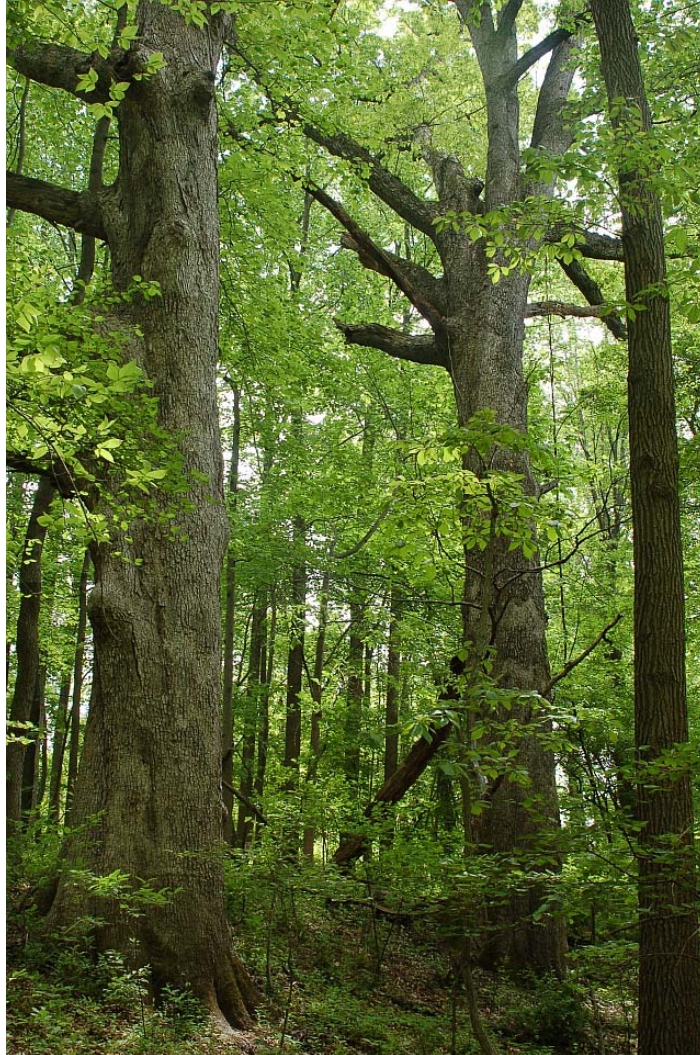


Final Report
Vegetation
of
Ridley Creek State Park



Submitted to the Pennsylvania Department of Conservation and Natural Resources

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Cover: Two big white oaks along a tributary of Ridley Creek north of Gradyville Road

Acknowledgements

Roger McChesney, Manager of Ridley Creek State Park and Anthony Mosloskie, Chief Ranger spent time orienting us to the park and facilitated access by automobile via the multiuse trail. Robert Witmer, of the Bureau of Forestry introduced us to archival maps and planting records for the Jeffords Estate. We also had helpful discussions with Tim Higgins, President, Friends of Ridley Creek State Park and Anne Murphy, Executive Director, Chester-Ridley-Crum Watersheds Association.

Executive Summary

Ridley Creek State Park is a suburban park in a landscape that has a long history of human use. Most of the natural vegetation was removed by the mid to late 1800s. In the past 300 years the landscape has gone from forest to farmland to private estate to heavily used public park.

Today the park is a mosaic of forest remnants, scattered wetlands, successional communities, meadows, and landscaped grounds. Relatively intact natural communities cover 37 percent of the area. Non-native, invasive plants dominate many of the successional areas. These thickets of invasive shrubs and vines interfere with natural patterns of succession and represent inferior habitat for birds and other wildlife.

An overabundance of white-tailed deer compounds the ecological degradation of the park landscape. Deer feed preferentially on native vegetation leaving most non-natives to proliferate. The browsing severity in the park is such that even plants such as spicebush and beech shoots are reduced to well-chewed remnants. Regeneration of canopy trees is virtually non-existent, shrub layers are decimated, and herbaceous plant diversity is reduced. Canopy failure is occurring in areas where blow downs of older trees have occurred.

Management actions to address the habitat degradation that is currently occurring must first focus on achieving a dramatic reduction in deer density.

Action to address the problem of invasive plants should begin with removal of scattered invasives present in the areas of most intact natural communities, the areas coded as #1 in Figure 4. Areas coded as #2 are mostly successional forest stands with an intact canopy composed of native trees. They should be treated as buffers for the more mature forest stands and eventual additions. Continued canopy development as they mature should help to diminish the vigor of non-native invasive shrubs through shading.

Management of the most highly impacted sites (coded #4 and #5 on Figure 4) should be the lowest priority to be undertaken only if time and resources permit. These sites are unlikely to degrade further.

Key Recommendations

- Reduce deer density throughout
- Remove scattered occurrences of invasive plants in highest quality natural areas
- Avoid forest fragmentation by maintaining canopy continuity and minimizing edge
- Remove occurrences of non-native, invasive plant species that are not yet widely distributed in the park so they do not become bigger problems in the future (see Figure 7)

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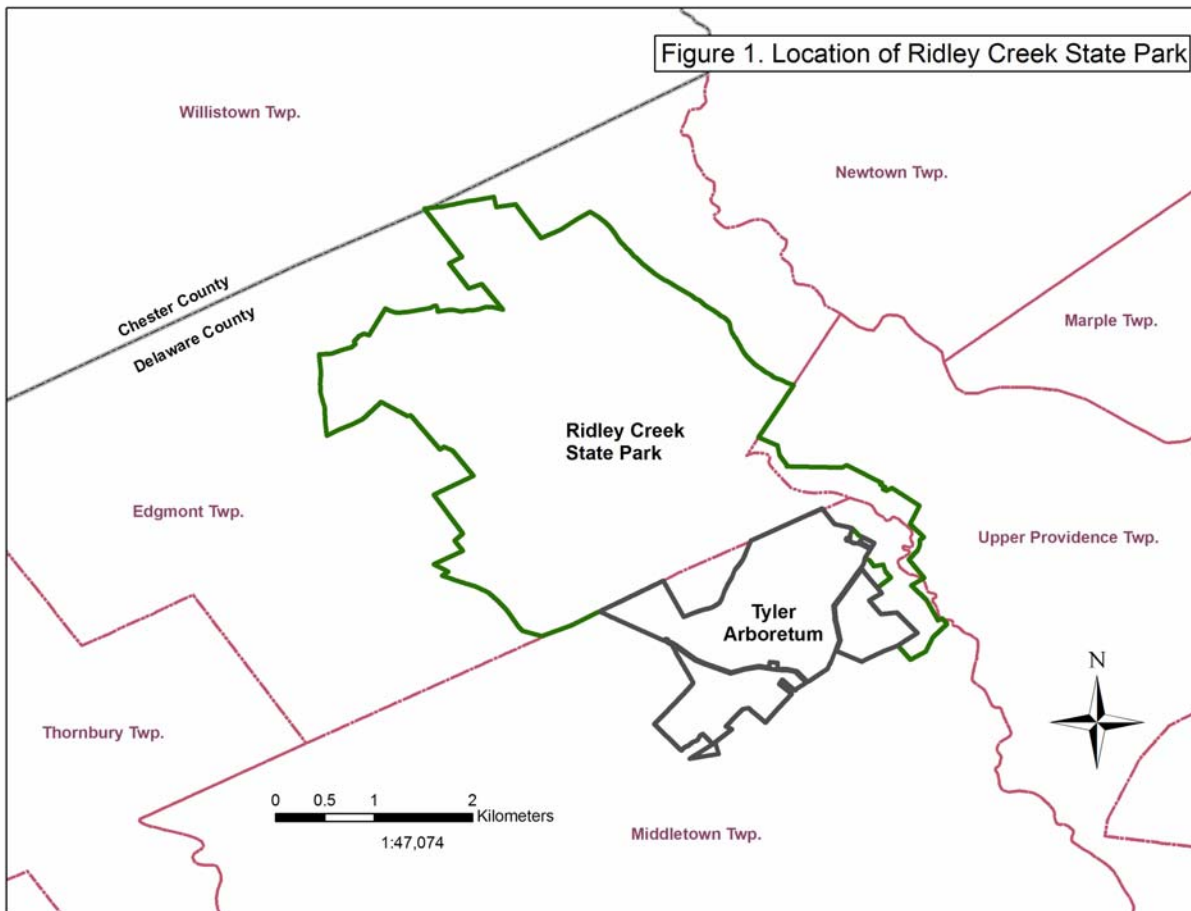
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I. Introduction

Location`

Ridley Creek State Park is located in the Piedmont Uplands physiographic region of southeastern Pennsylvania (Figure 1). Containing 2,206 acres, it lies in Delaware County southwest of the village of Newtown Square and 16 miles west of the city of Philadelphia. Most of the park is in Edgemont Township but small portions extend into Upper Providence and Middletown Townships. The park includes the former village of Sycamore Mills and numerous early farmsteads.



Geology

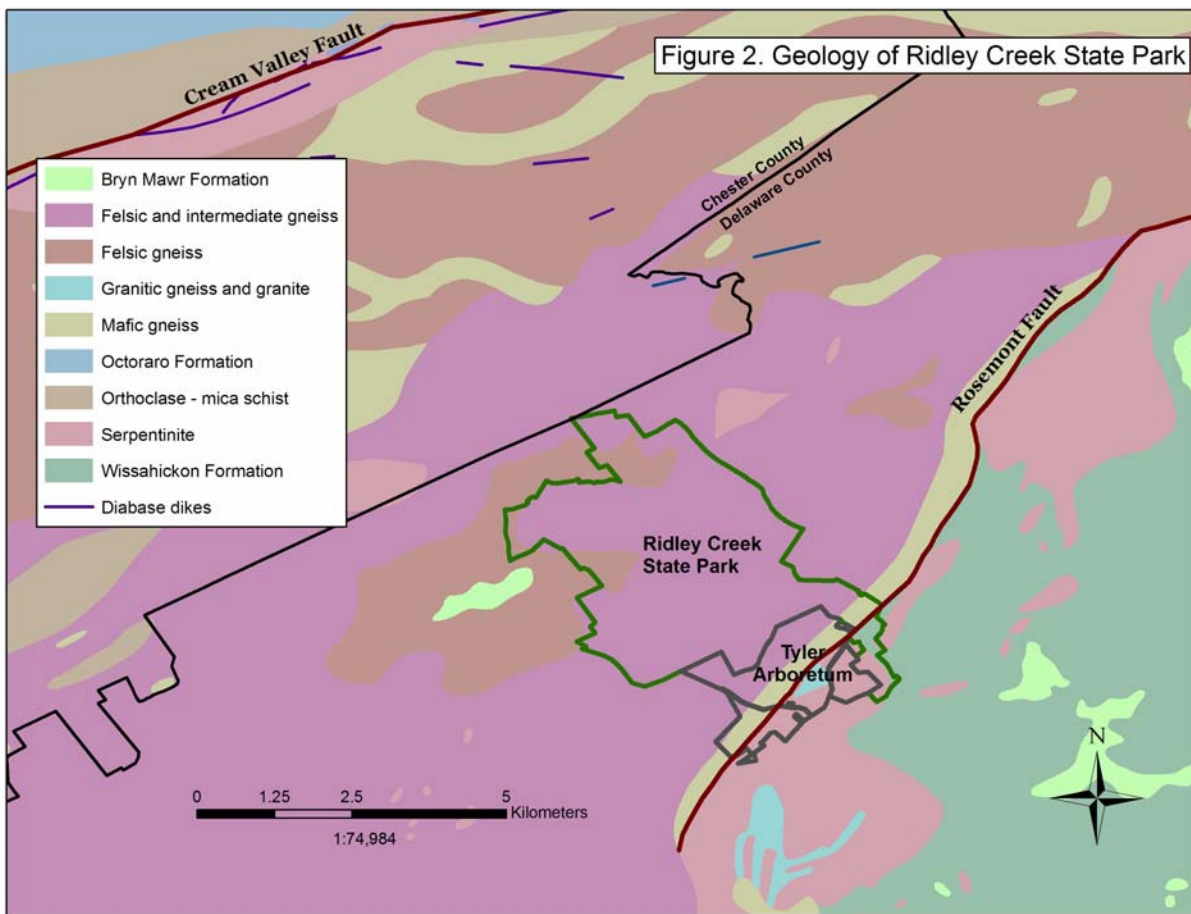
Lying between the Cream Valley fault and the Rosemont fault, most of the park is underlain by Grenville-age gneisses (Schultz 1999; Figure 2). The rocks are pre-Cambrian in age (1 billion years old). Clues to their metamorphic nature are apparent in the alternating light and dark bands visible in rock outcrops at several locations along Ridley Creek. A band of serpentinite is present where Ridley Creek crosses the Rosemont fault below Sycamore Mills; greenish boulders can be seen on the west side of the creek at this location. A larger serpentine outcrop occurs along Barrens Road in the

Tyler Arboretum where it supports a typical barrens community. South of the fault the geology is dominated by younger rocks of the Wissahickon Formation.

Evidence remains of localized quarrying of building stone at several locations in the park; in addition a small feldspar quarry was operated for a few years in the early 1900s (Figure 5).



*Gneiss outcrop along
Ridley Creek above
Sycamore Mills*



Hydrology

Ridley Creek State Park is entirely within the watershed of Ridley Creek, a tributary of the Delaware River. The park includes a 4.1-mile stretch of Ridley Creek; the lower portion of Dismal Run and several unnamed tributaries are also within the park.

Water Quality

Ridley Creek above the Media water intake is classified by the Pennsylvania Department of Environmental Protection as high quality, trout stocked fishery (HQ TSF) (Commonwealth of Pennsylvania 2006).

Ecological Context

The park is located in a landscape that was covered with deciduous forest at the time of European settlement. Because of its proximity to Philadelphia, most of the land was cleared for farming early in the development of the colony of Pennsylvania. Today the park and the adjacent 650-acre Tyler Arboretum form a green island surrounded by suburban development.

Special Designations

Ridley Creek State Park and Tyler Arboretum are part of the Upper Ridley/Crum Important Bird Area #72 as designated by Pennsylvania Audubon.

The village of Sycamore Mills, located within the park, has been designated as the Ridley Creek State Park Historic District on the National Register of Historic Places. Providence Mill, which ground corn, was established in 1718 to meet the needs of local farmers. Other water-powered mills soon sprang up along the creek creating a small industrial center.

Land Use History

By the early 1900s the Delaware County landscape was a pastoral array of farmsteads with agricultural fields and pastures separated by hedgerows. Only slopes and a few scattered woodlots retained native forest cover. Samuel Riddle bought up many of the farms and gave them to his niece as a wedding present when she married Walter Jeffords. The Jeffords created their Hunting Hill estate between 1914 and 1924 on land that is now occupied by the park. Landscaped grounds replaced some of the farm fields; others were used to raise cattle and thoroughbred race horses. Still other areas were planted with conifers or allowed to undergo secondary succession.

