruits.

Distribution

Reflexed flatsedge has a range from southern Pennsylvania south and west into Florida and Texas. In Pennsylvania, this species reaches a northern border of its known range and has been documented historically in a few southeastern counties.



Reflexed flatsedge (*Cyperus refractus*) seed head



Habitat

Reflexed flatsedge grows on sandy shorelines and scoured river islands in the Susquehanna River, and elsewhere in dry woods.

State Status & Conservation

The PA Biological Survey (PABS) has assigned reflexed flatsedge a rarity status of Endangered, based on the few populations that have been recently documented and the very limited state range. The viability of the riverine populations of reflexed flatsedge and its habitat will require maintaining the natural hydrology of the Susquehanna River, with its seasonal fluctuations in water levels, as well as retaining the natural conditions of the shorelines and islands. In upland sites, given the preference of the species for relatively open habitats, active management – such as fire, mowing, or invasive species removal – may be required to maintain the proper successional stage.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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Walter's Barnyard-grass (*Echinochloa walteri*)

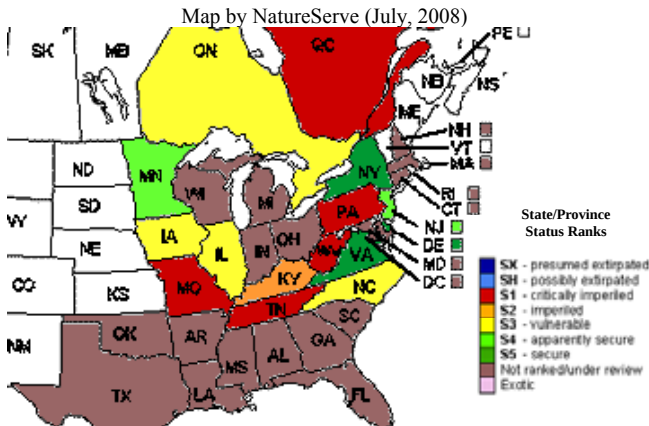
Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

Walter's barnyard-grass is an annual herb that may grow to 6 feet (2 meters) in height. The leaves are alternately arranged, lance-shaped, to about 1 foot (ca 30 cm) in length and about 1 inch (ca 2.5 cm) in width, usually long-hairy on the sheath portion that encloses the stem, parallel-veined, and not toothed on the margin. The flowers, appearing from August to September, are individually only a few millimeters in length and are aggregated in a branched cluster at the top of the stem. The small scales at the base of each flower have elongate needle-like projections, or awns, that give a bristly appearance to the flowering and fruiting clusters.

North American State/Province Conservation Status

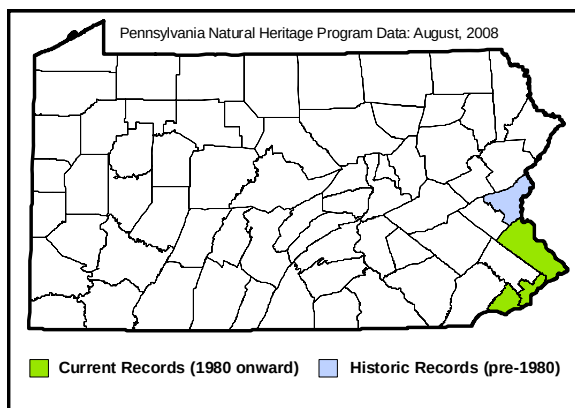


Distribution

Walter's Barnyard-grass has a range throughout the eastern half of North America. In Pennsylvania, it has been documented historically only in a few southeastern counties.

Habitat

Walter's Barnyard-grass grows in marshes, ditches and on shorelines, including intertidal wetlands.



State Status & Conservation

The PA Biological Survey (PABS) has assigned Walter's Barnyard-grass a rarity status of Endangered, based on the relatively few populations that have been documented and the restricted state range. The species does appear to be able to thrive in certain types of disturbed ground. The general habitat of this species has threats from exotic species, dredging and filling, and water pollution.



Walter's barnyard-grass (*Echinochloa walteri*)

photo source: PNHP

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
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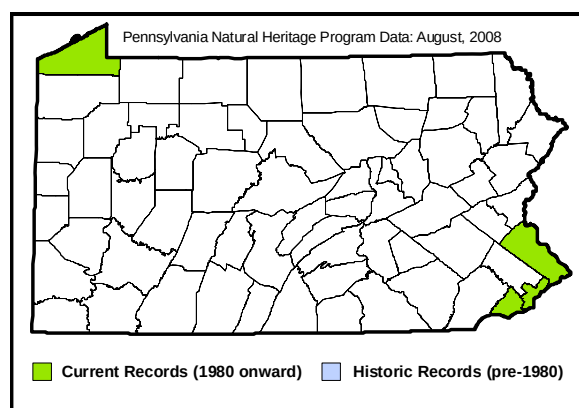
Little-spike Spike-rush (*Eleocharis parvula*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

Little-spike Spike-rush is a diminutive perennial herb typically only a few inches in height. The leaves are reduced to scales that are located at the base of the stem, which is the main photosynthetic portion of the plant. The flowers, appearing from June to September, are microscopic in size and are grouped together inside a scaly cluster at the top of the stem. The individual fruits are only about 1 millimeter in length and are 3-sided.



A clump of little-spike spike-rush (*Eleocharis parvula*)

Distribution

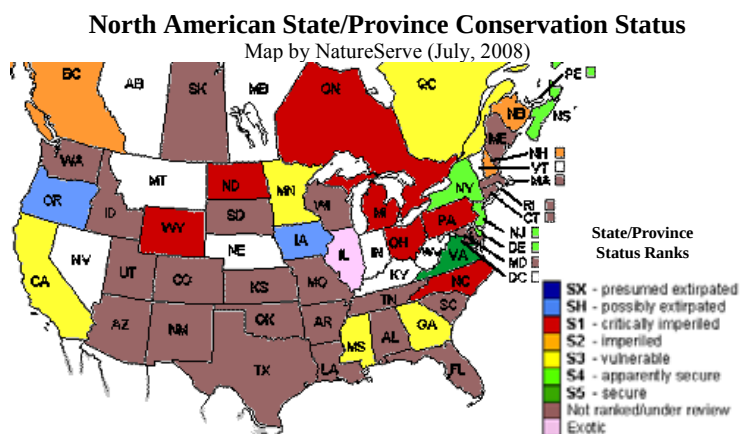
Little-spike Spike-rush has a range throughout North America. In Pennsylvania, it has been documented historically in a few southeastern counties and in Erie County.

Habitat

Little-spike Spike-rush grows in intertidal marshes, mudflats, and on shorelines. The intertidal populations are subjected to daily cycles of exposure and inundation.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Little-spike Spike-rush a rarity status of Endangered, based on the limited number of populations that have been confirmed, the small population sizes, the limited state range, and the specialized habitat. The known populations have threats from exotic species, dredging and filling, and water pollution.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Elephant's Foot (*Elephantopus carolinianus*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

Elephant's Foot is a perennial herb with a variably hairy stem that may grow to 3 feet (1 meter) in height. The leaves are arranged alternately, broadly elliptic in shape, shallowly toothed on the margin, more-or-less stalked at the base, hairy at least below, and to 10 inches (25 cm) long. The small, whitish or purplish individual flowers are grouped in flower heads, each of which is subtended by several leaf-like bracts that give the plant one of its distinctive features. The common name probably refers to the broad shape of the basal leaves in one of the species of the genus.

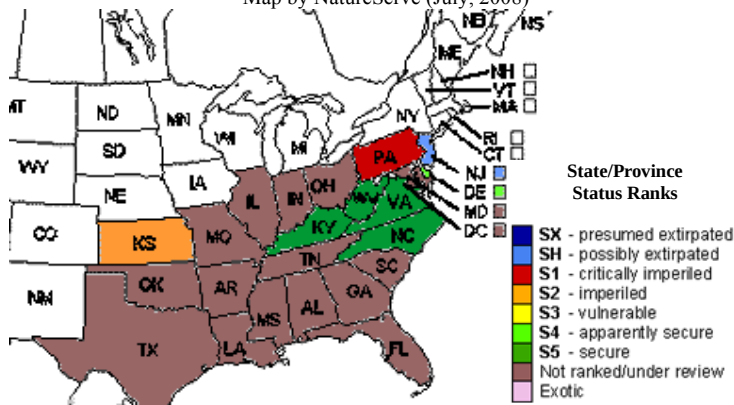


photo source: R Harrison Wiegand

Elephant's foot (*Elephantopus carolinianus*) flower

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

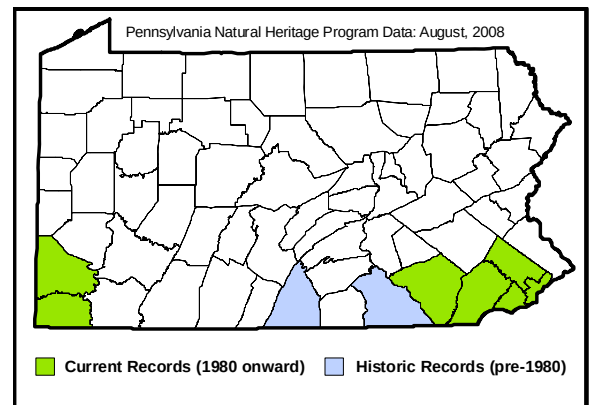
Elephant's Foot has a range from Pennsylvania west into Kansas and south into Texas and Florida. In Pennsylvania, it represents a southerly species and occurs at a northern border of its range, and has been found in several southern counties.

Habitat

Elephant's Foot grows in open woodlands, woodland borders, openings and clearings, and serpentine barrens, frequently in somewhat disturbed conditions.

State Status & Conservation

The PA Biological Survey (PABS) has currently assigned Elephant's Foot a rarity status of Endangered, because of the relatively few occurrences that have been confirmed and the limited state range. Recent field work has suggested that the species may be more frequent than current records indicate, and a different rarity status may be justified. Some populations of elephant's-foot are threatened by human-related habitat loss, natural succession, and invasive species. Since the species may occupy disturbed habitats, active management may be required to create the proper successional stage and ecological conditions for the species to thrive. .



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Round-leaved thoroughwort (*Eupatorium rotundifolium*)

Pennsylvania Plant Species of Concern

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Round-leaved Thoroughwort is a perennial herb with a hairy stem that may grow to 4 feet (1.3 meters) in height. The leaves are oppositely arranged, egg-shaped to orbicular, more-or-less stalkless at the base, rounded at the tip, toothed on the margin, prominently veined, and hairy on both surfaces. The flowers, appearing from June to October, are white and are grouped in clusters at the top of the stem.

Distribution

Round-leaved Thoroughwort has a range from Maine south and west into Florida and Texas. In Pennsylvania, it has been documented historically in numerous southern, particularly southeastern, counties.

Habitat

Round-leaved Thoroughwort grows in open woods and woods borders, clearings, thickets, old fields, and disturbed ground.

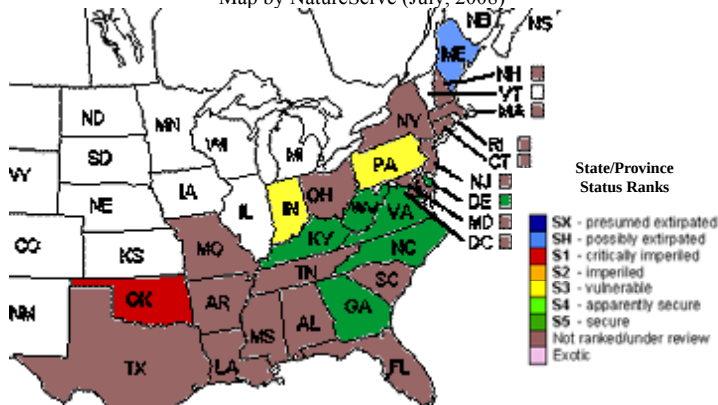


Round-leaved thoroughwort (*Eupatorium rotundifolium*) in bloom

photo source: Ann Rhoads, Morris Arboretum

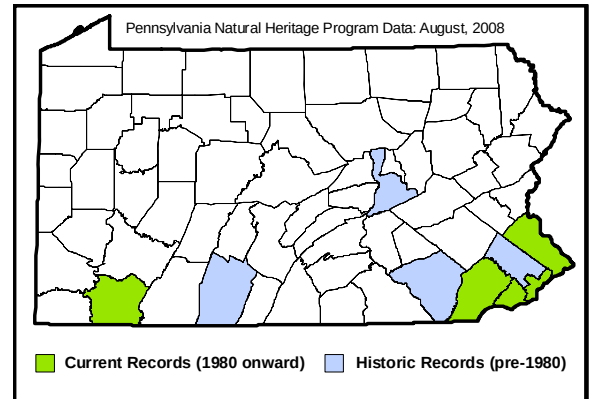
North American State/Province Conservation Status

Map by NatureServe (July, 2008)



State Status & Conservation

The PA Biological Survey (PABS) has assigned Round-leaved Thoroughwort a rarity status of Undetermined, meaning that additional field surveys and analysis are required before a more permanent rarity status, if appropriate, can be applied. The known populations have threats from habitat loss, competition, and exotic species, and will generally require some sort of disturbance, such as mowing or fire, in order to maintain the proper successional stage for the species to thrive over the long term.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Multiflowered Mud-plantain (*Heteranthera multiflora*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G4 (Apparently Secure)

Identification

Multiflowered Mud-plantain is a creeping perennial herb with hairless stems. The leaves are alternately arranged, broadly heart-shaped or kidney-shaped, untoothed on the margin, stalked at the base, rounded or very blunt at the tip, hairless on both surfaces, and with numerous curving veins on the fleshy blades. The flowers, appearing from July to October, are white to very pale purple and have 6 lobe-like segments. The male portion of the flower, the stamen, has purplish hairs, which helps to distinguish this species from the more common species *Heteranthera reniformis*, which has whitish hairs. The fruit is a many-seeded capsule.

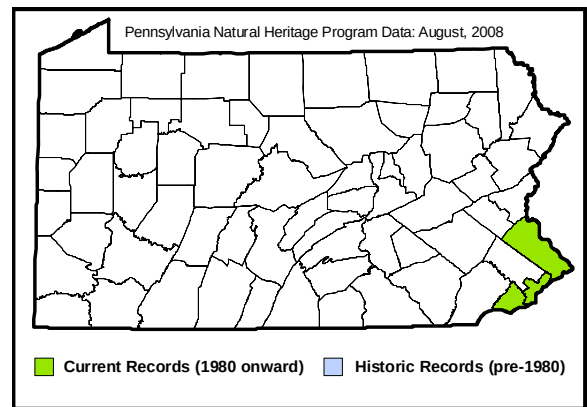
Distribution

Multiflowered Mud-plantain has a range in central and coastal mid Atlantic portions of North America. In Pennsylvania, the species has been documented historically only in a few southeastern counties along the Delaware River.