Establishment of the state park

The land which is now the park was acquired by the state between 1965 and 1979; the bulk of it (2,171 acres) it was purchased from the Walter M. Jeffords family. The park, named for the stream that bisects the property, opened for public use in 1972.

Development of the state park brought more changes in land use as public use facilities were developed and most farming activity ceased. The successional forests and woodlands that cover more than half of the park today reflect the conversion from farms

to estate, and finally state park. Colonial Pennsylvania Plantation, which has been a working farm for 300 years, provides a glimpse of early farm life in the area.

Although several day-use areas that were part of the original park facilities have since been closed and gated, 14 picnic areas remain open and are heavily used. The multi-use trail, a 5-mile loop, is very popular with bicyclists, joggers, and walkers. Ridley Creek, which is stocked with trout throughout the season, attracts numerous fishermen, especially the lower section, which is designated for fly fishing only.

Previous Studies of the Natural Resources of Ridley Creek State Park

PNHP-listed elements – There are historical records from the park of two plants classified by the Pennsylvania Natural Heritage Program: puttyroot orchid (*Aplectrum hyemale* – PA rare) was last documented in 1991 and heart-winged sorrel (*Rumex hastatulus* – PA extirpated) was collected once in 1971, the only time the plant has been found in Pennsylvania.

Plant communities – The 2005 Resource Management Plan for Ridley Creek State Park includes a vegetative cover map prepared by Mark Hoffman, Pennsylvania Bureau of Forestry in 1992. Oak-dominated forests were found to occupy 1,276 acres. Plantations occupied 122.54 acres. The remainder of the land was classified as non-forested.

Invasive species – Several invasive species were noted in the 2005 Resource Management Plan including multiflora rose, autumn-olive, (Oriental) bittersweet, Japanese knotweed, Japanese honeysuckle, and mile-a-minute.

Deer browse survey – A survey of browsing intensity and deer density was carried by the Bureau of State Parks in conjunction with the Bureau of Forestry in 2007. Three transects were established for data gathering purposes. Estimated overwintering deer density ranged from 81-139 deer per square mile. Browsing was noted on 63 percent of highly preferred plants and 82 percent of medium preference plants. Only 5 percent of the plots surveyed showed desirable regeneration.

II. Goals

- Describe the existing vegetation of Ridley Creek State Park
- Document the current status of PNHP-listed plants
- Describe the extent and impact of invasive plants on park ecosystems
- Develop a strategy for addressing problems caused by invasive species

III. Inventory Plant Communities

Methods

We used a two tiered process to map plant communities. Aerial photo interpretation using 2005 aerial photography plus geology and topography layers (<http://www.pasda.psu.edu>) was the first step in establishing vegetation polygons. In addition, we examined 1937 aerial photography (<http://www.PennPilot.psu.edu>) to gain insight into the impact of past land use on current vegetation. The second stage in defining existing community types involved walking the polygons and noting species assemblages and other relevant conditions including hydrology and disturbance.

Students in our Field Botany class at the University of Pennsylvania documented species composition of forests on Hunting Hill by use of point quarter transects in a class project carried out in October-November 2007.

Plant community descriptions were based on field notes of specific sites and transect data. Plant community nomenclature follows Fike (1999) and Stone et al. (2005), except for successional community types which are not treated in either reference.

In addition, plant community polygons were visually scored for the degree of impact by invasive non-native species. A 1-5 scale was employed as indicated in Table 1. Meadows, pastures, and landscaped areas around residences, institutional buildings, and park facilities were not included.

Table 1. Scoring system for Invasive Species Impact on Native Vegetation

	<i>dominant vegetation strata (canopy in forested sites)</i>	<i>understory/shrub layer (if applicable)</i>
1	invasives 0-5% cover	invasives few scattered invasives present
2	Invasives 0-5% cover	invasives 5-25 % cover
3	Invasives 5-25% cover	invasives 25-50% cover
4	invasives 25-50% cover	invasives 50-75% cover
5	Invasives >50% cover	Invasives 75-100% cover

Isolated occurrences of invasive, non-native species were recorded as GPS points, when encountered. It was not practical to document the full extent of widespread and abundant invasive species such as mile-a-minute, autumn-olive, multiflora rose, winged euonymus, Japanese honeysuckle, or Japanese stiltgrass which occur throughout the park. Nor do we make any claim to have recorded all existing isolated occurrences.

Results

Vegetation types of Ridley Creek State park include one upland forest type, six wetland communities, four successional communities, and five cultivated types (Table 2; Figure 3).

Mature upland forests are present on slopes and other areas that were never cleared for farming, they consist of *red oak - mixed hardwood forest*. Selective harvesting of timber in the past reduced the oak component in some areas leaving mainly American beech. Over browsing by deer threatens to further alter canopy composition by eliminating regeneration of oak, hickory, and tuliptree leaving only the root shoots of American beech, which continue to proliferate. We observed canopy failure in several small forest areas where recent blow-downs have left gaps that are being filled with invasive, non-native shrubs.

Wetland communities are located along Ridley Creek and several tributary streams. Although impacted by invasives, they retain their identity as natural community types ranging from palustrine (swamp) forest or woodland to open marsh.

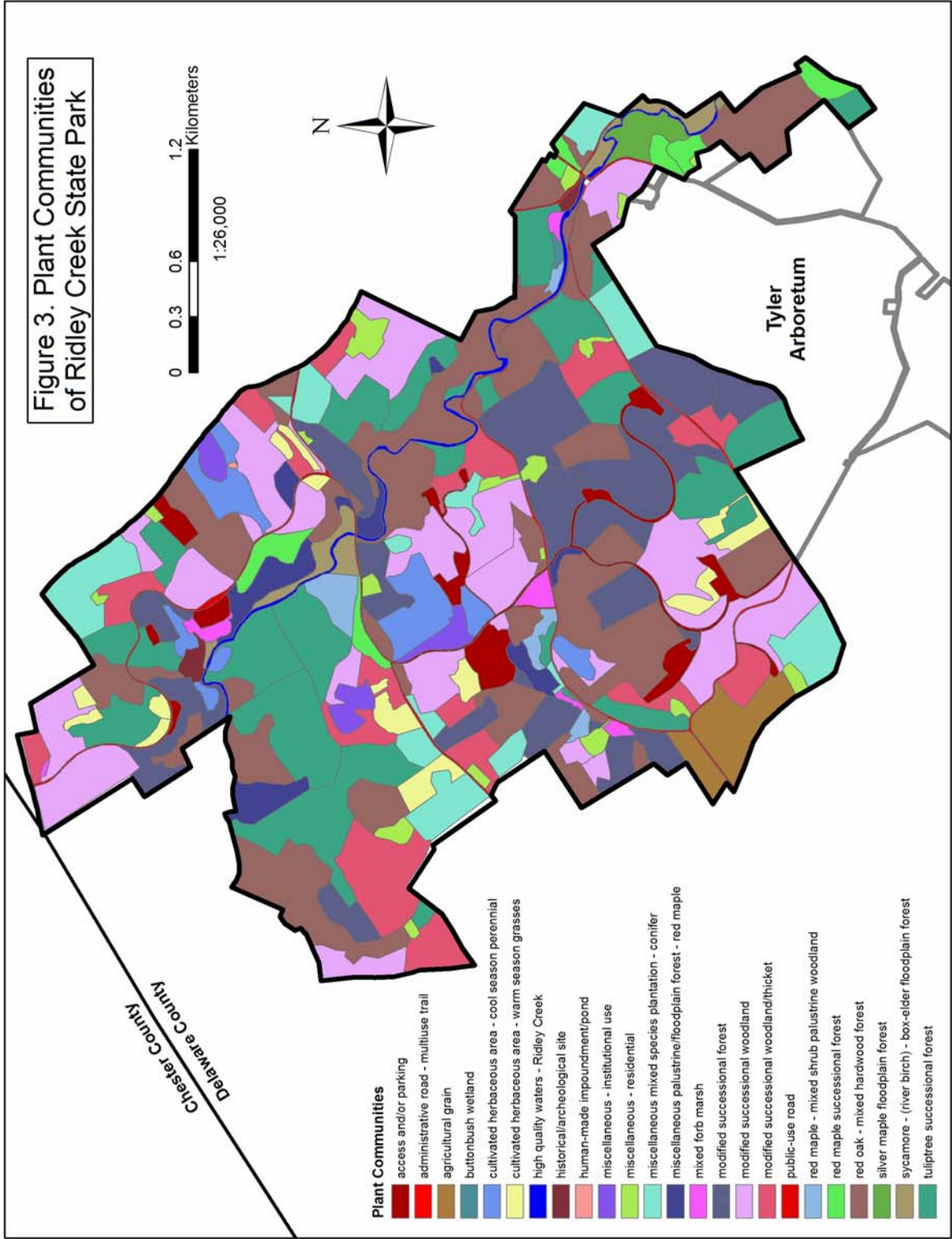
Successional communities dominate 54 percent of the park area; they represent the spontaneous re-vegetation of lands that were formerly cleared and farmed. Older successional areas exhibit canopy development, mainly tuliptree or red maple. Other areas, referred to as woodlands or thickets, have not developed continuous tree cover and are characterized by scattered trees in a matrix of non-native, invasive shrubs and vines. Descriptions of all community types are in Appendix A.

Table 2. Plant Community Types of Ridley Creek State Park

<i>Upland community</i>	<i>Status*</i>	<i>Acres</i>
Red oak – mixed hardwood forest	GNR, S5	520.8
<i>Wetland communities</i>		
Sycamore – box-elder floodplain forest	GNR, S3	30.9
Silver maple floodplain forest	GNR, S3	17.0
Miscellaneous palustrine forest (red maple)		57.5
Red maple – mixed shrub palustrine woodland	GNR, S5	25.3
Buttonbush wetland	GNR, S4	1.8
Mixed forb marsh	GNR, S3	17.2
Herbaceous vernal pond	GNR, S3S4	<1
<i>Successional communities</i>		
Red maple successional forest		45
Tuliptree successional forest		407.8
Modified successional forest		249.0
Modified successional woodland		472.2
Modified successional woodland/thicket		
<i>Anthropogenic communities</i>		
Miscellaneous / mixed species plantation (conifer)		151.7
Cultivated herbaceous area – warm season grasses		59
Cultivated herbaceous area – cool season perennial		76.5
Agricultural herbaceous area		49.3
Residential/institutional landscaping		75.2

* see Appendix D for an explanation of status codes

Figure 3. Plant Communities of Ridley Creek State Park

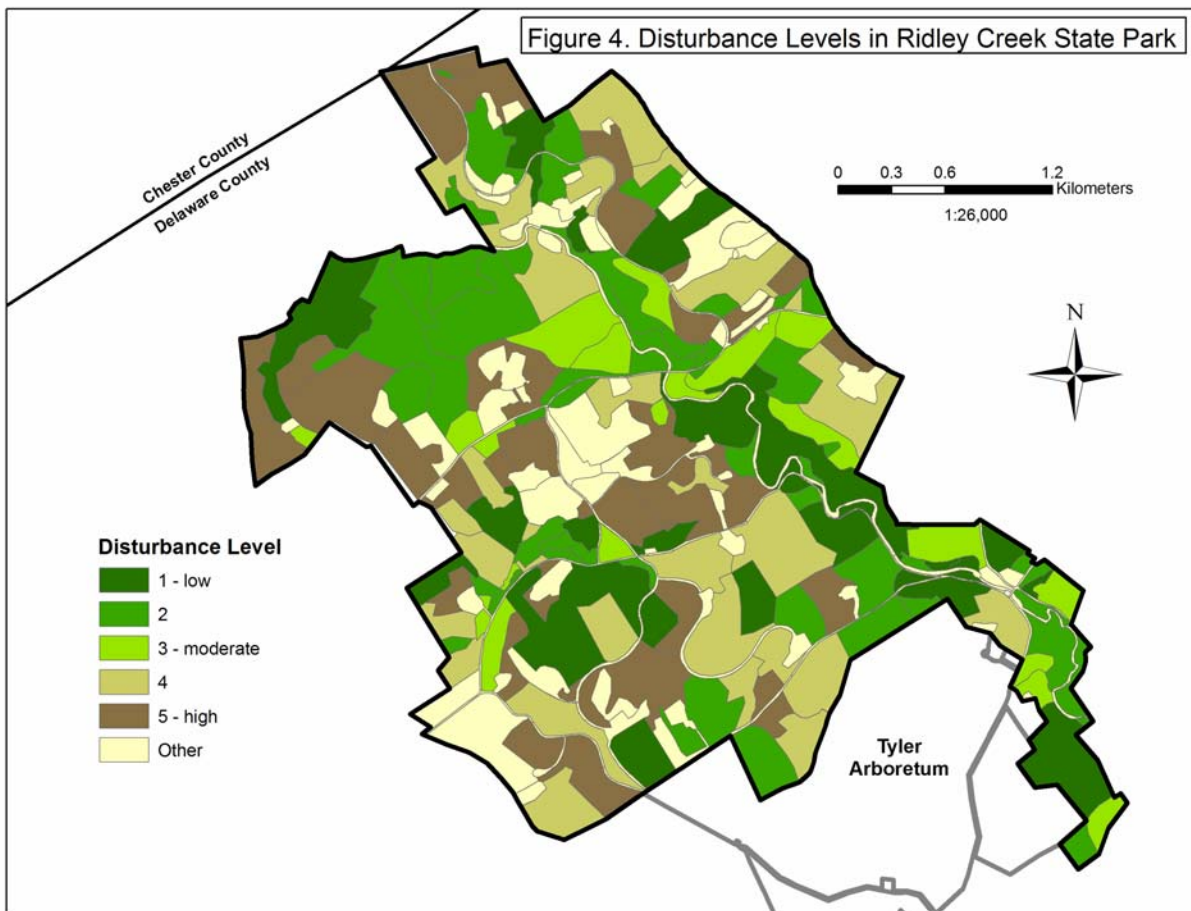


In addition to identifying the vegetation type, we scored each polygon to indicate the level of impact by non-native, invasive plants (Table 3; Figure 4).

Table 3. Levels of Impact of Invasive Plants on Park Vegetation
(Totals do not add up to 100 percent because not all land uses are included in the table)

<i>impact</i>	<i>acres</i>	<i>% of total park area*</i>
1	454.0	17.4
2	511.2	19.6
3	202.3	7.8
4	507.0	19.4
5	526.4	20.2

Overall 37 percent of the park vegetation falls into the least impacted class (categories 1 and 2) and 39.6 percent is severely impacted (categories 4 and 5). Although there is a rough correspondence between vegetation type and invasives impact score, not all mature red oak – mixed hardwood forest tracts are scored as #1. Although the canopy layer may be entirely native species, some tracts have been invaded in the shrub layer by shade tolerant invasives such as winged euonymus raising their score. There are similar differences among successional forests because of the degree on impact of invasives on the canopy versus the shrub layer.



Plant Diversity

Methods

Our goal was to compile as complete a list of vascular plants as possible; however, such a list must always be viewed as a work in progress. Most areas of the park were walked with emphasis on forested areas, wetlands, steep slopes, and other specialized habitats. Species lists were compiled for the park from field notes, transect data, herbarium specimens, and other observations. Nomenclature follows Rhoads and Block 2007. Plants are referred to in the text by common names for greater readability. The complete plant list (Appendix B) is organized in five groups: aquatic plants; ferns and fern allies; grasses, sedges, and rushes; wildflowers and other herbaceous plants; and woody species. In this report the lists are alphabetized by common name within each of the five groups and include scientific and plant family names for reference. An Excel spreadsheet has also been provided.

Rare plant searches were conducted by targeting locations of prior reports of PNHP-listed species as well as general observations. Searches were carried out at seasons when a maximum number of plants were in identifiable condition; some sites were visited at several seasons. Typically we targeted specific rare plants in our searches, that is, we examined the vegetation with a very specific search image in mind. Alternately, we scrutinize the vegetation with the goal of identifying all the plants. Based on years of experience, we are able to effectively recognize unusual species for a given area by mentally inventorying everything we see. This is the opposite of the process described above. Instead of searching for a specific plant, the focus is on anything that does not fit the pattern of expected species.

Herbarium specimens were collected to document rare species, other unusual plants, and species that could not be determined in the field. All specimens were entered in the Pennsylvania Flora Database, mounted, and deposited in the Herbarium of the Morris Arboretum of the University of the Pennsylvania (MOAR).

Results

We have compiled a list of 317 species for the park; 230 (73 percent) are native plants (Table 4).

Table 4. Plant Diversity at Ridley Creek State Park

	<i>native</i>	<i>introduced</i>	<i>total</i>
Aquatic plants	5	2	7
Ferns and fern allies	17	0	17
Sedges, grasses, and rushes	46	8	54
Wildflowers and other herbaceous species	94	49	143
Trees, shrubs, and woody vines	69	27	96
Totals	230	87	317

Species of concern – We found only one plant that is classified by the Pennsylvania Natural Heritage Program during our field work in Ridley Creek State Park. A small population of crane-fly orchid (*Tipularia discolor* - PA rare) was discovered on a wooded slope along Ridley Creek (Figure 5) . We were unable to relocate either puttyroot (*Aplectrum hyemale*) or heart-leaved dock (*Rumex hastatulus*). We included the location of puttyroot in Figure 5 as it has been recorded at the site within the past 20 years and may yet be rediscovered. Heart-winged dock has not been seen for 37 years and unlikely to be present. Fact sheets for all three species are included in Appendix C.

It should be noted that although two additional PNHP-listed plants, American holly and umbrella magnolia, are present in the park, both are represented by planted specimens.

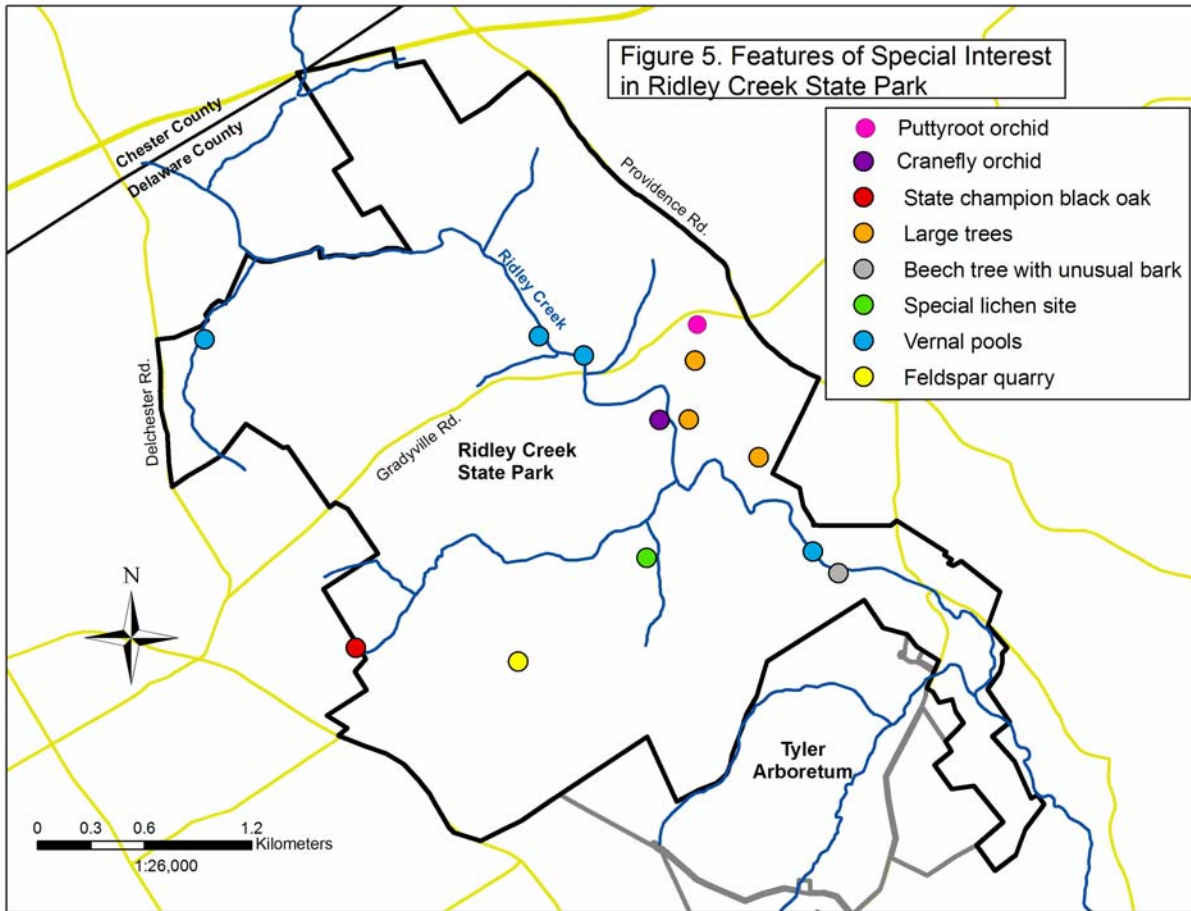
Winter leaf of crane-fly orchid at Ridley Creek State Park



A beard lichen (*Usnea* sp.) was found by park manager Roger McChesney in the fall of 2007. Repeated searches by Rhoads and Block did not turn up any additional occurrences in the park. This find is significant because pendant fruticose lichens such as this one are very rare in southeastern Pennsylvania.



Beard lichen (Usnea sp.)



Invasive species – Although only 27 percent of the species we found in the park are non-native, this figure alone does not adequately convey the extent to which the park landscape is dominated by invasive, non-native plants.

Because so much of the park was cleared and farmed, successional growth dominated by non-native invasive species covers extensive areas. Aerial photography from 1937 (<http://www.PennPilot.psu.edu>) reveals a pastoral landscape of fields and hedgerows (Figure 6). Forested land occupied only 28 percent of what is now the park; seventy percent of the land surface had been cleared and farmed. In contrast, by 2005 only 7 percent of the land was under cultivation and 54 percent was occupied by successional growth (Table 5).

Table 5. Land Cover in 1937 and 2005

(Totals do not add up to 100 percent because not all land uses are included in the table)

	1937	2005
forest	26%	24%
farmland	67%	7%*
successional growth	3%	54%
conifer plantations	1%	6%

** farmland figure for 2005 includes fields planted in warm season grasses as well as grain crops.*

Today non-native, invasive species are common throughout the park. Species that are most abundant include; multiflora rose, autumn-olive, winged euonymus, Japanese honeysuckle, Oriental bittersweet, mile-a-minute, Japanese stiltgrass, and garlic mustard. Four species; Canada thistle, mile-a-minute, multiflora rose, and purple loosestrife are classified as noxious weeds by the Pennsylvania Department of Agriculture.

Isolated patches of invasive species with the potential to spread further include: Norway maple, empress-tree, goutweed, tree-of-heaven, porcelain-berry, Japanese angelica-tree, wintercreeper, common-reed, English ivy, and bamboo (Figure 7).

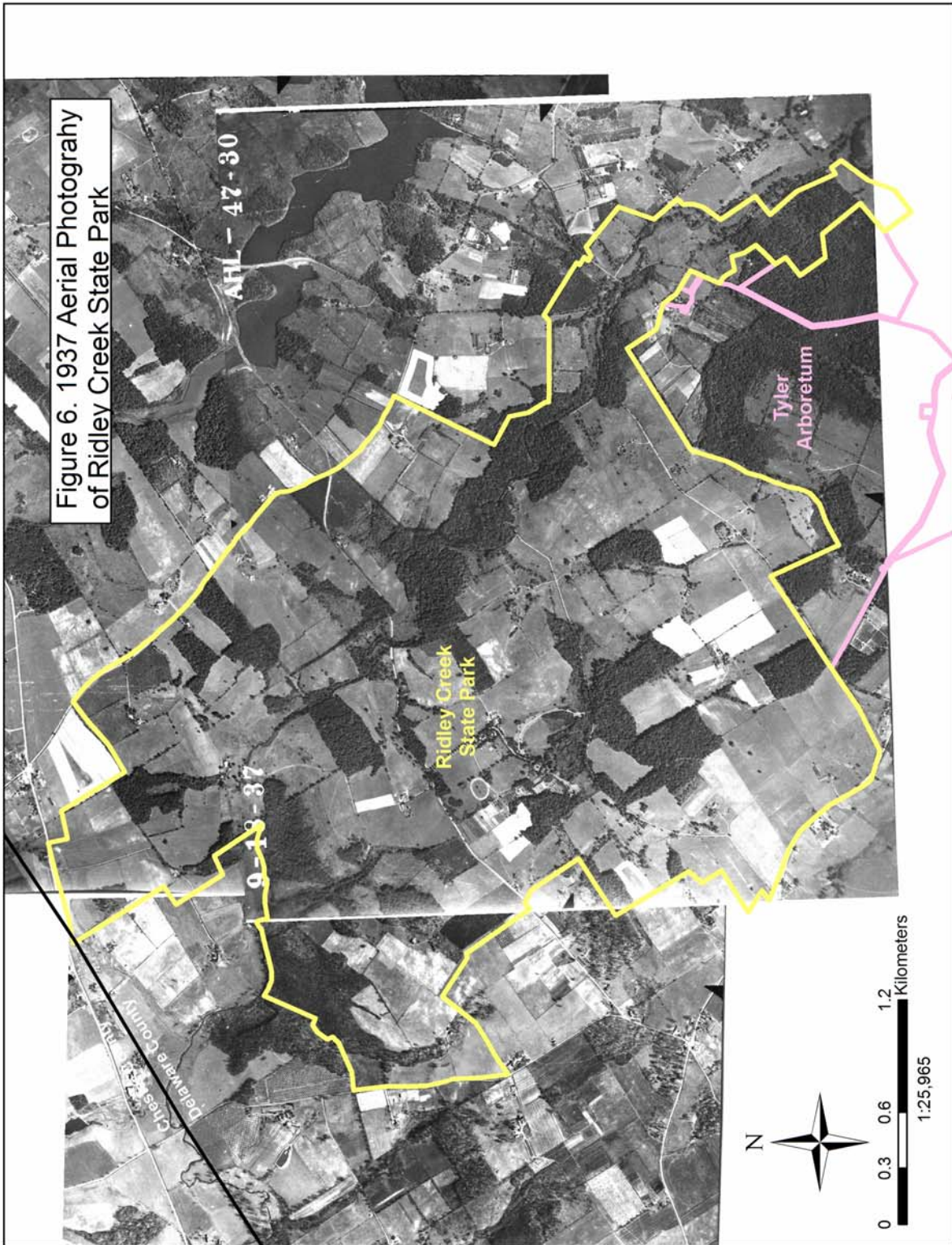
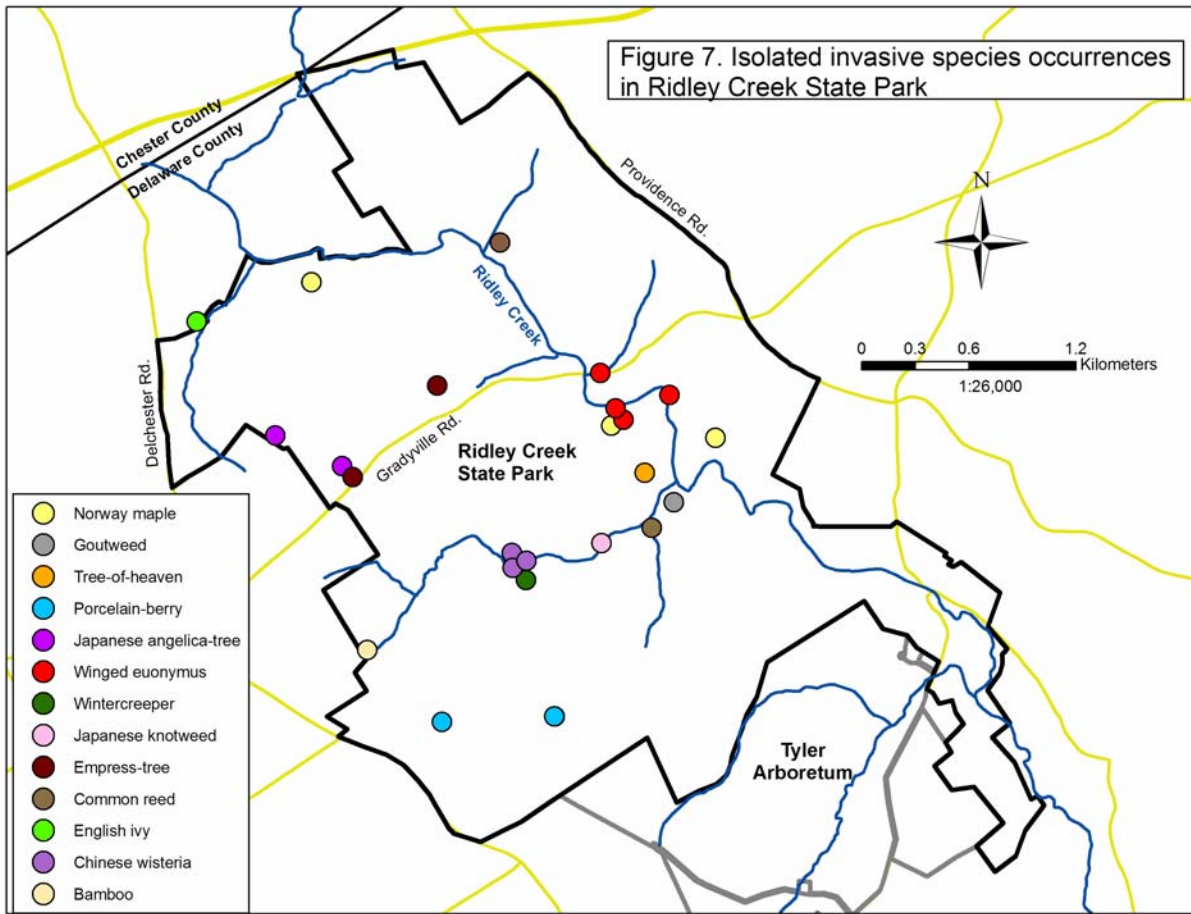


Figure 6. 1937 Aerial Photography of Ridley Creek State Park



IV. Discussion

Status of Plant Communities

Red oak – mixed hardwood forest – The red oak – mixed hardwood forest which is present today on slopes along Ridley Creek represents the forest cover that existed in southeastern Pennsylvania at the time of European settlement. Harshberger (1904) studied forest formations present in the portion of the Piedmont of southeastern Pennsylvania that is drained by Ridley Creek, Crum Creek, Darby Creek, Chester Creek, Brandywine Creek, and Wissahickon Creek. Although making the point that removal of almost all of the original forest and the introduction of cultivated plants had altered the character of the vegetation, Harshberger found primeval forest remnants on Crum Creek (part of the site now known as Crum Woods on the Swarthmore College campus) and Wissahickon Creek.