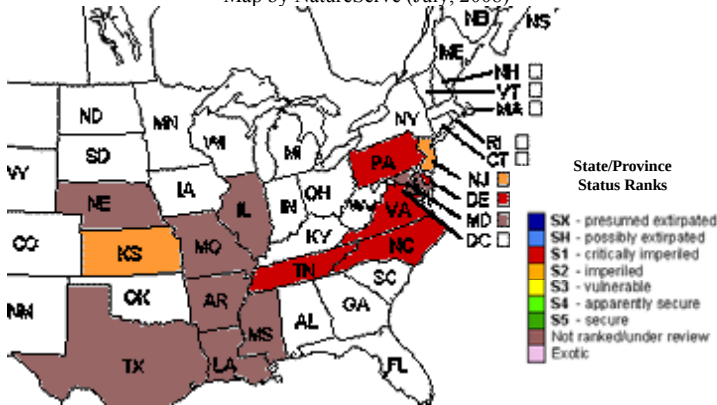
photo source: PNHP

Multiflowered mud-plantain (*Heteranthera multiflora*)



North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

Multiflowered Mud-plantain grows in intertidal marshes, mudflats, and shorelines along the lower Delaware River. The plants are subjected to daily cycles of exposure and inundation.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Multiflowered Mud-plantain a rarity status of Endangered, based on the few populations that have been documented, its restricted state range, and the very specialized habitat. The known populations have threats from exotic species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
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Forked Rush (*Juncus dichotomus*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) **Global Rank: G5** (Secure)

Identification

Forked Rush is a perennial herb with rounded, slender stems that may grow to 3 feet (1 meter) in height, but is often much smaller. The leaves are elongate, about 1/16 inch (2 mm) wide, rounded in cross section or channeled near the top, and usually much shorter than the length of the stem. The flowers, appearing in late spring and summer, are grouped in clusters at the top of the stem. Flowers have 6 pointed petals and sepals that average about 3/16 inch (5 mm) long. The petals and sepals remain around the fruit, a brownish, many-seeded capsule, as it ripens.

Distribution

Forked Rush has a range mostly near the coastal from Maine south into Florida and west into the southwestern states. In Pennsylvania, it has been documented historically in some southern, particularly southeastern, counties.

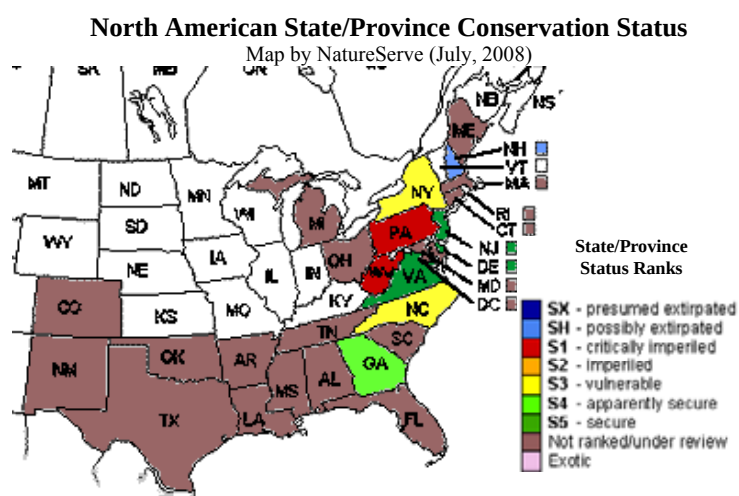


photo source: John Kunsman, PNHP

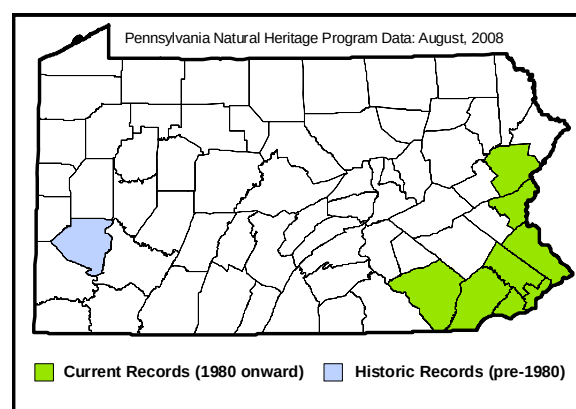
Forked rush (*Juncus dichotomus*)

Habitat

Forked Rush grows in moist to damp old fields, marshes, openings, clearings, and ditches.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Forked Rush a rarity status of Endangered, based on the relatively few populations that have been recently confirmed and the generally small population sizes. The viability of populations of this species and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology around wetlands. Active management – such as fire, mowing, or invasive species removal – may be required to maintain the proper successional stage at sites where it grows.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



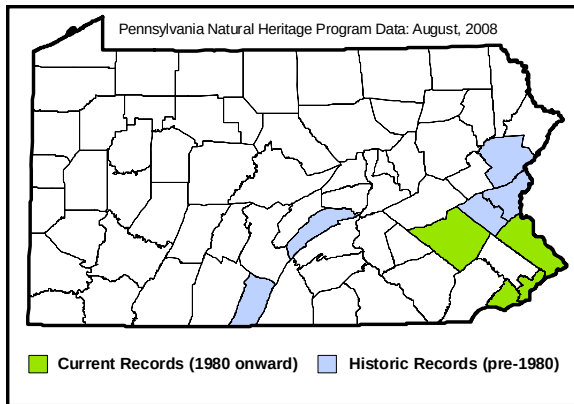
Bugleweed (*Lycopus rubellus*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

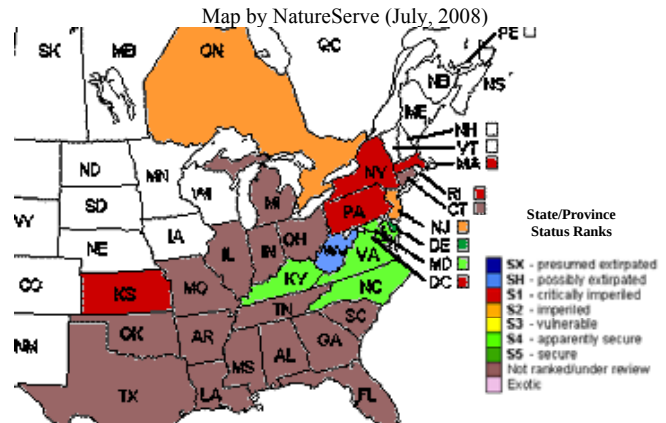
Identification

Bugleweed is a perennial herb that may grow to 3 feet (1 meter) in height. The stem may be hairy or hairless, and when broken lacks the mint-like aroma that is characteristic of most members of the mint family. The leaves are oppositely arranged, lance-shaped to elliptic, from 2 to 4 inches (5 -10 cm) in length and ½ to 1 inch (1-3 cm) in width, stalked at the base, pointed at the tip, and variably toothed on the margin. The flowers, appearing from July to September, are arranged in dense clusters above the base of the leaf stalk. The sepal lobes in this species are relatively long and pointed at the tip.



Clump of bugleweed (*Lycopus rubellus*) growing along the Delaware River shoreline

North American State/Province Conservation Status



Distribution

Bugleweed has a range from southern New England to Quebec and south into Florida and Texas. In Pennsylvania, the species has been documented historically in several eastern counties, but particularly along the lower Delaware River.

Habitat

Bugleweed grows in intertidal marshes, mudflats, shorelines, and ditches.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Bugleweed a rarity status of Endangered, based on the relatively few populations that have been documented and the limited state range. The populations have threats from exotics species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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Oblique Milkvine (*Matelea obliqua*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) **Global Rank: G4?** (Apparently Secure?)

Identification

Oblique milkvine is an herbaceous perennial vine that is a member of the milkweed family, so that a broken stem or leaf stalk will reveal a milky sap. The stems are hairy and twining. The leaves are oppositely arranged, broadly oval in outline with heart-shaped bases, with a well-developed leaf stalk, and not toothed on the margin. The flowers, appearing from April to October, are purplish-brown and have 5 petals that are united at their bases. The flowers are held on stalks in small clusters from the leaf axils. The fruits are elongate pods to 3 inches (ca 7 cm) in length, and have scattered warty projections on the outer surface. The individual seeds have elongate hairs.

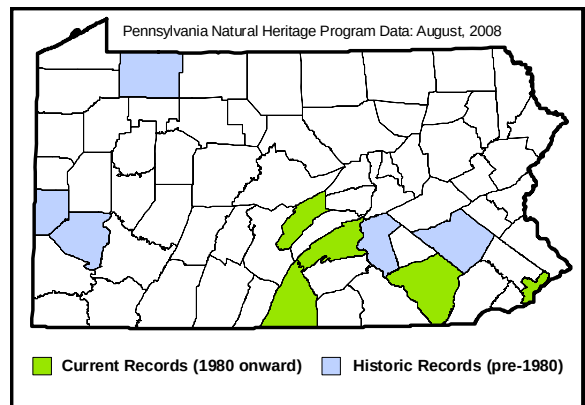
Distribution

Oblique milkvine has a range from Pennsylvania south into Georgia and west into Missouri and Mississippi. In Pennsylvania, it has been documented historically in numerous widely-scattered, mostly southern counties.



photo source: PNHP

Oblique milkvine (*Matelea obliqua*) flowers

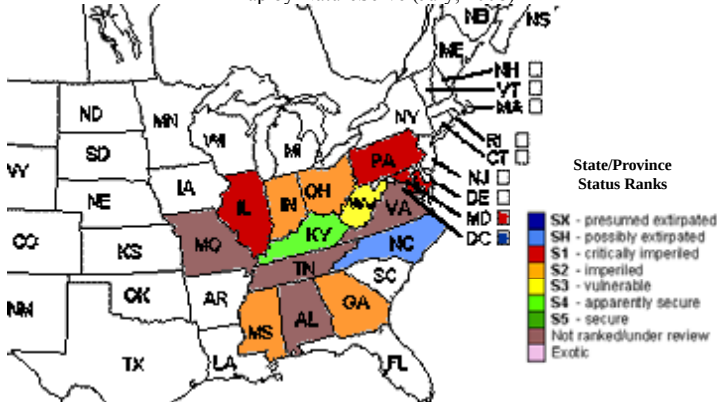


Habitat

Oblique milkvine grows in open woodlands, woods borders, and thickets, particularly on limestone substrates.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



State Status & Conservation

The PA Biological Survey (PABS) has assigned oblique milkvine a rarity status of Endangered, based on the relatively few populations that have been recently documented and the mostly small population sizes. The known populations have threats from competition, habitat loss, and exotic species, and will generally require some sort of disturbance, such as mowing or fire, in order to maintain the proper successional stage for the species to thrive over the long term.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Golden Club (*Orontium aquaticum*)

Pennsylvania Watch Listed Plant Species

State Rank: S4 (Apparently Secure) Global Rank: G5 (Secure)

Identification

Golden club is a perennial herb that may grow up to 2 feet (about 2/3 meter) in height. This species belongs to the same family as Jack-in-the-Pulpit. The leaves are lance-shaped to oblong to elliptic, dark green, lack teeth on the margin, up to 12 inches (30 cm) in length, pointed at the tip and with a well-developed stalk at the base. The leaf surface causes water to bead up and so the leaves always appear dry. The individual flowers, appearing in April and May, are scattered on the golden-yellow tip of a club-shaped flowering stem, which is white in color directly below the flowers.

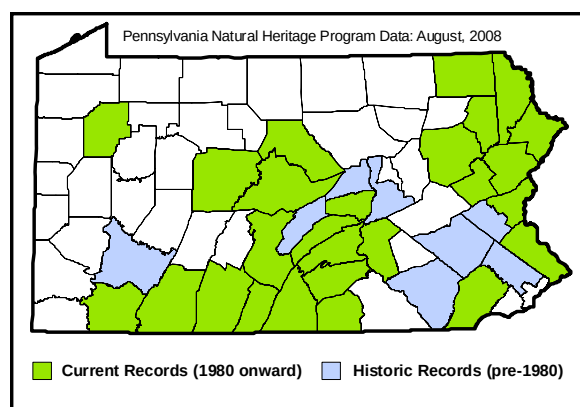
Distribution

Golden Club has a range from New York and Massachusetts south and west into Florida and Texas. In Pennsylvania, the species has been documented historically throughout most of the state.



photo source: Sally Ray, PNHP

Golden club in bloom (*Orontium aquaticum*)

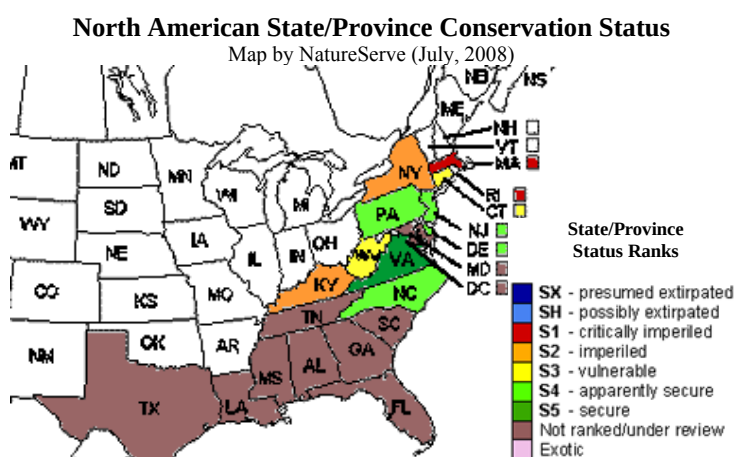


Habitat

Golden Club grows in shallow water of lakes and ponds, oxbow floodplains, slow-moving streams, and swamps.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Golden Club to the Watch list, which indicates that the species appears to be frequent enough and secure enough not to require an official rarity status, but deserves to be monitored because of its localized distribution and in order to detect possible negative trends in the status of the species. Some populations of Golden Club are impacted by water pollution, excessive deer and waterfowl browsing, and exotic species.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
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- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Velvety Panic-grass (*Panicum scoparium*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) **Global Rank: G5** (Secure)

Identification

Velvety Panic-grass is a perennial herb that may grow up to 4 feet (1.3 meters) in height. The stems are covered with short, soft, dense, spreading hairs that give the species its name. The portion of the stem just below each node or joint usually has a ring that is sticky to the touch. The leaf blades are alternately arranged, lance-shaped, with parallel veins, not toothed on the margin, and covered with the same sort of hairs as the stem. The flowers, appearing from June to October, are individually only a few millimeters in length and are arranged in clusters that are found at the top of the stem and its branches. Of the many species of panic-grass in the Pennsylvania, this one can be recognized by the velvety hairs on the stems and leaves.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)

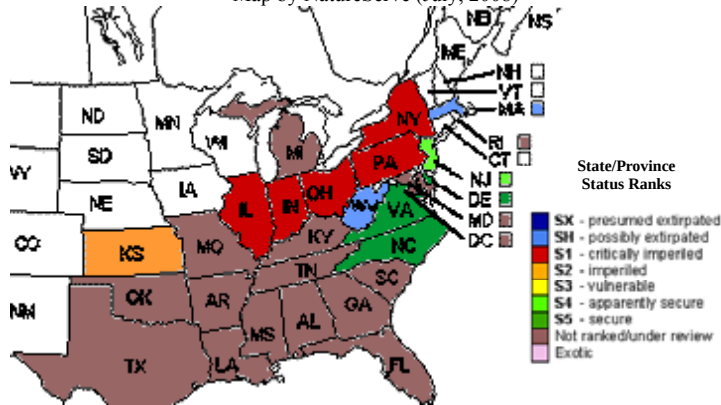


photo source: John Roemer

Distribution

Velvety Panic-grass has a range from Massachusetts south and west into Florida and Texas. In Pennsylvania, it represents a southerly species, and has been documented in a few southeastern counties.

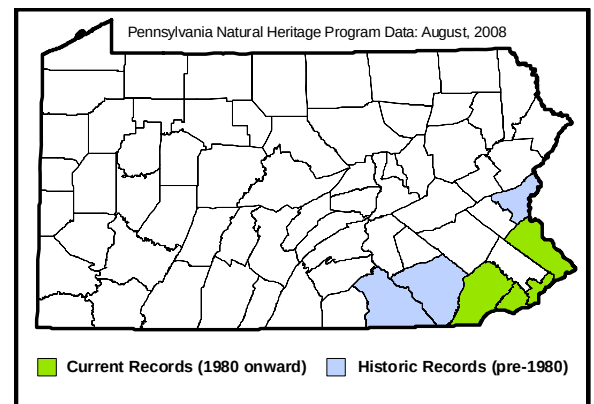
Habitat

Velvety Panic-grass grows in damp to seasonally wet clearings, abandoned fields, marshes, and disturbed ground.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Velvety Panic-grass a rarity status of Endangered, based on the limited number of populations documented for the species and its small state range. Recent field surveys have been successful in discovering more populations of the species, so this rarity status may be amended to reflect a lesser degree conservation significance. Some of the known populations of Velvety Panic-grass have threats from habitat loss, competition, and exotic species.