Based on his study of these fragments, Harshberger described upland forests characterized by chestnut, white ash, white oak, red oak, scarlet oak, beech, shagbark hickory, pignut hickory, mockernut hickory and hackberry. Tuliptree, black walnut, and American elm were present in creek and river bottoms. On stream banks and floodplains red maple, hornbeam, sycamore, silver maple, and pin oak were prominent. These descriptions correspond well with what we see today in Ridley Creek State Park with the exception that chestnut blight has reduced chestnut to occasional stump sprouts.

At Ridley Creek State Park vestiges of earlier forests include several large oaks and hickories, in scattered locations (see cover photo and Figure 5) and the state champion black oak, which is located in a small remnant of mature forest along the multi-use trail.

Another change is the increased presence of tuliptree, which reflects the abundance of successional forests. Tuliptree is a fast-growing, light-demanding species that readily colonizes open land. The wind-dispersed seeds are blown from adjacent established forests. Although early successional, tuliptree persists in the forest canopy, growing to massive sizes and living up to 300 years. Harshberger described tuliptrees six feet in diameter. Specimens approaching that size can still be found in Crum Woods on the Swarthmore College campus.

Several small forested tracts in the northern part of the park have experienced blow-downs of canopy trees which have opened the sites to invasion by invasive shrubs due to the absence of a native forest understory. Restoration of areas like this may require control of invasive species coupled with planting of desirable canopy species. If the current level of browsing continues, more areas will become similarly degraded as canopy trees die and are not replaced.

Ssuccessional forests – Tuliptree successional forest covers over 400 acres in Ridley Creek State Park, primarily adjacent to mature forest stands (Figure 3). The expected successional pattern is for them to mature into red oak – mixed hardwood forest; meanwhile they serve as buffers to the older stands. Although the shrub layer in these

young forests often contains abundant multiflora rose, autumn-olive, and/or Oriental bittersweet, as the canopy matures these shade-intolerant invasive species should decline.

However, winged euonymus, another non-native invasive shrub, is shade tolerant and not only grows, but also flowers and produces abundant seeds in the shade of a forest canopy. Winged euonymus appears to have been planted along the woods road that parallels Ridley Creek in the Hunting Hill section. It was included on the planting list for the Olmsted Brothers landscaping plan for the Jeffords' estate. Winged euonymus has spread throughout the adjacent forested slopes; ironically, only the fact that deer browse it heavily is preventing it from completely dominating the shrub layer.

Scattered occurrences are present in other areas also; some water-borne dispersal of seeds is very likely occurring via Ridley Creek as scattered plants of winged euonymus are present along the creek banks below Gradyville Road (Figure 7).

Successional red maple forests are present on lower slopes. White ash is a common associate and the shrub layer is typically strongly influenced by non-native invasive species including multiflora rose, wineberry, Amur honeysuckle, Japanese honeysuckle, Oriental bittersweet, and autumn-olive. Maintenance of an intact canopy is important to allow these forests to shade the exotic shrubs and encourage a native shrub layer of spicebush and arrow-wood viburnum to develop.

Modified successional forest and modified successional woodland and thicket are community types that are more severely impacted by invasive shrubs and vines. Modified successional forests may have non-native trees such as tree-of-heaven as part of the canopy. Woodlands have not developed a continuous tree canopy; they are characterized by scattered trees that cover 20-60 percent of the area. Both the modified successional forest and modified successional woodland are characterized by a dense layer of non-native shrubs and vines that inhibits normal patterns of succession. Autumn-olive, multiflora rose, porcelain berry, Oriental bittersweet, Japanese honeysuckle, and mile-a-minute are typically abundant. Several native species of grape may also be present, grape has evolved to take advantage of trees on forest edges to reach the light.

Wetlands – Red maple palustrine forest is present along several small tributary streams in permanently or seasonally wet areas that may have been used as pasture in the past. An herbaceous layer dominated by skunk-cabbage is diagnostic. Multiflora rose is usually scattered throughout and areas of open marsh may be interspersed. We interpret these areas as mid-successional forests that will mature to bottomland oak – hardwood associations in time. Maintenance of the existing canopy is important to gradually diminish the prominence of invasive shrubs.

Floodplain forests occupy alluvial flats areas along Ridley Creek. Non-native species are often present in the shrub layer including multiflora rose, obtuse-leaved privet, and Japanese honeysuckle. A large stand of Japanese knotweed on the floodplain between Sycamore Mills and the mouth of Dismal Run has been targeted for control; good

progress has been made, but there is more work to do. Replanting with native riparian species is an essential part of the project.

Buttonbush wetland is represented by a single area located in a former back channel of Ridley Creek; it is not seriously affected by invasive species. Red maple – mixed shrub palustrine woodland is present at several locations including one along Ridley Creek north of Gradyville Road; this hummocky community is heavily impacted by non-native invasive shrub species including multiflora rose and obtuse-leaved privet. Controlling invasive species in these areas would be very challenging. Standing water, at least early in the season allows the area to serve as an amphibian breeding site.

Herbaceous vernal pools are present on the floodplain of the creek in the vicinity of Gradyville Road and Sycamore Mills (Figure 5).

Grasslands – Cultivated areas include active pastures and meadows planted with warm season grasses. Pastures are present at Colonial Pennsylvania Plantation, Hidden Valley Farm, and around the Pennsylvania Resources Council headquarters on Providence Road. The pastures appear to be heavily grazed throughout the year by horses and other domestic animals.

One meadow area along Gradyville Road is a mixture of native and non-native grasses and forbs. It appears to have been a pasture that is now being maintained by occasional mowing.

Stands of warm season grasses have been established on former pastures where thickets of invasive shrubs and vines had developed. Beginning in 2001 selected sites were cleared and planted; they are maintained through annual mowing.

Threats

Deer overabundance

Some generalist wildlife species such as white-tailed deer, cottontail rabbits, gray squirrels, raccoons, and opossums have adapted very successfully to living in close proximity to humans. While this provides opportunities for park visitors to view wildlife, it also brings problems. The absence of large predators, and limited hunting opportunities have allowed deer to multiply in suburban areas. The impact of over abundant deer on natural areas constitutes a serious ecological threat.

Ecological impact – It is impossible to discuss the status of natural vegetation in Ridley Creek State Park without considering the impact of the Virginia white-tailed deer. Existing tracts of mature forest are threatened by deer overabundance. Over browsing has eliminated regeneration of canopy trees. A browse survey carried out in 2007 revealed that desirable regeneration was present on only five percent of the plots studied. Although mature trees are out of reach of hungry deer and continue to produce seeds, seedling and sapling trees that represent the future of the forest are vulnerable to both browsing and buck rub (damage caused by mature male deer scraping their antlers

against saplings). This can only result in canopy failure as existing trees die, a phenomenon that is already apparent at several locations in the park.

The understory and shrub layers have been reduced to a few browse-tolerant species. Even spicebush and root sprouts of beech, neither of which are highly preferred food plants of deer, are being heavily browsed in most areas of the park. Sensitive species such as bladdernut, pinxter-flower, arrow-wood viburnum, maple-leaf viburnum, and alternate-leaved dogwood, are reduced to a few suppressed fragments. Witch-hazel, and mountain laurel show a browse line, and are unable to produce new basal shoots to replace aging stems.

Diversity in the herbaceous layer has also been affected with non-preferred species such as blue cohosh and wild leek locally abundant but others reduced in both size and abundance. However, even in the most heavily browsed areas it is still possible to find suppressed fragments of species such as false Solomon's-seal that should be more common. This suggests that recovery could occur if deer density was reduced. The longer severe browsing continues however, the greater the losses will be.

Over browsing by deer also affects other forest animals; studies have shown that consumption of acorns by deer can negatively affect small mammals such as squirrels and white-footed mice. Loss of forest understory due to over browsing was shown to affect the diversity of birds in a ten-year study in northwestern Pennsylvania. Birds that nest on the ground (such as Ovenbirds) or in the shrub or understory layers are most vulnerable.

Reducing deer numbers is critical to preserving and/or restoring natural habitat and the diversity of species in Ridley Creek State Park and throughout the region.

Invasive Plants

Invasive, non-native plants are another serious environmental threat. Introduced species such as Japanese honeysuckle, multiflora rose, autumn-olive, mile-a-minute, Japanese knotweed, Japanese stiltgrass, Amur honeysuckle, Japanese honeysuckle, Norway maple, winged euonymus, tree-of-heaven, and many more are found throughout the park.

Former agricultural areas are especially vulnerable because of the removal of native vegetation. Floodplains and riparian areas are also vulnerable. Not only are they often narrow forested strips that are entirely edge habitat, but they are also subjected to natural disturbance due to flood scouring. In addition, a constant source of seeds and other propagules are carried in from upstream sources and spread by floodwaters.

Ecological impacts - Invasive plants compete with native species for space and resources. They inhibit succession, alter forest structure and composition, and affect the functioning of ecosystems. For example, research at Drew University in New Jersey has shown that the diversity of native species in the forest understory was reduced under a canopy of Norway maple compared to the native sugar maple.

A study of nesting success by Wood Thrushes and Robins found predation of nests was higher in non-native honeysuckle and buckthorn shrubs compared with native shrubs.

A butterfly, the West Virginia white, is threatened by the abundance of the non-native garlic mustard, which competes with toothwort, a native forest wildflower that is the butterfly's larval food plant. A toxin in the leaves of garlic mustard is fatal to the larvae.

Research at the Stroud Water Research Center in Chester County, Pennsylvania has shown that aquatic ecosystems can be affected by the nature of streamside vegetation. Leaf litter consisting of multiflora rose, Oriental bittersweet, and empress-tree (all non-native terrestrial species) resulted in reduced survival in mayfly nymphs compared to litter of white ash, hickory, and American beech. Mayflies are aquatic in their immature stages.

Effects of Japanese stiltgrass on forest soils in New Jersey included increased pH and thinned litter and organic layers. Garlic mustard has recently been found to suppress the growth of forest trees by inhibiting soil fungi that form beneficial associations with the roots of trees known as mycorrhizae.

Deer overabundance compounds the invasive species problem in several ways. Deer clearly prefer native species over non-natives with the result that, as native species disappear; the forest understory is opened up to the spread of exotics such as winged euonymus, bush honeysuckles, and wineberry. In addition deer have been shown to serve as dispersers of seeds of non-native species including autumn-olive and honeysuckle.

Management strategies – The most effective invasive plant control strategy involves first targeting areas that are still relatively free of invasives in order to keep them from deteriorating. At Ridley Creek State Park this means going into areas of mature red oak – mixed hardwood forest to remove the few winged euonymus or Norway maples that have become established. Note that both of these species are plants that can grow and reproduce indefinitely in the shade. Several areas of mixed forb marsh would benefit from the removal of scattered multiflora rose plants. And an infestation of naturalized Chinese wisteria threatens an area of red maple – mixed shrub palustrine woodland and mixed forb marsh near the entrance to the multiuse trail.

Eliminating a local seed source goes a long way toward reducing the future threat to tracts that have not yet become severely impacted by invasive species. In contrast, a delay in the treatment of heavily invaded sites is unlikely to lead to further deterioration in their condition.

Another important strategy is maintaining an intact forest canopy and preventing forest fragmentation. Although some invasive species can grow in the shade, most will decline and eventually disappear if the canopy remains intact. Invasive, non-native shrubs and vines such as multiflora rose, autumn-olive, Amur honeysuckle, and Japanese honeysuckle in the understory of tuliptree successional forest and red maple successional forest will decline over time as the canopy expands and thickens. Forest edges, however,

remain vulnerable to invasion due to greater access to sunlight, thus we often see a “wall” of multiflora rose and autumn-olive at the edge of a forest stand.

Biological control – There are signs that multiflora rose may be on the decline due to rose rosette, a lethal virus disease that is spread by mites. We have observed rose rosette disease at Ridley Creek State Park and throughout southeastern Pennsylvania.

In another promising development, researchers at the University of Delaware are evaluating a stem-boring weevil (*Rhyncomimus latipes* Korotyaev), that may provide biological control of mile-a-minute.

V. Conclusions and Recommendations

A core area of relatively intact forest and wetland communities extend through Ridley Creek State Park forming a corridor along the creek and its tributaries. However, these natural communities are threatened by deer overabundance and invasive species.

Deer overabundance

Deer overabundance must be reduced to assure the future of the park's forests. Any efforts to control invasive species and restore forest health will be in vain if current browse levels continue. In addition, herbaceous species classified by the Pennsylvania Natural Heritage Program are also jeopardized by the excessive numbers of deer currently present in the park.

Recommendations

- Reduce deer density throughout.
- Obtain the services of an ecologist to design a statistically valid sampling protocol for the park and establish regular monitoring of deer density and browsing impact.
- Construct exclosures in the park to educate the public about the impact of deer

Invasive species

We have identified areas of the park that have intact natural communities, with only scattered invasives (#1 sites on Figure 4), which we recommend as prime sites in which to concentrate non-native species control efforts. The highest quality natural communities include mature red oak – mixed hardwood forests and several wetland tracts.

Sites identified as #2 in Figure 4 are relatively intact natural communities; the canopy is dominated by native species but the shrub layer includes a significant representation of invasives. These sites include mature red oak – mixed hardwood forest where winged euonymus is a prominent element in the shrub layer and some successional forests.

Tuliptree successional forests and red maple successional forests adjacent to core areas of high quality forest should be treated as buffers and managed to create connectivity and maintain canopy closure. The effect will be to extend forest interior conditions and reduce the vigor of shade intolerant invasive species by reducing edge habitat. Most of these sites are coded as #2 or #3 in Figure 4.

At the other end of the spectrum are the most severely impacted areas (coded as #4 and #5 in Figure 4). These are sites where dense stands of invasive non-native species are inhibiting normal succession. They are a low priority for management action because their degraded condition is not likely to deteriorate further.

Complete removal of existing vegetation followed by replanting is probably the only effective way to alter these most degraded sites. Such radical treatment has resulted in establishment of warm season grass meadows in the park since 2001. We recommend

similar treatment in the remaining severely impacted areas as time and resources permit, but suggest that establishment of mixed meadows containing native cool and warm season grasses and forbs be considered.

Another element of an invasives species control strategy involves eradicating occurrences of species that are in initial stages of invasion or are limited to one or a few sites. Example include the infestation of wisteria at the entrance to the multiuse trail, it has invaded the edge of the adjacent wetland community.

Japanese angelica tree (*Aralia elata*) in the vicinity of 401 Gradyville Road is an example of a plant that could become more troublesome in the future due to its ability to invade the forest understory. A patch of bamboo near the multiuse trail should also be targeted for eradication. These and other localized infestations are shown in Figure 7.

Recommendations

Highest priority

- Reduce deer density throughout.
- Remove scattered invasives in the highest quality natural habitats, especially shade tolerant species such as winged euonymus and Norway maple.
- Continue the project to eradicate Japanese knotweed on the floodplain of Ridley Creek between Sycamore Mills and the mouth of Dismal Run and replant with native riparian species.

Medium priority

- Control winged euonymus growing along the banks of Ridley Creek in the Hunting Hill area to reduce the spread of seeds downstream.
- Avoid fragmentation of forest stands, encourage the development of successional forest stands adjacent to mature forest to foster connectivity and reduce edge.
- Control isolated occurrences of invasive species that are in initial stages of invasion or limited to one or a few sites.

Low priority

- Convert additional areas of modified successional woodland/thicket to meadows as time and resources permit. Consider more diverse mixtures of native grasses (cool season and warm season species) and forbs to provide habitat for butterflies, other insects, and grassland birds.

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Appendix A. Plant Community Types of Ridley Creek State Park

Upland Forest Community Type

Red oak – mixed hardwood forest - This forest type accounts for all the mature forests in Ridley Creek State Park. Because most of the land was cleared for farming in the 1700s



Red oak – mixed hardwood forest on a slope along Ridley Creek

and early 1800s, the mature forest stands that remain are mostly on steep, rocky slopes that couldn't be tilled. Most of these areas are located along Ridley Creek.

The forest canopy contains red oak, black oak, white oak, American beech, black birch, tuliptree, bitternut hickory, shagbark hickory, white ash, and an occasional

basswood. Past forest management practices, such as selective harvesting of oaks, plus over browsing by deer has skewed the species composition toward a beech monoculture in some areas.

Understory species include flowering dogwood, witch-hazel, hornbeam, and beech shoots. Native shrubs include spicebush and maple-leaf viburnum.

Herbaceous species include trout-lily, spring beauty, pipsissewa, white wood aster, Dutchman's-britches, wild leek, spreading Jacob's-ladder, blue cohosh, dwarf ginseng, common blue violet, downy yellow violet, liverleaf, toothwort, mayapple, wild-licorice, aniseroot, woodrush, honewort, Christmas fern, maidenhair fern, silvery glade fern, lady fern, hay-scented fern. Grasses present include woodland bluegrass, wedgegrass, and brachyelytrum; numerous sedges are also present (*Carex radiata*, *C. hirtifolia*, *C. festucacea*, *C. laxiflora*, *C. blanda*, *C. amphibola*, *C. pennsylvanica*, *C. gracilescens*, *C. swanii*).

PNHP-listed species found in this community type include one small population of crane-fly orchid.

These forests are very vulnerable to invasion by shade tolerant invasive species such as Norway maple, winged euonymus, Japanese barberry, garlic mustard, and Japanese stiltgrass. Other non-native species such as Oriental bittersweet, autumn-olive, multiflora

rose, and Japanese honeysuckle invade around the edges and in canopy gaps, but are not as shade tolerant.

Overbrowsing by deer is prevalent throughout, canopy trees are not regenerating with the exception of root shoots of beech. Native shrubs are sparse or completely missing in some areas. Recent tree falls have thinned the canopy so much in some locations that non-native invasive species now dominate the shrub layer.

Wetland Community Types

Miscellaneous palustrine forest - Red maple dominates the canopy of this lowland forest type, green ash, white ash, black walnut, wild black cherry, and American elm may also be present. Hornbeam is common in the understory. The shrub layer is dominated by spicebush; winterberry holly, southern arrow-wood, and blackhaw may also be present. Native vines include poison ivy and summer grape. The non-natives Japanese honeysuckle and multiflora rose are often abundant.

The herbaceous layer dominated by skunk-cabbage is diagnostic. Other species may include New York fern, sensitive fern, lady fern, jack-in-the-pulpit, jewelweed, false nettle, wood nettle, jumpseed, hooked crowfoot, wood geranium, spreading Jacob's-ladder, wild leek, hog-peanut, and several sedges (*Carex stricta*, *C. prasina*, *C. amphibola*, *C. laxiculmis*, *C. sparganoides*, *C. squarrosa*, *C. blanda*, *C. laxiflora*). Non-native species include Indian-strawberry, Japanese stiltgrass, star-of-Bethlehem, gill-over-the-ground, wood bluegrass, moneywort, mile-a-minute,



*Red maple palustrine forest,
note the dominance of skunk-cabbage in the herbaceous layer*

Sycamore – box-elder floodplain forest – Sycamores with their mottled white bark mark the extent of floodplains along stream courses. Other trees may include shagbark hickory, black walnut, red maple, box-elder, green ash, and hornbeam. The shrub layer is primarily spicebush with southern arrow-wood, and blackhaw; in addition non-native, invasive species such as multiflora rose, winged euonymus, autumn-olive and Japanese honeysuckle are often abundant.

Native herbaceous species include false mermaid, Virginia waterleaf, spreading Jacob's-ladder, spiderwort, jack-in-the-pulpit, trout lily, spring-beauty, wild leek, hooked crowfoot, small-flowered crowfoot, fringed loosestrife, jumpseed, and several sedges

(*Carex amphibola*, *C. squarrosa*, *C. lurida*, *C. trichocarpa*).



Sycamore floodplain forest along Ridley Creek at Sycamore Mills

Invasive, non-native species include common reed (*Phragmites australis*), Japanese knotweed, stinging nettle, garlic mustard, Japanese stiltgrass, low smartweed, ivy-leaved speedwell, moneywort, Japanese stiltgrass, Japanese hops, and mile-a-minute. While not yet as abundant as it is at many places in southeastern Pennsylvania, lesser celandine is present and may be on the increase.

Silver maple floodplain forest - Widely spaced, large silver maple trees characterize this forest type in Ridley Creek State Park. The only occurrence is along Ridley Creek just down stream from Sycamore Mills. Other trees present include wild black cherry, red maple, black walnut, mockernut hickory, elm, and ash.

The understory is quite open with only a few scattered small trees, shrubs, and vines such as crabapple, cockspur hawthorn, nannyberry, frost grape, and poison ivy. The herbaceous layer includes jack-in-the-pulpit, false mermaid, wood reedgrass, *Carex grayii*, *Carex trichocarpa*, and several non-native species including stinging nettle and Japanese stiltgrass.



A large silver maple on the floodplain of Ridley Creek below Sycamore Mills

Red maple – mixed shrub palustrine woodland - Areas fitting this description lie along Ridley Creek above Gradyville Road. Red maples are scattered; box elder, poison-ivy, spicebush, and frost grape are other native woody species that are present. However, invasive species are a significant component; multiflora rose, obtuse-leaved privet and

crabapple are dominant species. Herbaceous species include jewelweed, common cat-tail, moneywort, soft rush, and forget-me-not. In early spring there are areas of standing water that support breeding amphibians such as spring peepers.

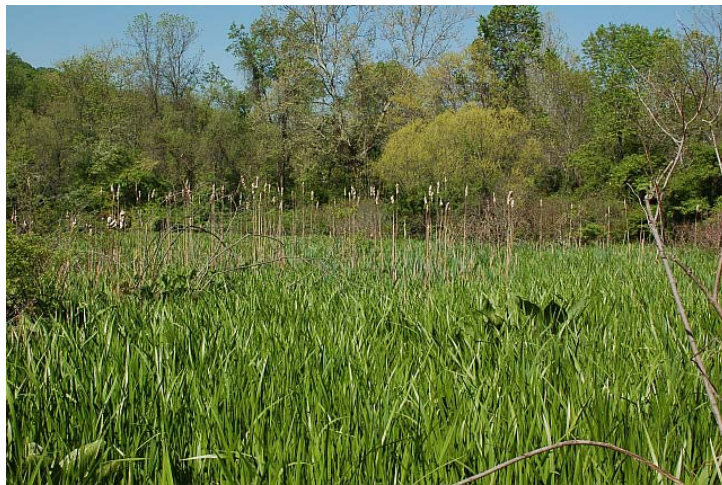
Buttonbush wetland - This wetland community is characterized by buttonbush with scattered smooth alder, black willow, and red maple. Herbaceous species include northern blue flag, soft rush, common cat-tail, reed canary grass, skunk-cabbage, sedges, golden saxifrage, and and forget-me-not. The location of this community type at Ridley Creek State Park appears to be an old flood channel of Ridley Creek.



Buttonbush swamp along Ridley Creek above Sycamore Mills

Mixed forb marsh - Skunk-cabbage, sensitive fern, sweetflag, and fowl mannagrass are the dominant species in these open wetland communities. Sedges may also be prominent (*Carex trichocarpa*, *C. stipata*, *C. stricta*, *C. crinita* var. *crinita*, *C. annectens*, *C. vulpinoides*, *C. lurida*). Small patches of common cat-tail are frequently present.

Other herbaceous species include soft rush, false hellebore, jewelweed, jack-in-the-pulpit, bittercress, Pennsylvania bittercress, wood nettle, false nettle, tearthumb (*Persicaria sagittata* and *P. arifolium*), wood nettle, long-leaved stitchwort, turtlehead, and non-natives including stinging nettle, rough bluegrass, Japanese stiltgrass, and mile-a-minute.



Mixed forb marsh with sweetflag dominating the foreground, site is adjacent to the parking area for Colonial Pennsylvania Plantation.

Scattered clumps of trees or shrubs are usually present including red maple, black willow, pussy willow, silky dogwood, smooth alder, buttonbush, swamp rose, black elderberry, and the non-native multiflora rose.

These marsh communities are found in low, wet areas along streams and often grade into palustrine red maple forest at the margins.

Herbaceous vernal pond –

A vernal pond is present on the floodplain of Ridley Creek just above Gradyville Road; it is located within a sycamore floodplain community.

The pool contains clumps of soft rush, *Carex crinita*, *C. stipata*, and fowl mannagrass. A few spring peppers were calling at the site in May 2008.



Vernal pond on the floodplain of Ridley Creek above the Gradyville Road bridge.

Successional Community Types

Tuliptree successional forest - Lands that were cleared and later allowed to undergo secondary succession have developed near monocultures of tuliptree. Hornbeam, red maple, and crabapple may be present in the understory.

The shrub layer consists of spicebush with non-native invasive species such as multiflora rose, autumn-olive, oriental bittersweet, and Japanese honeysuckle often very abundant.

The herbaceous layer in older stands may contain a high diversity of native woodland species including Christmas fern, beech fern, maidenhair fern,

rattlesnake fern, lady fern, silvery glade fern, New York fern, bloodroot, wood anemone, common blue violet, downy yellow violet, blue cohosh, jack-in-the-pulpit, black cohosh, showy orchis, false



Successional tuliptree forest along Ridley Creek at Hunting Hill

Solomon's-seal, Solomon's-seal, wild leek, mayapple, trout lily, spring-beauty, honewort, black snakeroot, white wood aster, zigzag goldenrod, and sedges (*Carex laxiflora*, *C. blanda*, *C. radiata*, *C. hirtifolia*, *C. gracillima*, *C. gracilescens*, *C. striatula*, *C. pennsylvanica*).

In time other species should become established and eventually these successional stands should become red oak – mixed hardwood forests; however, heavy browsing by deer could retard the process. These stands are often adjacent to red oak – mixed hardwood forest stands and can serve as buffers and eventual additions to the mature forest cover.

Modified successional forest - These stands developed on lands that were formerly tilled fields or pastures. Typically a canopy of native trees is present consisting of red maple and white ash. Beneath them is a dense shrub layer dominated by multiflora rose, autumn-olive, Amur honeysuckle, winged euonymus, Japanese barberry, wineberry. Native shrubs including spicebush and blackberry may also be present. Vines including the native frost grape (*Vitis vulpina*) and non-natives such as Japanese honeysuckle and Oriental bittersweet are also prominent.



Modified successional forest with Oriental bittersweet shrouding the trees

Herbaceous species are few, but include jack-in-the-pulpit, white avens, enchanter's-nightshade, and non-natives such as garlic mustard and Japanese stiltgrass.

The presence of a native canopy provides the potential for a decline in the prominence of non-native shrubs in the future as species such as autumn-olive, multiflora rose, wineberry, Amur honeysuckle, Japanese honeysuckle, and Oriental bittersweet have limited shade tolerance. However, only tracts large enough to provide forest interior conditions will experience this effect. Edge habitat will continue to support the invasives.

Modified successional woodland - Like the modified successional forest, this community type has developed on lands that were formerly cleared and farmed. The species present are similar; however the relative abundance of the species is different. Trees are scattered and much of the area is dominated by non-native shrubs and vines.

Crabapple, autumn-olive, multiflora rose, obtuse-leaved privet, and wineberry are often very abundant. A few native species are also part of the mix including spicebush, blackberry, and blackcap raspberry. The few trees present are usually shrouded with vines including Oriental bittersweet, Japanese honeysuckle, and grape (native). In addition mile-a-minute and porcelain-berry are frequently present in the more open areas along with Japanese stiltgrass.



Modified successional woodland with mile-a-minute covering the open area in the foreground

These communities are the product of over browsing by deer which has inhibited native tree growth and favored the non-native invasive plants. They are unlikely to undergo “normal” secondary succession due to the combined effects of deer and invasives and are therefore prime candidates for conversion to meadows.

Anthropogenic Communities

Miscellaneous mixed species plantation – Several plantings of white pine are present in the park. As the pines age and decline, the plantations are being invaded by other species. White ash, red maple, wild black cherry, and tuliptree are the ginning of a native deciduous canopy. Sassafras and flowering dogwood form an understory along with the non-natives crabapple and Japanese angelica tree.