Velvety panic-grass (*Panicum scoparium*)



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Shrubby Camphor-weed (*Pluchea odorata*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) **Global Rank: G5** (Secure)

Identification

Shrubby Camphor-weed is an annual herb with a more-or-less hairy stem that may reach 3 feet (1 meter) in height, but may be much smaller. As the name implies, the entire plant has a camphor-like aroma and is somewhat sticky or greasy to the touch. The leaves are alternately arranged, lance-shaped to egg-shaped, from 1.5 to 6 inches (4-15 cm) in length and ½ to 3 inches (1-7 cm) in width, stalkless or short-stalked at the base, pointed at the tip, often somewhat hairy on both surfaces, and usually toothed on the margin. The flowers, appearing from August to October, are pinkish to purple and are grouped in a cluster at the top of the stem.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)

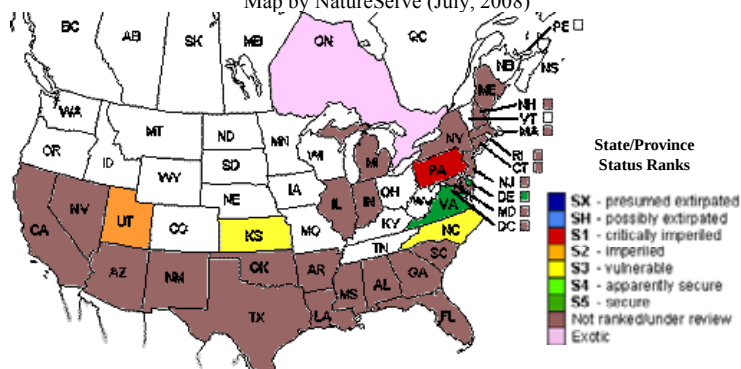


photo source: PNHP

Shrubby camphor-weed (*Pluchea odorata*)

Distribution

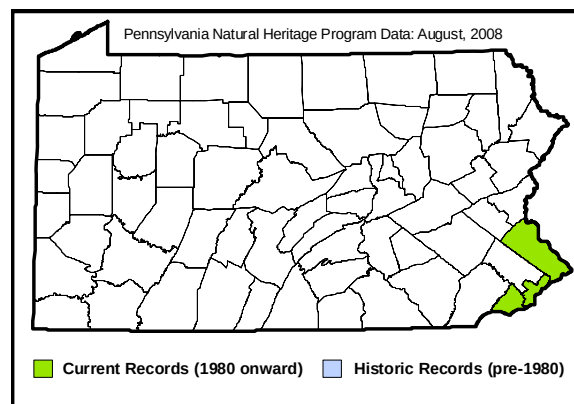
Shrubby Camphor-weed has a wide range in northeastern and southern North America, with the species being mostly coastal in the northeastern states. In Pennsylvania, it has been documented historically in a few southeastern counties.

Habitat

Shrubby Camphor-weed grows in natural coastal wetlands, but may also be found in disturbed ground, such as damp clearings, openings, ditches, and along roads.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Shrubby Camphor-weed a rarity status of Endangered, but has concentrated on identifying locations where the species is occupying relatively natural habitats, and has given a lower conservation priority to populations inhabiting disturbed sites. The more natural habitats have threats from exotic species, dredging and filling, and water pollution.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



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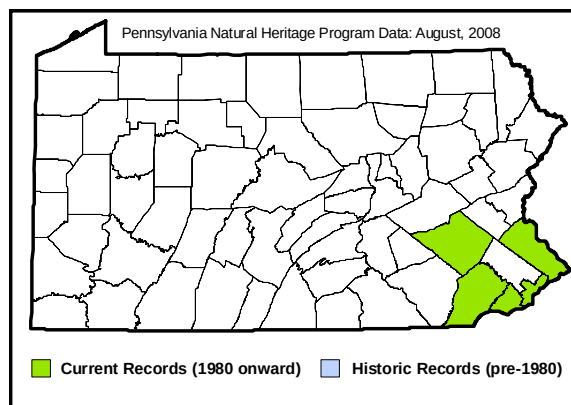
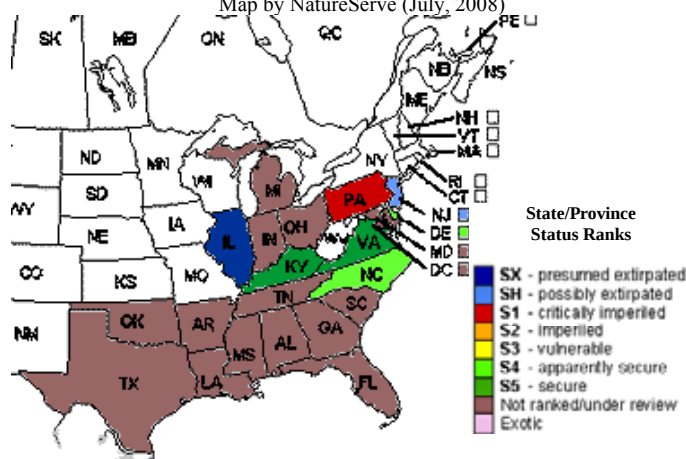
State Rank: S1 (Critically Imperiled) **Global Rank: G5** (Secure)

Autumn Bluegrass is a perennial herb with a slender hairless stem that may grow to 2 feet (60 cm) in height. The leaves are alternately arranged, linear in shape, not toothed on the margin, parallel-veined, up to 6 inches (15 cm) in length and 1/16 inch (2-3 mm) in width, and pointed at the tip. The flowers, appearing in May and June, are individually only a few millimeters in length. They are grouped in an open branched cluster at the top of the stem, with the main lower branches of the cluster tending to be arranged in pairs or occurring singly along the stem. Despite the common name, this species flowers and fruits in spring.



photo source: Ann Rhoads, Morris Arboretum

Map by NatureServe (July, 2008)



Autumn Bluegrass has a range from New Jersey west into Michigan and south into Florida and Texas. In Pennsylvania, it has been documented historically in several southeastern counties.

Autumn Bluegrass grows in moist woods and on streambanks and slopes.

The PA Biological Survey (PABS) has assigned Autumn Bluegrass a rarity status of Endangered, based on the relatively few populations that are documented and the small state range. Some populations are threatened by habitat loss and exotic species.

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Southern Red Oak (*Quercus falcata*)

Pennsylvania Endangered Plant Species

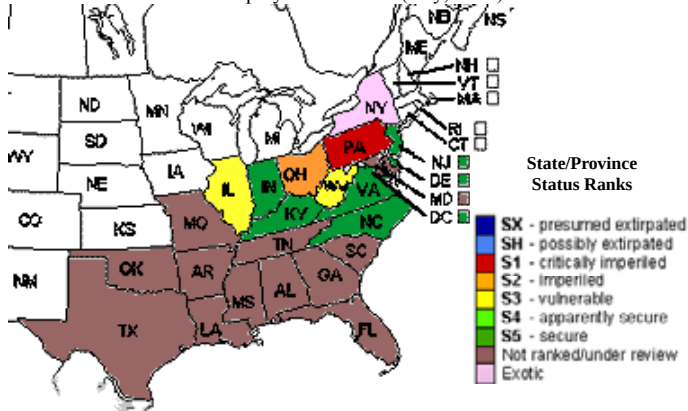
State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

Southern Red Oak is a deciduous tree that may grow to 80 feet (25 meters) in height. The bark is gray and furrowed. The leaves are alternately arranged, broadly "U" shaped at the base, have dense closely-pressed hairs on the undersurface, and with 3 to 7 bristle-tipped, usually tapering and pointed lobes that tend to have relatively few secondary lobes or teeth. The flowers, appearing from late April to May, are unisexual, with female flowers occurring singly or in pairs and male flowers arranged in much more conspicuous clusters of long, drooping catkins. The fruit is an acorn averaging about 1/2 inch (1.0-1.5 cm) in length, and is covered about 1/3 of its length by a scaly saucer-like cup.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

Southern Red Oak has a range from New York south and west into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented historically in a few southeastern counties

Habitat

Southern Red Oak grows in dry to moist woods, thickets, serpentine barrens, and on slopes.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Southern Red Oak a rarity status of Endangered, based on the relatively few populations that have been documented and the small state range. The known populations are threatened by habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

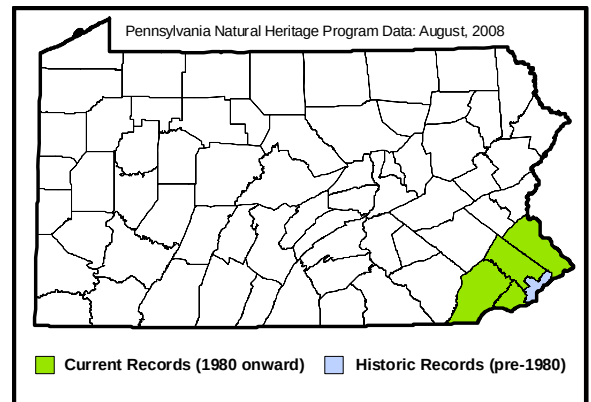
References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



photo source: PNHP

Southern red oak (*Quercus falcata*)



Willow Oak (*Quercus phellos*)

Pennsylvania Endangered Plant Species

State Rank: S2 (Imperiled) Global Rank: G5 (Secure)

Identification

Willow Oak is a deciduous tree that may grow to 80 feet (25 meters) in height. The bark is dark gray and furrowed. The leaves are alternately arranged, lance-shaped, without the lateral teeth and lobes typical of most Pennsylvania species of oaks, 2 to 4 inches (5 to 10 cm) long and 3/8 to 3/4 inch (less than 2 cm) wide, bristle-tipped, and usually hairless on both surfaces at maturity. The flowers, appearing from late April to May, are unisexual, with female flowers occurring singly or in pairs and male flowers arranged in much more conspicuous clusters of long, drooping catkins. The fruit is an acorn averaging about 3/8 inch (about 1 cm) in length, and is covered about 1/4 to 1/2 of its length by a scaly saucer-like cup.

Distribution

Willow Oak has a range from New York south and west into Texas and Florida, and is primarily coastal in the eastern portion of its distribution. In Pennsylvania, it represents a southerly species and has been documented historically in a few southeastern counties.



photo source: PNHP

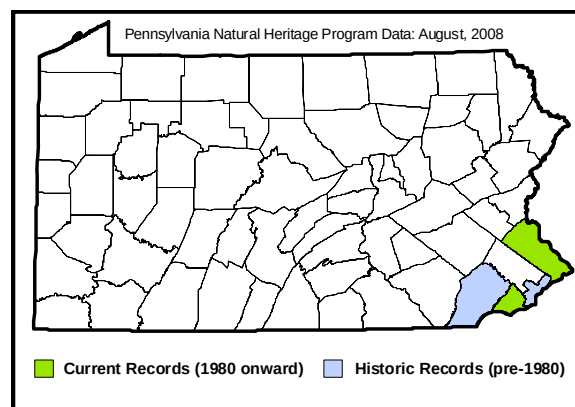
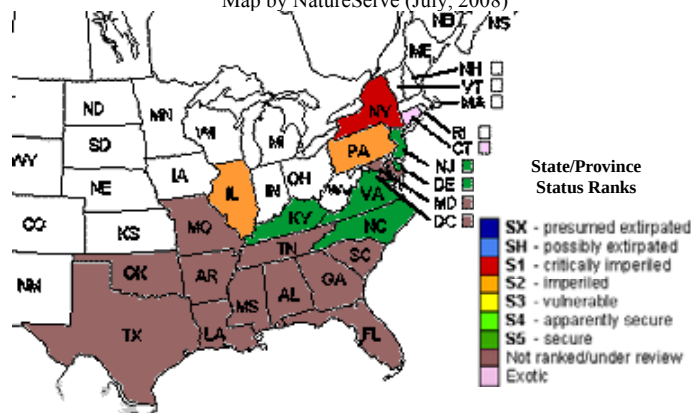
Willow oak (*Quercus phellos*)

Habitat

Willow Oak grows in damp to swampy woods, thickets, and bottomlands.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



State Status & Conservation

The PA Biological Survey (PABS) has assigned Willow Oak a rarity status of Endangered, based on the relatively few populations that have been documented and the limited state range. Some populations of Willow Oak are threatened by habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Long-lobed Arrowhead (*Sagittaria calycina* var. *spongiosa*)

Pennsylvania Endangered Plant Species

State Rank: S1 (Critically Imperiled) Global Rank: G5 (Secure)

Identification

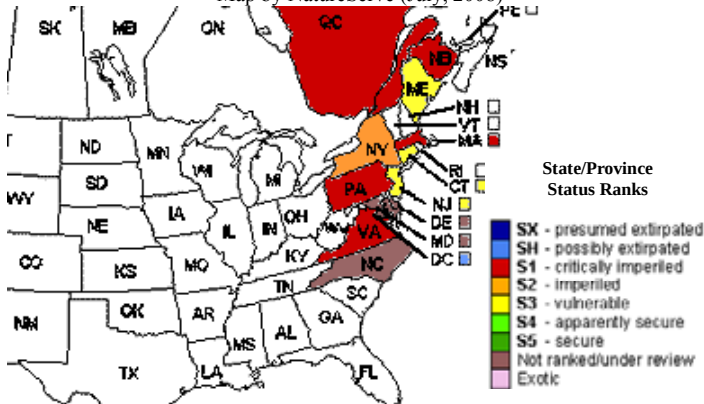
Long-lobed Arrowhead is a small annual herb growing to about 1 foot (30 cm) in height. The leaves have a relatively broad spongy leaf stalk that expands slightly at the tip into a spatula-like or elliptic blade. The flowers, appearing from July to September, have 3 white petals that are only a few millimeters in length. The flowers occur singly or up to a few in a whorl, with the stalks somewhat broad and spongy like the leaf stalks. The sepals of each flower are persistent and enclose the fruiting head, which consists of many small one-seeded, flattened fruits that are up to 2 millimeters in length.



Long-lobed arrowhead (*Sagittaria calycina* var. *spongiosa*) in a tidal marsh

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

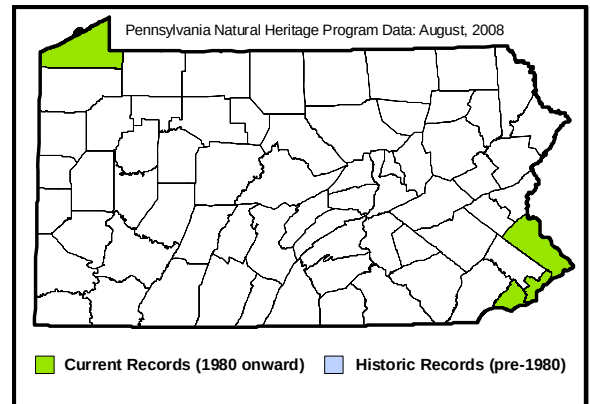
Long-lobed Arrowhead has a range along the Atlantic coast from maritime Canada south into North Carolina. In Pennsylvania, this species has been documented in the southeastern counties, and along Lake Erie in Erie County

Habitat

Long-lobed Arrowhead grows in intertidal marshes, mudflats, and shorelines. The intertidal populations are subjected to daily cycles of exposure and inundation.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Long-lobed Arrowhead a rarity status of Endangered, based on the limited number of populations that have been confirmed, the small population sizes, the limited state range, and the specialized habitat. The known populations have threats from exotic species, dredging and filling, and water pollution.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Subulate Arrowhead (*Sagittaria subulata*)

Pennsylvania Rare Plant Species

State Rank: S3 (Vulnerable) Global Rank: G4 (Apparently Secure)

Identification

Subulate Arrowhead is a small perennial herb generally only a few inches in height that forms small mats due to its horizontally-spreading stems. The leaves are linear to strap-shaped, up to 3 inches (7.5 cm) in length and 1/8 inch (4 mm) in width, somewhat spongy, and do not have an expanded leaf blade at the tip. The flowers, appearing from June to September, have 3 white petals that are only a few millimeters in length. The individual flowers are grouped in a whorl-like cluster. The sepals of each flower are persistent, and are spreading or bent down beneath the fruiting heads, which consist of a group of flattened, one-seeded fruits that are 1 or 2 mm in length.