Declining white pine plantation along Gradyville Road

Shrubs are also invading including the native spicebush and non-native species such as wineberry, autumn-olive, multiflora rose, and Amur honeysuckle. Native vines such as poison-ivy and Virginia creeper are present; non-native vines include Oriental bittersweet, Japanese honeysuckle, and mile-a-minute.

Native herbaceous species include spinulose wood fern, jack-in-the-pulpit and enchanter’s-nightshade, honewort, white avens, and jumpseed.

Cultivated herbaceous area - warm season grasses – Several areas in the park have been planted with mixtures of warm season grasses such as turkeyfoot, switchgrass, little bluestem, and Indian grass. Additional areas are being prepared for planting.

Cultivated herbaceous area - cool season mix – Grasslands meeting this description include active pastures at Colonial Pennsylvania Plantation and Hidden Valley Farm, the equestrian facility within the park, as well as former hayfields.

The pastures are mostly non-native cool season grasses and associated forbs, and are heavily grazed throughout the year.

Horse pasture at Hidden Valley Farm



Agricultural herbaceous area - rotation crops – Two fields on the west side of the park remain in agriculture. In June 2008 they were planted in corn and wheat.

Appendix B

Ridley Creek State Park Plant List 2007- 2008

<i>common name</i>	<i>scientific name</i>	<i>family</i>	<i>native or introduced</i>	<i>PNHP status</i>	<i>wetland indicator code</i>	<i>state noxious weed status</i>
aquatics						
Curly pondweed	<i>Potamogeton crispus</i>	Potamogetonaceae	I	N	OBL	N
Duckweed	<i>Lemna minor</i>	Araceae	N	N	OBL	N
Marsh-purslane	<i>Ludwigia palustris</i>	Onagraceae	N	N	OBL	N
Mud-plantain	<i>Heteranthera reniformis</i>	Pontederiaceae	N	N	OBL	N
Watercress	<i>Nasturtium officinale</i>	Brassicaceae	I	N	OBL	N
Water-starwort	<i>Callitriche stagnalis</i>	Plantaginaceae	I	N	OBL	N
Waterweed	<i>Elodea nuttallii</i>	Hydrocharitaceae	N	N	OBL	N
ferns and fern allies						
Broad beech fern	<i>Phegopteris hexagonoptera</i>	Polypodiaceae	N	N	FAC	N
Christmas fern	<i>Polystichum acrostichoides</i>	Polypodiaceae	N	N	N	N
Cinnamon fern	<i>Osmunda cinnamomea</i>	Osmundaceae	N	N	FACW	N
Ebony spleenwort	<i>Asplenium platyneuron</i>	Polypodiaceae	N	N	FACU	N
Field horsetail	<i>Equisetum arvense</i>	Equisetaceae	N	N	FAC	N
Hay-scented fern	<i>Dennstaedtia punctilobula</i>	Polypodiaceae	N	N	N	N
Lady fern	<i>Athyrium filix-femina</i> var. <i>angustum</i>	Polypodiaceae	N	N	FAC	N
Long beech fern	<i>Phegopteris connectilis</i>	Polypodiaceae	N	N	FACU+	N
Marginal wood fern	<i>Dryopteris marginalis</i>	Polypodiaceae	N	N	FACU-	N
Marsh fern	<i>Thelypteris palustris</i>	Polypodiaceae	N	N	FACW+	N
New York fern	<i>Thelypteris noveboracensis</i>	Polypodiaceae	N	N	FAC	N
Northern maidenhair	<i>Adiantum pedatum</i>	Polypodiaceae	N	N	FAC-	N
Rattlesnake fern	<i>Botrychium virginianum</i>	Ophioglossaceae	N	N	FACU	N
Sensitive fern	<i>Onoclea sensibilis</i>	Polypodiaceae	N	N	FACW	N
Silvery glade fern	<i>Deparia acrostichoides</i>	Polypodiaceae	N	N	FAC	N
Spinulose wood fern	<i>Dryopteris carthusiana</i>	Polypodiaceae	N	N	FAC+	N
Water horsetail	<i>Equisetum fluviatile</i>	Equisetaceae	N	N	OBL	N
grasses, sedges, and rushes						
Annual bluegrass	<i>Poa annua</i>	Poaceae	I	N	FACU	N
Bluegrass	<i>Poa cuspidata</i>	Poaceae	N	N	N	N
Brachyelytrum	<i>Brachyelytrum erectum</i>	Poaceae	N	N	N	N
Club-rush	<i>Trichophorum planifolium</i>	Cyperaceae	N	N	N	N

Common reed	<i>Phragmites australis</i> ssp. <i>australis</i>	Poaceae	I	N	FACW	N
Common woodrush	<i>Luzula echinata</i>	Juncaceae	N	N	FACU	N
Deer-tongue grass	<i>Dichanthelium clandestinum</i>	Poaceae	N	N	FAC+	N
Field woodrush	<i>Luzula multiflora</i>	Juncaceae	N	N	FACU	N
Fowl mannagrass	<i>Glyceria striata</i>	Poaceae	N	N	OBL	N
Kentucky bluegrass	<i>Poa pratensis</i>	Poaceae	I	N	FACU	N
Little bluestem	<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	Poaceae	N	N	FACU	N
Nodding fescue	<i>Festuca obtusa</i>	Poaceae	N	N	FACU	N
Orchardgrass	<i>Dactylis glomerata</i>	Poaceae	I	N	FACU	N
Panic grass	<i>Dichanthelium boscii</i>	Poaceae	N	N	N	N
Panic grass	<i>Dichanthelium dichotomum</i>	Poaceae	N	N	FAC	N
Prairie wedgegrass	<i>Sphenopholis obtusata</i> var. <i>obtusata</i>	Poaceae	N	N	FAC-	N
Reed canary-grass	<i>Phalaris arundinacea</i>	Poaceae	N	N	FACW	N
Riverbank wild-rye	<i>Elymus riparius</i>	Poaceae	N	N	FACW	N
Rough bluegrass	<i>Poa trivialis</i>	Poaceae	I	N	FACW	N
Sedge	<i>Carex albicans</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex amphibola</i>	Cyperaceae	N	N	FAC	N
Sedge	<i>Carex blanda</i>	Cyperaceae	N	N	FAC	N
Sedge	<i>Carex cephalophora</i>	Cyperaceae	N	N	FACU	N
Sedge	<i>Carex debilis</i> var. <i>rudgei</i>	Cyperaceae	N	N	FAC	N
Sedge	<i>Carex digitalis</i>	Cyperaceae	N	N	UPL	N
Sedge	<i>Carex festucacea</i>	Cyperaceae	N	N	FAC	N
Sedge	<i>Carex gracilescens</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex hirtifolia</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex laxiculmis</i> var. <i>laxiculmis</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex laxiflora</i>	Cyperaceae	N	N	FACU	N
Sedge	<i>Carex lucorum</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex lurida</i>	Cyperaceae	N	N	OBL	N
Sedge	<i>Carex pensylvanica</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex prasina</i>	Cyperaceae	N	N	OBL	N
Sedge	<i>Carex radiata</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex rosea</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex sparganioides</i>	Cyperaceae	N	N	FACU	N
Sedge	<i>Carex squarrosa</i>	Cyperaceae	N	N	FACW	N
Sedge	<i>Carex stipata</i> var. <i>stipata</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex striatula</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex swanii</i>	Cyperaceae	N	N	FACU	N

Sedge	<i>Carex torta</i>	Cyperaceae	N	N	FACW	N
Sedge	<i>Carex trichocarpa</i>	Cyperaceae	N	N	OBL	N
Sedge	<i>Carex virescens</i>	Cyperaceae	N	N	N	N
Sedge	<i>Carex vulpinoidea</i>	Cyperaceae	N	N	OBL	N
Short hair sedge	<i>Carex crinita</i> var. <i>crinita</i>	Cyperaceae	N	N	OBL	N
Smooth brome	<i>Bromus inermis</i>	Poaceae	I	N	N	N
Soft rush	<i>Juncus effusus</i> var. <i>pylpei</i>	Juncaceae	N	N	FACW+	N
Stiltgrass	<i>Microstegium vimineum</i>	Poaceae	I	N	FAC	N
Tussock sedge	<i>Carex stricta</i>	Cyperaceae	N	N	OBL	N
Wood bluegrass	<i>Poa nemoralis</i>	Poaceae	I	N	FAC	N
Wood reedgrass	<i>Cinna arundinacea</i>	Poaceae	N	N	FACW	N
Woodland bluegrass	<i>Poa alsodes</i>	Poaceae	N	N	FACW-	N
Woodland bluegrass	<i>Poa sylvestris</i>	Poaceae	N	N	FACW	N
wildflowers and other herbaceous plants						
American dog violet	<i>Viola labradorica</i>	Violaceae	N	N	FACW	N
Anise root	<i>Osmorhiza longistylis</i>	Apiaceae	N	N	FACU	N
Asiatic dayflower	<i>Commelina communis</i> var. <i>communis</i>	Commelinaceae	I	N	FAC-	N
Bedstraw	<i>Galium aparine</i>	Rubiaceae	N	N	FACU	N
Beechdrops	<i>Epifagus virginiana</i>	Orobanchaceae	N	N	N	N
Beggar's-lice	<i>Hackelia virginiana</i>	Boraginaceae	N	N	FACU	N
Bigleaf aster	<i>Eurybia macrophylla</i>	Asteraceae	N	N	N	N
Bitter dock	<i>Rumex obtusifolius</i>	Polygonaceae	I	N	FACU-	N
Bittercress	<i>Cardamine bulbosa</i>	Brassicaceae	N	N	OBL	N
Black snake root	<i>Sanicula marilandica</i>	Apiaceae	N	N	UPL	N
Black snakeroot	<i>Actaea racemosa</i>	Ranunculaceae	N	N	N	N
Blue cohosh	<i>Caulophyllum thalictroides</i>	Berberidaceae	N	N	N	N
Blue marsh violet	<i>Viola cucullata</i>	Violaceae	N	N	FACW+	N
Blunt-leaved sandwort	<i>Moehringia lateriflora</i>	Caryophyllaceae	N	N	FAC	N
Boneset	<i>Eupatorium perfoliatum</i>	Asteraceae	N	N	FACW+	N
Broad-leaved plantain	<i>Plantago major</i>	Plantaginaceae	I	N	FACU	N
Broom-rape	<i>Orobanche uniflora</i>	Orobanchaceae	N	N	FACU	N
Bugleweed	<i>Lycopus virginicus</i>	Lamiaceae	N	N	OBL	N
Bulbous buttercup	<i>Ranunculus bulbosus</i>	Ranunculaceae	I	N	UPL	N
Canada thistle	<i>Cirsium arvense</i>	Asteraceae	I	N	FACU	Y
Common blue violet	<i>Viola sororia</i>	Violaceae	N	N	FAC-	N
Common burdock	<i>Arctium minus</i>	Asteraceae	I	N	FACU-	N
Common cat-tail	<i>Typha latifolia</i>	Typhaceae	N	N	OBL	N

Common chickweed	<i>Stellaria media</i>	Caryophyllaceae	I	N	N	N
Common dandelion	<i>Taraxacum officinale</i>	Asteraceae	I	N	FACU-	N
Common groundsel	<i>Senecio vulgaris</i>	Asteraceae	I	N	FACU	N
Common meadow buttercup	<i>Ranunculus acris</i>	Ranunculaceae	I	N	FAC+	N
Common milkweed	<i>Asclepias syriaca</i>	Apocynaceae	N	N	FACU-	N
Common mullein	<i>Verbascum thapsus</i>	Scrophulariaceae	I	N	N	N
Common periwinkle	<i>Vinca minor</i>	Apocynaceae	I	N	N	N
Common polypody	<i>Polypodium virginianum</i>	Polypodiaceae	N	N	N	N
Common ragweed	<i>Ambrosia artemisiifolia</i>	Asteraceae	N	N	FACU	N
Corn speedwell	<i>Veronica arvensis</i>	Plantaginaceae	I	N	N	N
Cow-parsnip	<i>Heracleum lanatum</i>	Apiaceae	N	N	FACU-	N
Cranefly orchid	<i>Tipularia discolor</i>	Orchidaceae	N	PR	FACU	N
Creeping-charlie	<i>Lysimachia nummularia</i>	Myrsinaceae	I	N	FACW-	N
Curly dock	<i>Rumex crispus</i>	Polygonaceae	I	N	FACU	N
Cutleaf coneflower	<i>Rudbeckia laciniata</i> var. <i>laciniata</i>	Asteraceae	N	N	FACW	N
Daisy fleabane	<i>Erigeron annuus</i>	Asteraceae	N	N	FACU	N
Daisy fleabane	<i>Erigeron philadelphicus</i>	Asteraceae	N	N	FACU	N
Doorweed	<i>Polygonum aviculare</i>	Polygonaceae	I	N	N	N
Downy yellow violet	<i>Viola pubescens</i> var. <i>pubescens</i>	Violaceae	N	N	FACU-	N
Dutchman's-breeches	<i>Dicentra cucullaria</i>	Papaveraceae	N	N	N	N
Dwarf ginseng	<i>Panax trifolius</i>	Araliaceae	N	N	N	N
Early saxifrage	<i>Saxifraga virginensis</i>	Saxifragaceae	N	N	FAC-	N
Early wintercress	<i>Barbarea verna</i>	Brassicaceae	I	N	N	N
Enchanter's-nightshade	<i>Circaea canadensis</i> ssp. <i>canadensis</i>	Onagraceae	N	N	FACU	N
False hellebore	<i>Veratrum viride</i>	Melanthiaceae	N	N	FACW+	N
False nettle	<i>Boehmeria cylindrica</i> var. <i>cylindrica</i>	Urticaceae	N	N	FACW+	N
False solomon's-seal	<i>Maianthemum racemosum</i>	Ruscaceae	N	N	N	N
False-mermaid	<i>Floerkea proserpinacoides</i>	Limnanthaceae	N	N	FAC	N
Field garlic	<i>Allium vineale</i>	Alliaceae	I	N	FACU-	N
Field pennycress	<i>Thlaspi arvense</i>	Brassicaceae	I	N	N	N
Field thistle	<i>Cirsium discolor</i>	Asteraceae	N	N	UPL	N
Fieldcress	<i>Lepidium campestre</i>	Brassicaceae	I	N	N	N
Forget-me-not	<i>Myosotis scorpioides</i>	Boraginaceae	I	N	OBL	N
Fringed loosestrife	<i>Lysimachia ciliata</i>	Myrsinaceae	N	N	FACW	N
Garlic-mustard	<i>Alliaria petiolata</i>	Brassicaceae	I	N	FACU-	N
Giant chickweed	<i>Myosoton aquaticum</i>	Caryophyllaceae	I	N	FACW	N
Giant ragweed	<i>Ambrosia trifida</i>	Asteraceae	N	N	FAC	N

Gill-over-the-ground	<i>Glechoma hederacea</i>	Lamiaceae	I	N	FACU	N
Golden saxifrage	<i>Chrysosplenium americanum</i>	Saxifragaceae	N	N	OBL	N
Great nettle	<i>Urtica dioica</i> ssp. <i>dioica</i>	Urticaceae	I	N	FACU	N
Greater celandine	<i>Chelidonium majus</i>	Papaveraceae	I	N	UPL	N
Hairy bittercress	<i>Cardamine hirsuta</i>	Brassicaceae	I	N	FACU	N
Halberd-leaf tearthumb	<i>Persicaria arifolia</i>	Polygonaceae	N	N	OBL	N
Heal-all	<i>Prunella vulgaris</i> ssp. <i>vulgaris</i>	Lamiaceae	I	N	FACU+	N
Honewort	<i>Cryptotaenia canadensis</i>	Apiaceae	N	N	FAC	N
Hooked crowfoot	<i>Ranunculus recurvatus</i>	Ranunculaceae	N	N	FAC+	N
Horse balm	<i>Collinsonia canadensis</i>	Lamiaceae	N	N	FAC+	N
Indian strawberry	<i>Duchesnea indica</i>	Rosaceae	I	N	FACU-	N
Indian-pipe	<i>Monotropa uniflora</i>	Ericaceae	N	N	FACU-	N
Ivy-leaved speedwell	<i>Veronica hederifolia</i>	Plantaginaceae	I	N	N	N
Jack-in-the-pulpit	<i>Arisaema triphyllum</i> ssp. <i>triphyllum</i>	Araceae	N	N	FACW-	N
Japanese angelica-tree	<i>Aralia elata</i>	Araliaceae	I	N	N	N
Japanese hops	<i>Humulus japonicus</i>	Cannabaceae	I	N	FACU	N
Japanese knotweed	<i>Fallopia japonica</i>	Polygonaceae	I	N	FACU-	N
Japanese pachysandra	<i>Pachysandra terminalis</i>	Buxaceae	I	N	N	N
Japanese pearlwort	<i>Sagina japonica</i>	Caryophyllaceae	I	N	N	N
Jewelweed	<i>Impatiens capensis</i>	Balsaminaceae	N	N	FACW	N
Jumpseed	<i>Persicaria virginiana</i>	Polygonaceae	N	N	FAC	N
Lanceleaf figwort	<i>Scrophularia lanceolata</i>	Scrophulariaceae	N	N	FACU+	N
Lesser celandine	<i>Ranunculus ficaria</i>	Ranunculaceae	I	N	N	N
Liverleaf	<i>Anemone americana</i>	Ranunculaceae	N	N	N	N
Long-leaved stitchwort	<i>Stellaria longifolia</i>	Caryophyllaceae	N	N	FACW	N
Low smartweed	<i>Persicaria longiseta</i>	Polygonaceae	I	N	FACU-	N
Lyre-leaved sage	<i>Salvia lyrata</i>	Lamiaceae	N	N	UPL	N
Marsh watercress	<i>Rorippa palustris</i>	Brassicaceae	N	N	OBL	N
Mayapple	<i>Podophyllum peltatum</i>	Berberidaceae	N	N	N	N
Mexican-tea	<i>Dysphania ambrosioides</i>	Amaranthaceae	I	N	FACU	N
Mile-a-minute weed	<i>Persicaria perfoliata</i>	Polygonaceae	I	N	FAC	Y
Moonseed	<i>Menispermum canadense</i>	Menispermaceae	N	N	FACU	N
Mouse-ear chickweed	<i>Cerastium glomeratum</i>	Caryophyllaceae	I	N	UPL	N
Neckweed	<i>Veronica peregrina</i> ssp. <i>peregrina</i>	Plantaginaceae	N	N	FACU-	N
Nipplewort	<i>Lapsana communis</i>	Asteraceae	I	N	N	N
Northern blue flag	<i>Iris versicolor</i>	Iridaceae	N	N	OBL	N
Orange day-lily	<i>Hemerocallis fulva</i>	Hemerocallidaceae	I	N	UPL	N
Partridge-berry	<i>Mitchella repens</i>	Rubiaceae	N	N	FACU	N

Pennsylvania bittercress	<i>Cardamine pensylvanica</i>	Brassicaceae	N	N	OBL	N
Pipsissewa	<i>Chimaphila maculata</i>	Ericaceae	N	N	N	N
Poor-man's-pepper	<i>Lepidium virginicum</i>	Brassicaceae	N	N	FACU-	N
Purple dead-nettle	<i>Lamium purpureum</i>	Lamiaceae	I	N	N	N
Purple loosestrife	<i>Lythrum salicaria</i>	Lythraceae	I	N	FACW+	Y
Purple-leaved willow-herb	<i>Epilobium coloratum</i>	Onagraceae	N	N	FACW+	N
Puttyroot orchid	<i>Aplectrum hyemale</i>	Orchidaceae	N	PR	FAC	N
Ramp	<i>Allium tricoccum</i>	Alliaceae	N	N	FACU+	N
Rattlesnake-root	<i>Prenanthes altissima</i>	Asteraceae	N	N	FACU-	N
Rattlesnake-weed	<i>Hieracium venosum</i>	Asteraceae	N	N	N	N
Sheep sorrel	<i>Rumex acetosella</i>	Polygonaceae	I	N	UPL	N
Shinleaf	<i>Pyrola elliptica</i>	Ericaceae	N	N	UPL	N
Showy orchis	<i>Galearis spectabilis</i>	Orchidaceae	N	N	N	N
Skunk cabbage	<i>Symplocarpus foetidus</i>	Araceae	N	N	OBL	N
Small-flowered crowfoot	<i>Ranunculus abortivus</i>	Ranunculaceae	N	N	FACW-	N
Solomon's-seal	<i>Polygonatum biflorum</i> var. <i>biflorum</i>	Ruscaceae	N	N	FACU	N
Solomon's-seal	<i>Polygonatum pubescens</i>	Ruscaceae	N	N	N	N
Spiderwort	<i>Tradescantia virginiana</i>	Commelinaceae	N	N	FACU	N
Spikenard	<i>Aralia racemosa</i>	Araliaceae	N	N	N	N
Spreading Jacob's-ladder	<i>Polemonium reptans</i>	Polemoniaceae	N	N	FACU	N
Spring-beauty	<i>Claytonia virginica</i>	Portulacaceae	N	N	FAC	N
Star-of-Bethlehem	<i>Ornithogalum umbellatum</i>	Hyacinthaceae	I	N	FACU	N
Sweet flag	<i>Acorus calamus</i>	Acoraceae	I	N	OBL	N
Sweet-cicely	<i>Osmorhiza claytonii</i>	Apiaceae	N	N	FACU-	N
Tall meadow-rue	<i>Thalictrum pubescens</i>	Ranunculaceae	N	N	FACW+	N
Tearthumb	<i>Persicaria sagittata</i>	Polygonaceae	N	N	OBL	N
Thyme-leaved speedwell	<i>Veronica serpyllifolia</i>	Plantaginaceae	I	N	FAC+	N
Toothwort	<i>Cardamine concatenata</i>	Brassicaceae	N	N	FACU	N
Turtlehead	<i>Chelone glabra</i>	Plantaginaceae	N	N	OBL	N
Virginia waterleaf	<i>Hydrophyllum virginianum</i>	Boraginaceae	N	N	FAC	N
White avens	<i>Geum canadense</i>	Asteraceae	N	N	FACU	N
White vervain	<i>Verbena urticifolia</i> var. <i>urticifolia</i>	Verbenaceae	N	N	FACU	N
White wood aster	<i>Eurybia divaricata</i>	Asteraceae	N	N	N	N
Wild ginger	<i>Asarum canadense</i>	Aristolochiaceae	N	N	FACU-	N
Wild lettuce	<i>Lactuca canadensis</i>	Asteraceae	N	N	FACU-	N
Wild licorice	<i>Galium circaezans</i> var. <i>circaezans</i>	Rubiaceae	N	N	UPL	N
Wild onion	<i>Allium canadense</i>	Alliaceae	N	N	FACU	N
Winter aconite	<i>Eranthis hyemalis</i>	Ranunculaceae	I	N	N	N

Wood anemone	<i>Anemone quinquefolia</i>	Ranunculaceae	N	N	FACU	N
Wood geranium	<i>Geranium maculatum</i>	Geraniaceae	N	N	FACU	N
Wood-nettle	<i>Laportea canadensis</i>	Urticaceae	N	N	FAC	N
Wrinkle-leaf goldenrod	<i>Solidago rugosa</i> ssp. <i>rugosa</i> var. <i>rugosa</i>	Asteraceae	N	N	FAC	N
Yellow star-grass	<i>Hypoxis hirsuta</i>	Hypoxidaceae	N	N	FAC	N
Yellow trout-lily	<i>Erythronium americanum</i>	Liliaceae	N	N	N	N
Yellow-flowered sanicle	<i>Sanicula odorata</i>	Apiaceae	N	N	FACU	N
Zigzag goldenrod	<i>Solidago flexicaulis</i>	Asteraceae	N	N	FACU	N
trees, shrubs, and woody vines						
Alternate-leaved dogwood	<i>Cornus alternifolia</i>	Cornaceae	N	N	N	N
American beech	<i>Fagus grandifolia</i>	Fagaceae	N	N	FACU	N
American elder	<i>Sambucus canadensis</i>	Adoxaceae	N	N	FACW	N
American elm	<i>Ulmus americana</i>	Ulmaceae	N	N	FACW-	N
American filbert	<i>Corylus americana</i>	Betulaceae	N	N	FACU-	N
American holly	<i>Ilex opaca</i>	Aquifoliaceae	N	PT	FACU	N
Amur honeysuckle	<i>Lonicera maackii</i>	Caprifoliaceae	I	N	N	N
Amur maple	<i>Acer ginnala</i>	Sapindaceae	I	N	N	N
Autumn-olive	<i>Elaeagnus umbellata</i>	Elaeagnaceae	I	N	N	N
Basswood	<i>Tilia americana</i> var. <i>americana</i>	Malvaceae	N	N	FACU	N
Bigtooth aspen	<i>Populus grandidentata</i>	Salicaceae	N	N	FACU-	N
Bitternut hickory	<i>Carya cordiformis</i>	Juglandaceae	N	N	FACU+	N
Black alder	<i>Alnus glutinosa</i>	Betulaceae	I	N	FACW-	N
Black ash	<i>Fraxinus nigra</i>	Oleaceae	N	N	FACW	N
Black huckleberry	<i>Gaylussacia baccata</i>	Ericaceae	N	N	FACU	N
Black locust	<i>Robinia pseudoacacia</i>	Fabaceae	N	N	FACU-	N
Black oak	<i>Quercus velutina</i>	Fagaceae	N	N	N	N
Black walnut	<i>Juglans nigra</i>	Juglandaceae	N	N	FACU	N
Black willow	<i>Salix nigra</i>	Salicaceae	N	N	FACW+	N
Black-cap	<i>Rubus occidentalis</i>	Rosaceae	N	N	N	N
Black-haw	<i>Viburnum prunifolium</i>	Adoxaceae	N	N	FACU	N
Bladdernut	<i>Staphylea trifolia</i>	Staphyleaceae	N	N	FAC	N
Box-elder	<i>Acer negundo</i>	Sapindaceae	N	N	FAC+	N
Butternut	<i>Juglans cinerea</i>	Juglandaceae	N	N	FACU+	N
Buttonbush	<i>Cephalanthus occidentalis</i>	Rubiaceae	N	N	OBL	N
Canada hemlock	<i>Tsuga canadensis</i>	Pinaceae	N	N	FACU	N

Catbrier	<i>Smilax glauca</i>	Smilacaceae	N	N	FACU	N
Catbrier	<i>Smilax rotundifolia</i>	Smilacaceae	N	N	FAC	N
Chestnut oak	<i>Quercus montana</i>	Fagaceae	N	N	FACW	N
Chinese wisteria	<i>Wisteria sinensis</i>	Fabaceae	I	N	N	N
Cockspur hawthorn	<i>Crataegus crus-galli</i>	Rosaceae	N	N	FACU	N
Common blackberry	<i>Rubus allegheniensis</i>	Rosaceae	N	N	FACU-	N
Dogberry	<i>Celtis occidentalis</i>	Cannabaceae	N	N	FACU	N
Eastern white pine	<i>Pinus strobus</i>	Pinaceae	N	N	FACU	N
Empress-tree	<i>Paulownia tomentosa</i>	Paulowniaceae	I	N	N	N
English elm	<i>Ulmus procera</i>	Ulmaceae	I	N	N	N
English ivy	<i>Hedera helix</i>	Araliaceae	I	N	N	N
Flowering dogwood	<i>Cornus florida</i>	Cornaceae	N	N	FACU-	N
Forsythia	<i>Forsythia suspensa</i>	Oleaceae	I	N	N	N
Frost grape	<i>Vitis riparia</i>	Vitaceae	N	N	FACW	N
Frost grape	<i>Vitis vulpina</i>	Vitaceae	N	N	FAC	N
Hop-hornbeam	<i>Ostrya virginiana</i>	Betulaceae	N	N	FACU-	N
Hornbeam	<i>Carpinus caroliniana</i>	Betulaceae	N	N	FAC	N
Japanese barberry	<i>Berberis thunbergii</i>	Berberidaceae	I	N	N	N
Japanese corktree	<i>Phellodendron amurense</i>	Rutaceae	I	N	N	N
Japanese honeysuckle	<i>Lonicera japonica</i>	Caprifoliaceae	I	N	FAC-	N
Jetbead	<i>Rhodotypos scandens</i>	Rosaceae	I	N	N	N
Linden viburnum	<i>Viburnum dilatatum</i>	Adoxaceae	I	N	N	N
Lowbush blueberry	<i>Vaccinium pallidum</i>	Ericaceae	N	N	N	N
Maple-leaved viburnum	<i>Viburnum acerifolium</i>	Adoxaceae	N	N	N	N
Mockernut hickory	<i>Carya tomentosa</i>	Juglandaceae	N	N	FACU	N
Mountain laurel	<i>Kalmia latifolia</i>	Ericaceae	N	N	FACU	N
Multiflora rose	<i>Rosa multiflora</i>	Rosaceae	I	N	FACU	Y
Nannyberry	<i>Viburnum lentago</i>	Adoxaceae	N	N	FAC	N
Northern red oak	<i>Quercus rubra</i>	Fagaceae	N	N	FACU-	N
Norway maple	<i>Acer platanoides</i>	Sapindaceae	I	N	UPL	N
Norway spruce	<i>Picea abies</i>	Pinaceae	I	N	N	N
Obtuse-leaved privet	<i>Ligustrum obtusifolium</i>	Oleaceae	I	N	N	N
Oriental bittersweet	<i>Celastrus orbiculatus</i>	Celastraceae	I	N	UPL	N
Pawpaw	<i>Asimina triloba</i>	Anonaceae	N	N	FACU+	N
Photinia	<i>Photinia villosa</i>	Rosaceae	I	N	N	N
Pinxter-flower	<i>Rhododendron periclymenoides</i>	Ericaceae	N	N	FAC	N
Poison-ivy	<i>Toxicodendron radicans</i>	Anacardiaceae	N	N	FAC	N
Porcelain-berry	<i>Ampelopsis brevipedunculata</i>	Vitaceae	I	N	N	N