Distribution

Subulate Arrowhead has a range from Massachusetts south along the coast into Florida and Alabama. In Pennsylvania, it has been documented recently only in a few southeastern counties along the Delaware River.

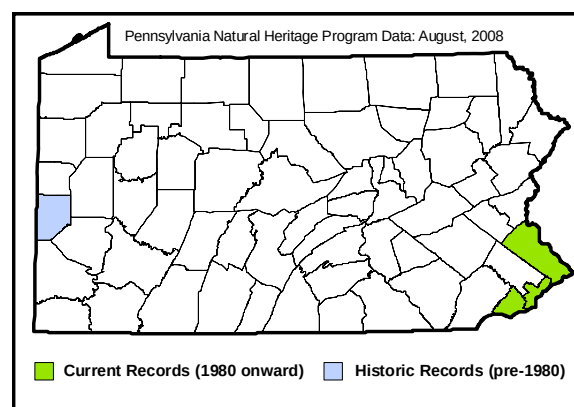
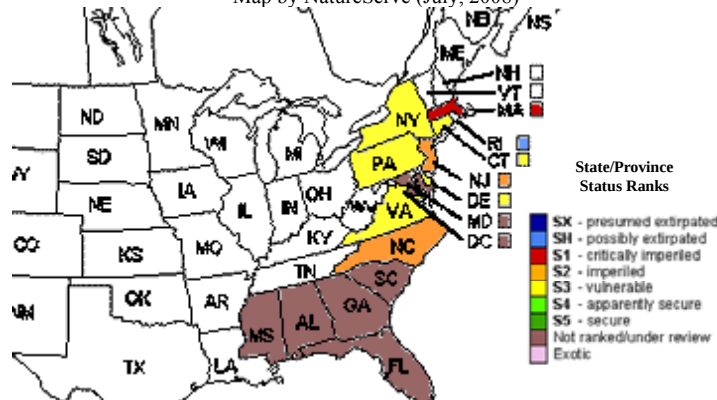


photo source: Andrew Strassman, PNHP

Subulate arrowhead (*Sagittaria subulata*)

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Habitat

Subulate Arrowhead grows in intertidal marshes, mudflats, and river shores. The intertidal populations are subjected to daily cycles of exposure and inundation.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Subulate Arrowhead a rarity status of Rare. The species appears to be successful enough in maintaining its populations so as not to be endangered or threatened with extirpation, yet has a very limited range in the state and a very specialized habitat. The populations of Subulate Arrowhead have threats from exotic species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



River Bulrush (*Schoenoplectus fluviatilis*)

Pennsylvania Rare Plant Species

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

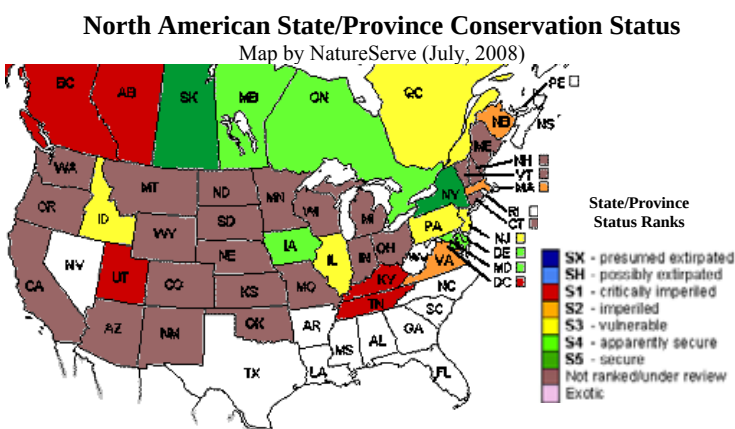
River Bulrush is a perennial herb that forms colonies from underground stems. The triangular aerial stems are robust and may grow from 2½ to 6½ feet (0.7-2 m) in height. The leaves are alternately arranged, grass-like, elongate, averaging about 3/8 inch (1 cm) wide, and somewhat V-shaped in cross-section. The flowers, appearing from June to August, are grouped in ½ to 1½ inch (1.5-4 cm) spikelets. The spikelets are grouped in a branching cluster at the top of the stem that is subtended by several spreading, leaf-like bracts. The individual fruits are about 3/16 inch (3.5-5 mm) long.

Distribution

River Bulrush has a very broad range, with the exception of the southeastern states, across North America. In Pennsylvania, it has been documented historically mostly in the northwestern and southeastern counties.



photo source: PNHP



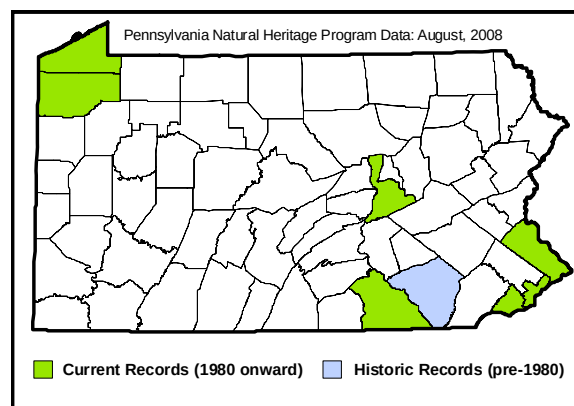
Habitat

River Bulrush grows on the shorelines of rivers and streams, and also in marshes and other wet places.

State Status & Conservation

The PA Biological Survey (PABS) has assigned River Bulrush a rarity status of Rare, since the species seems to be relatively successful at maintaining its populations and does not appear to be endangered or threatened with extirpation, yet has a localized distribution in the state. The viability of the riverine populations of river bulrush may be enhanced by maintaining the water quality and natural hydrology of the streams, with their seasonal fluctuations and scouring, as well as retaining natural conditions along the shoreline areas.

For non-riverine populations, establishing buffers and protecting the hydrology around wetlands are necessary. Invasive species represent a threat to the habitat of river bulrush.



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Pennsylvania Natural Heritage Program

Smith's Bulrush (*Schoenoplectus smithii*)

Pennsylvania Endangered Plant Species

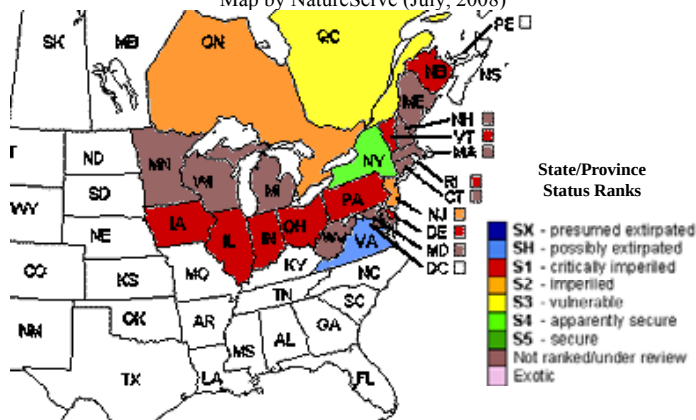
State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

Smith's Bulrush is an annual herb with a soft, three-sided stem that may grow to 1.5 feet in height (0.5 meter), but is usually much smaller. The leaves, which may be absent, are mostly clustered at the base of the stem, linear in shape, entire on the margin, and variable in length. The flowers, appearing from July to September, are individually only 1 to 2 mm length, being aggregated in stalkless clusters that are attached at a single point on the middle to upper portion of the stem, and are overtopped by a slender leaf-like bract. The individual fruits are black at maturity, about 2 mm in length, and lack the subtending bristles found in *Schoenoplectus purshianus*, which is a more common, similar-looking species.