Pussy willow	<i>Salix discolor</i>	Salicaceae	N	N	FACW	N
Red maple	<i>Acer rubrum</i>	Sapindaceae	N	N	FAC	N
River birch	<i>Betula nigra</i>	Betulaceae	N	N	FACW	N
Rosebay	<i>Rhododendron maximum</i>	Ericaceae	N	N	FAC	N
Sassafras	<i>Sassafras albidum</i>	Lauraceae	N	N	FACU-	N
Shadbush	<i>Amelanchier arborea</i>	Rosaceae	N	N	FAC-	N
Shagbark hickory	<i>Carya ovata</i>	Juglandaceae	N	N	FACU	N
Silky dogwood, kinnikinnik	<i>Cornus amomum</i> ssp. <i>amomum</i>	Cornaceae	N	N	FACW	N
Silver maple	<i>Acer saccharinum</i>	Sapindaceae	N	N	FACW	N
Smooth alder	<i>Alnus serrulata</i>	Betulaceae	N	N	OBL	N
Sourgum	<i>Nyssa sylvatica</i>	Nyssaceae	N	N	FAC	N
Southern arrow-wood	<i>Viburnum dentatum</i>	Adoxaceae	N	N	FAC	N
Spicebush	<i>Lindera benzoin</i>	Lauraceae	N	N	FACW-	N
Sugar maple	<i>Acer saccharum</i>	Sapindaceae	N	N	FACU	N
Summer grape	<i>Vitis aestivalis</i>	Vitaceae	N	N	FACU	N
Swamp rose	<i>Rosa palustris</i>	Rosaceae	N	N	OBL	N
Swamp white oak	<i>Quercus bicolor</i>	Fagaceae	N	N	FACW+	N
Sweet cherry	<i>Prunus avium</i>	Rosaceae	I	N	N	N
Sycamore	<i>Platanus occidentalis</i>	Plantaginaceae	N	N	FACW-	N
Tree-of-heaven	<i>Ailanthus altissima</i>	Simaroubaceae	I	N	FACU-	N
Tuliptree	<i>Liriodendron tulipifera</i>	Magnoliaceae	N	N	FACU	N
Umbrella-tree	<i>Magnolia tripetala</i>	Magnoliaceae	N	PT/PR	FACU	N
Virginia-creeper	<i>Parthenocissus quinquefolia</i>	Vitaceae	N	N	FACU	N
White ash	<i>Fraxinus americana</i> var. <i>americana</i>	Oleaceae	N	N	FACU	N
White mulberry	<i>Morus alba</i>	Moraceae	I	N	UPL	N
White oak	<i>Quercus alba</i>	Fagaceae	N	N	FACU	N
Wild black cherry	<i>Prunus serotina</i>	Rosaceae	N	N	FACU	N
Wineberry	<i>Rubus phoenicolasius</i>	Rosaceae	I	N	N	N
Winged euonymous	<i>Euonymus alatus</i>	Celastraceae	I	N	N	N
Winterberry	<i>Ilex verticillata</i>	Aquifoliaceae	N	N	FACW+	N
Wintercreeper	<i>Euonymus fortunei</i>	Celastraceae	I	N	N	N
Witch-hazel	<i>Hamamelis virginiana</i>	Hamamelidaceae	N	N	FACU+	N

* Pennsylvania Natural Heritage Program codes: PT=threatened, PR=rare, N=not coded

** U.S. Fish and Wildlife Service wetland indicator codes: OBL=obligate wetland species, FACW=facultative wetland species, FACU=facultative upland species, UPL=upland species, N=not coded.

Appendix C. Fact Sheets – Species of Special Concern

Cranefly orchid (*Tipularia discolor*)

Puttyroot orchid (*Aplectrum hyemale*)

Heart-leaved sorrel (*Rumex hastatulus*)

(See Appendix D. for explanation of status codes)

PUTTYROOT ORCHID

Aplectrum hyemale (Muhl.ex Willd.) Nuttall
Orchidaceae (Orchid Family)

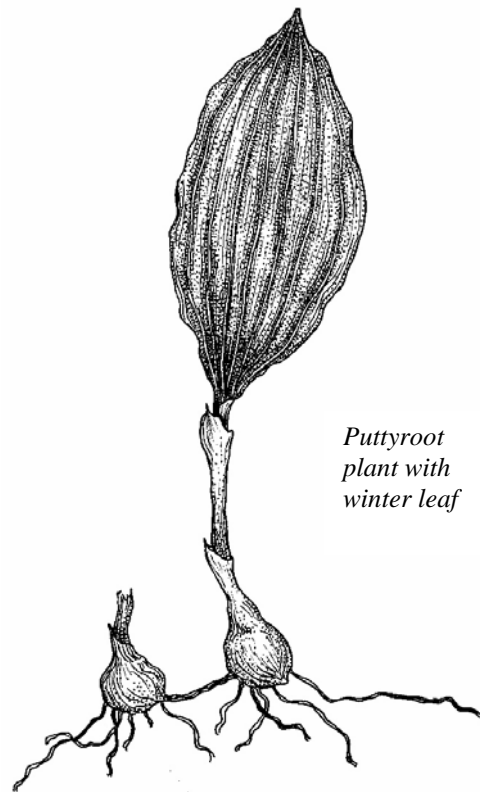
State status: S3, PA rare

Global status: G5

Description – Crane-fly is a native orchid that produces a winter leaf that is visible from October to May; however, flowering occurs in June when no leaves are visible. The single leaf is elliptical, 4-8 inches long, longitudinally pleated and striped green and white. A corm below ground stores energy to support the production of the flowers, which are in an erect raceme. The sepals are greenish or yellowish tinged with purple and the lip is white with purple spots.

Habitat – In Pennsylvania puttyroot is a plant of moist, rich deciduous forest on slopes and bottomlands.

Range – Puttyroot grows from southern New England and Wisconsin to South Carolina and Arkansas. In Pennsylvania it is limited to a cluster of sites in the southeastern corner of the state.



Puttyroot is classified as extirpated (PX) in Connecticut; critically imperiled (S1) in New York, Massachusetts, and New Jersey; imperiled (S2) in Delaware, and secure (S5) in Virginia and Maryland. Its winter leaf strategy limits its ability to survive in areas with heavy snow cover.

Management issues – Overabundance of deer is the greatest threat to the survival of puttyroot. These plants produce only one leaf each year, if it is browsed the plant is weakened and its probability of flowering is reduced. The winter-leaf strategy evolved to take advantage of a time of year when other plants, either in the canopy or the herbaceous layer were not blocking access to sunlight. However, a winter-green leaf is very visible on the forest floor and therefore susceptible to being eaten by deer.

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
- Nature Serve. 2008. <http://www.natureserve.org/explorer/>. Accessed 6/22/2008.
- Pennsylvania Flora Database. 2008. www.paflora.org. Accessed 6/22/2008.
- Whigham, Dennis F. 19189. The effect of experimental defoliation on the growth and reproduction of a woodland orchid, *Tipularia discolor*. *Canadian J. Botany* 68: 1812-1816.

Fact sheet prepared by Ann F. Rhoads, Morris Arboretum of the University of Pennsylvania, June 2008.
Drawings by Anna Aniśko.

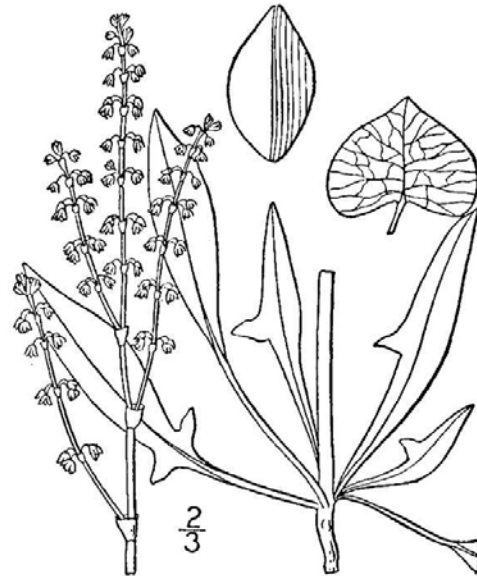
HEART-WINGED SORREL
***Rumex hastatulus* Baldwin ex Elliott**
Polygonaceae (Smartweed Family)

State status: SX, TU/PX
Global status: G5

Description – Heart-winged sorrel is an annual or short-lived perennial plant with an erect stem and taproot. It spreads by slender rhizomes. The leaves, which are narrow with two spreading basal lobes, occur in a basal rosette and arranged alternately on the erect flowering stem. Heart-winged sorrel is similar to the common sheep sorrel (*Rumex acetosella*); it differs in being larger (stems are up to 16 inches tall) and having winged fruits.

Habitat – Heart-winged sorrel is a plant of meadows, cultivated fields, waste places, and alluvial habitats.

Range – Heart-winged sorrel is a plant of the southeastern United States ranging from Pennsylvania and Illinois to Florida and Texas. It is classified as extirpated (PX) in New York, Pennsylvania, and Illinois at the northern limit of its range, and apparently secure (S5) in North Carolina. In Pennsylvania it is known from a single site, the Ridley Creek State Park location.



Rumex hastatulus, source of image: USDA Plants database <http://plants.usda.gov/>

Management issues – This plant was originally found at Ridley Creek State Park in 1971, when it was described as growing in a meadow southeast of Ridley Creek. Although there is still a meadow in the location described, intense grazing by cattle belonging to the Colonial Pennsylvania Plantation keeps the vegetation clipped to a few inches in height.

References:

- Flora of North America Editorial Committee. 2005. *Flora of North America*, Vol. 5. Oxford University Press, New York, NY.
- Nature Serve. 2008. <http://www.natureserve.org/explorer/>. Accessed 6/22/2008.
- Pennsylvania Flora Database. 2008. www.paflora.org. Accessed 6/22/2008.
- Wherry, Edgar T. 1972. *Rumex hastatulus*, a new Delaware County taxon. *Bartonia* 41: 84.

Fact sheet prepared by Ann F. Rhoads, Morris Arboretum of the University of Pennsylvania, June 2008..

CRANEFLY ORCHID
Tipularia discolor (Pursh) Nuttall
Orchidaceae (Orchid Family)

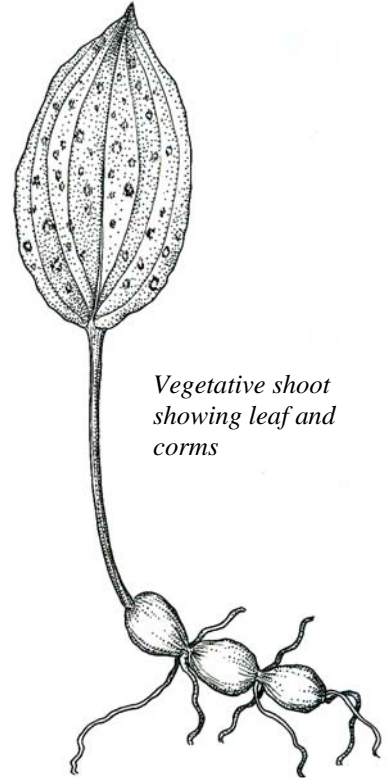
State status: S3, PA rare
Global status: G4G5

Description – Cranefly is a native orchid that produces a winter leaf that is visible from October to May. Flowering occurs in July or early August when no leaves are present. The single leaf is ovate, dark green above, and purple on the lower surface. A corm below ground stores energy to support the production of a flowering stem. The flowers are greenish-purple and have a long spur.

Habitat – Cranefly is a plant of deciduous forests, often along stream banks. The winter leaf strategy takes advantage of the increased availability of sunlight during the season when trees are dormant and leafless. The flowering stems can be found in very densely shaded sites in mid-summer as they rely on the energy stored in the corms to support their growth. The flowers are moth pollinated.

Range – Cranefly is a plant of the southeastern United States from New Jersey and Pennsylvania to Georgia, Louisiana and eastern Texas. Its winter leaf growth strategy limits its northern extent as significant snow cover would be a problem.

Cranefly is classified as critically imperiled (S1) in New York and Massachusetts, vulnerable (S3) in New Jersey, apparently secure (S4) in West Virginia. In Pennsylvania it is limited to a cluster of sites in the southeastern corner of the state.



Vegetative shoot showing leaf and corms



flower

Management issues – Over browsing by deer is the single greatest threat to Cranefly orchid. Each plant produces only a single leaf per year. Research has shown that if that leaf is browsed 3 years in a row, the plant will die. Unfortunately the leaves are very visible on the forest floor in the wintertime when little else is green.

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
Nature Serve. 2008. <http://www.natureserve.org/explorer/>. Accessed 2/20/2008.
Pennsylvania Flora Database. 2008. www.paflora.org. Accessed 2/20/2008.
Whigham, Dennis F. 19189. The effect of experimental defoliation on the growth and reproduction of a woodland orchid, *Tipularia discolor*. *Canadian J. Botany* 68: 1812-1816.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, February 2008. Drawings by Anna Aniřko.

Appendix D Species of Concern Status Codes

Global (G) and State (S) ranks (assigned by The Nature Conservancy)

G1 or S1 – Critically imperiled
G2 or S2 – Imperiled
G3 or S3 – Vulnerable
G4 or S4 – Apparently secure S4B – breeding populations only
G5 or S5 – Secure S5N – non-breeding populations
GU or SU – Unrankable SUB – breeding populations unrankable
T5 – subspecific taxon
G?Q – unrankable due to taxonomic uncertainty

Pennsylvania Status

PE – Pennsylvania extirpated
PT – Pennsylvania threatened
PR – Pennsylvania rare
PX – Pennsylvania extirpated
PV – Pennsylvania vulnerable
TU – Tentatively undetermined
PC – Candidate
CA – Candidate at risk
CR – Candidate rare
DL – Delisting recommended
NR – Not ranked

Proposed Status

For many plants status changes have been proposed by the Vascular Plants Technical Committee of the Pennsylvania Biological Survey, but not yet incorporated into official regulations. Proposed status is shown by listing the official status followed by a slash (/) followed by the proposed status as in the following example: (TU/PE).

Federal status (Endangered Species Act of 1973)

LE – Listed endangered
LT – Listed threatened

Origin

N – Native
I – Introduced

Source:

Pennsylvania Natural Heritage Program website

<http://www.naturalheritage.state.pa.us/rankstatusdef.aspx>, accessed 3/21/2008