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

Smith's Bulrush has a range in northeastern North America and the Great Lakes states. In Pennsylvania, it has been documented historically in scattered locations, particularly in the southeastern counties along the Delaware River and in the northwestern counties.

Habitat

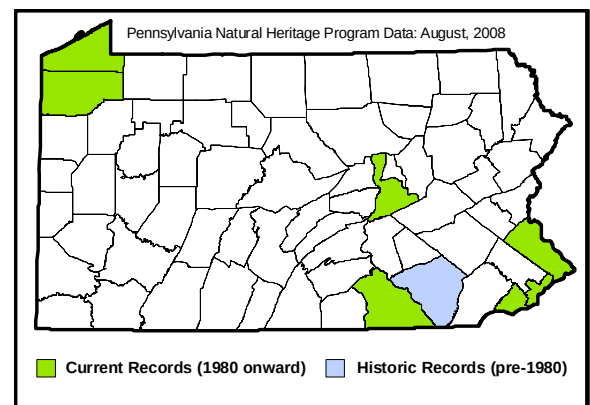
Smith's Bulrush grows in intertidal marshes, mudflats, and on shorelines. The populations in intertidal marshes are subjected to daily cycles of exposure and inundation.

State Status & Conservation

The PA Biological Survey (PABS) has assigned Smith's Bulrush a rarity status of Endangered, based on the relatively few populations that have been confirmed, the usually small population sizes, the limited state range, and the specialized habitat. The known populations have threats from exotic species, dredging and filling, and water pollution.



A clump of Smith's bulrush (*Schoenoplectus smithii*)



References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Wild Senna (*Senna marilandica*)

Pennsylvania Endangered Plant Species

State Rank: S1 (critically imperiled), Global Rank: G5 (secure)

Identification

Wild Senna is an erect, bushy perennial herb that can grow up to 6 feet (about 2 meters) tall. The leaves are alternately arranged, have a dome-shaped gland near the base of the leaf stalk, and are divided into 4 to 8 pairs of oblong to elliptic leaflets that are not toothed on the margin. The flowers, appearing in July and August, have 5 yellow petals that are about 0.5 inch (10 to 15 mm) in length, as well as 10 stamens that differ in size and shape. The fruit is a pea-like pod from 2.5 to 4 inches (6 to 10 cm) in length and is divided into numerous rectangular segments that are distinctly wider than long. A similar but more common species, *Senna hebecarpa*, has fruit segments that are about as wide as long.

Distribution

Wild Senna has a wide range in eastern and central North America. In Pennsylvania, the species has been documented historically from scattered counties mostly in southern half of the state.

Habitat

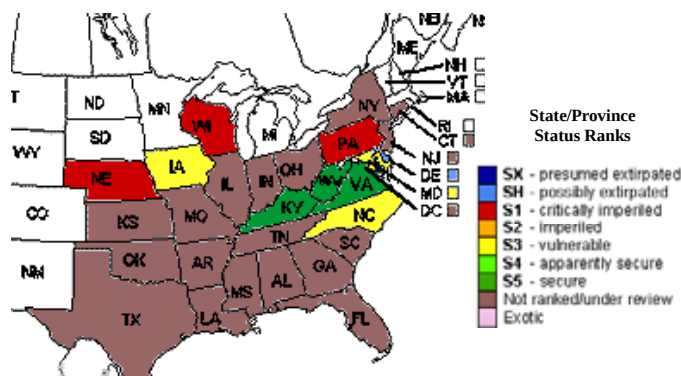
Wild Senna grows in a variety of habitats, including clearings, woods borders, road banks, open slopes, bottomlands, and thickets. It appears to have an affinity for disturbed ground.



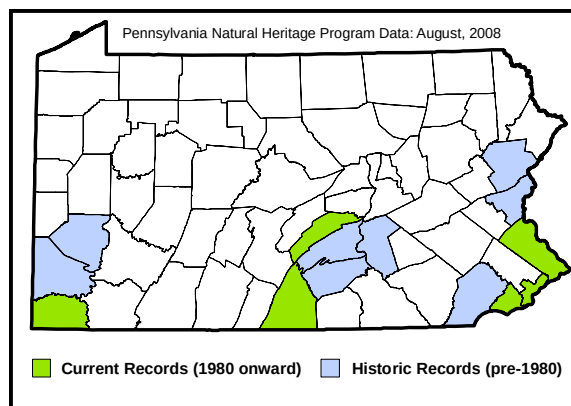
photo source: Robert W. Freckmann Herbarium, UWSP Emmet J. Judziewicz

North American State/Province Conservation Status

Map by NatureServe (November, 2008)



Blooming wild senna (*Senna marilandica*)



State Status & Conservation

The PA Biological Survey (PABS) has assigned Wild Senna a rarity status of Endangered, based on the few populations that have been documented and the relatively small size of most populations. The known populations have threats from competition, habitat loss, and exotic species, and will generally require some sort of disturbance, such as mowing or fire, in order to maintain the proper successional stage for the species to thrive over the long term.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.



Annual Wild Rice (*Zizania aquatica*)

Pennsylvania Rare Plant Species

State Rank: S3 (Vulnerable) Global Rank: G5 (Secure)

Identification

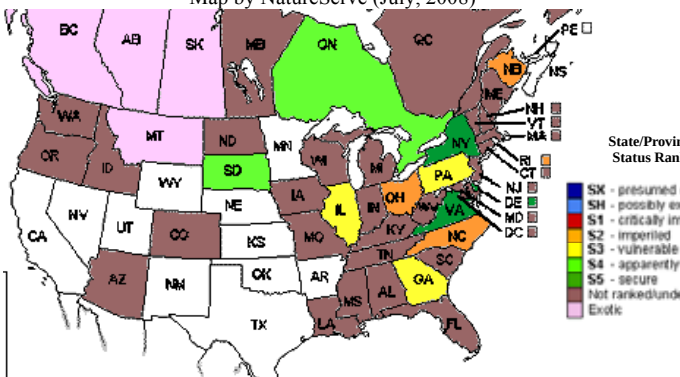
Annual Wild Rice has very tall, hairless stems that may grow to 9 feet (3 meters) in height. The leaf blades are alternately arranged, linear to lance-shaped, pointed at the tip, not toothed on the margin, parallel-veined, and often well over 1 foot (30 cm) in length and up to 2 inches (5 cm) in width. The flowers are grouped in a large branched cluster at the top of the stem, with the female flowers located on the ascending upper branches and the male flowers located on the spreading or drooping lower branches. The small bracts subtending each female flower have an elongate bristle-like projection, or awn, up to 2.25 inches (6 cm) in length.



photo source: PNHP

North American State/Province Conservation Status

Map by NatureServe (July, 2008)



Distribution

Annual Wild Rice has a range throughout much of North America, with part of the distribution expanded by deliberate introduction. In Pennsylvania, it has been documented historically in several southeastern counties, as well as the counties of Erie and Huntingdon.

Habitat

Annual Wild Rice grows in marshes, particularly intertidal marshes along the Delaware River in southeastern Pennsylvania, as well as on shorelines and in shallow water elsewhere.

Annual wild rice (*Zizania aquatica*)

State Status & Conservation

The PA Biological Survey (PABS) has assigned Annual Wild Rice a rarity status of Rare. The species appears to have an ample number of populations and to be adaptable enough so as not to be endangered or threatened with extirpation, yet has a very localized distribution in the state. Some populations of Annual Wild Rice have threats from exotic species, dredging and filling, and water pollution.

References

- NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at <http://www.natureserve.org/explorer>.
- Pennsylvania Natural Heritage Program. 2008.
- Rhoads, A. F. and W. M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A. F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual, Second Edition. University of Pennsylvania Press, Philadelphia.

