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September 12, 2016

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426
Via eFiling

**RE: PennEast Pipeline Company, LLC (“PennEast”) –
PennEast Pipeline Project: FERC Docket No. CP15-558-000**

**Comment Letter of Intervenor Cooks Creek Watershed Association re: Draft
Environmental Impact Statement**

Dear Ms. Bose,

On behalf of Intervenor Cooks Creek Watershed Association (“CCWA”), we respectfully submit this letter in regard to the Commission’s Draft Environmental Impact Statement (“DEIS”) for the proposed PennEast pipeline project. As CCWA has previously noted, it retains significant concerns about the pipeline’s path through the Cooks Creek Watershed. These concerns are set forth more at length below, including that the Commission has unnecessarily rushed the DEIS review process.

Summary of Issues Addressed in this Letter

- I. Insufficient Time for Comprehensive Review of the DEIS
- II. Proceeding to Approve the PennEast Project in the Absence of Full, Complete Information From the Applicant and the Ability for Comment on that Information Violates Federal Law
 1. Lack of Final Plans Available for Review
 2. Lack of Clarity over Full Scope of Impacts to Cooks Creek Watershed
 3. Erosion and Sediment Control & Post-Construction Stormwater Management

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4. Geology/Karst; Blasting
 5. Wildlife Impacts, including Threatened and Endangered Species
 6. Durham Caves and Bat Populations
 7. Groundwater
 8. Invasive Species
 9. Horizontal Directional Drilling (“HDD”)
- III. Groundwater Risks Not Seriously Addressed in the DEIS by the Commission or PennEast
 - IV. Cooks Creek Watershed is a “Sensitive Waterbody” due to its “Exceptional Value” Classification, and its Inclusion in the Delaware River Basin Commission Special Protection Waters Program, and its High Conservation Priority Status
 - V. New Information from PADEP on Water Quality in Cooks Creek Confirms Its Fragility and Need for Heightened Protection
 - VI. The Cooks Creek Watershed – and All HQ, EV, and Special Protection Waters in Pennsylvania – Deserve Heightened Analysis and Protection to the Same Extent as New Jersey Waterways
 - VII. The Commission’s Cumulative Impacts Analysis Relies on Data and Mitigation Plans that are Absent or Unfinished, and Omits Other Foreseeable Impacts
 - VIII. Potential Re-Routing Outside of the Watershed Absent from Alternatives Analysis
 - IX. Water Withdrawals
 - X. Conclusion

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I. Insufficient Time for Comprehensive Review of the DEIS

The Commission issued a Notice of Availability for the DEIS on Friday, July 22, 2016, in the middle of summer, with a deadline of September 12, 2016 for comments. Volume I of the DEIS alone is 417 pages. CCWA has done its best to review the massive document in the short time the Commission has provided.

Contrary to how FERC has handled the present matter, the entire point of the process under the National Environmental Policy Act (“NEPA”) is to allow considered review of the environmental impacts of a proposed project, and what alternatives may be less damaging. A considered review simply cannot occur on a rushed basis, and, as will be further explained, without enough data from the project proponent on what the impacts are actually going to be.

The Commission should provide more time for the public to review and comment, particularly since PennEast continues to supplement information regularly. CCWA recognizes that there are limitations on how long a comment period the Commission may establish without seeking input from either the company or other cooperating agencies. However, the Commission at a minimum should not be issuing a DEIS when the company has not provided the Commission with a full, data-based assessment of expected impacts. If nothing else, the lack of such information constitutes “good cause” for a longer comment deadline here. 42 U.S.C. § 4370m-4(d)(1)(B).

CCWA does not believe that the Commission is properly able to issue the DEIS and make statements on the absence of a significant environmental impact and the lack of other alternatives when information is lacking and the timing appears rushed. The amount of information that PennEast *still* has not provided on its proposed operations and impacts is striking and pervasive.

II. Proceeding to Approve the PennEast Project in the Absence of Full, Complete Information From the Applicant and the Ability for Comment on that Information Violates Federal Law

The pervasive lack of information on potential environmental impacts and measures to avoid, minimize, and mitigate such impacts stymies the Commission’s ability to comply with the requirements of the National Environmental Policy Act (“NEPA”). It also substantially hinders the ability of the public and other agencies to comment in an informed manner. If the Commission proceeds with a final Environmental Impact Statement and certificate issuance in the face of such problems, it will violate the express language of NEPA and its associated regulations.

As the Commission is well aware, NEPA requires that every federal agency preparing an Environmental Impact Statement “to the fullest extent possible” include “a detailed statement . . . on” *inter alia* “(i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, . . . [and] (iv) the relationship between local short-term uses of man’s environment and the maintenance

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and enhancement of long-term productivity.” 42 U.S.C. § 4332(C)(i), (ii), (iv). The discussion of “environmental consequences” required by these sections of NEPA is supposed to “form[] the scientific and analytic basis” for the Commission’s alternatives analysis. 40 C.F.R. § 1502.16.

It is impossible for the Commission, other agencies, and the public to meaningfully analyze the “direct” and “indirect” effects of the proposed PennEast pipeline, much less their “significance” or how they compare to the Commission’s slated alternatives, including the no-action alternative. 40 C.F.R. §§ 1502.16, 1508.8. Indeed, without information on, for example, PennEast’s proposed stormwater management, it is impossible to fully assess either the direct effects of pipeline construction and post-construction stormwater management, or the indirect effects to water quality, aesthetics, and other considerations that can occur “later in time or farther removed in distance, but are still reasonably foreseeable.” 40 C.F.R. § 1508.8(a)-(b). It is equally impossible to provide comments that are “as specific as possible.” 40 C.F.R. § 1503.3.

Although this list is not exhaustive, CCWA has identified the following deficiencies in information either on proposed impacts, and on impact avoidance, minimization, and mitigation:

1. Lack of Final Plans Available for Review. PennEast does not have all of the monitoring plans/mitigation plans/management plans prepared or available for public comment. This includes plans ranging from bog turtle plans to stormwater management and blasting plans. This is a serious oversight because neither CCWA nor the Commission can adequately assess *what* the impacts will be, and whether they have been avoided, minimized, and mitigated to the greatest extent possible. Further, despite commenting requirements and the Commission’s obligation to consider the scope of impacts before acting, it would appear that the Commission plans to address this situation merely by approving construction and having plans filed after-the-fact with the Secretary. Contrary to NEPA, this completely cuts off public and other agency review. Indeed, it completely obliterates the entire point of NEPA, which is to intelligently assess the impacts of the proposed action, compare it to potential alternatives, and then make a selection. 42 U.S.C. §§ 4331, 4332; 40 C.F.R. §§ 1502.14, 1502.16.
2. Lack of Clarity over Full Scope of Impacts to Cooks Creek Watershed
 - a. **Page ES-6, Paragraph 3** – It is unclear from PennEast’s submittals whether it intends to cross wetlands within the Cooks Creek Watershed.¹ Due to their Exceptional Value status, any such wetland crossings should either be avoided altogether or not be performed by surface cut. If mitigation is required, CCWA requires that it be done within the Cooks Creek Watershed, not simply proximal or from a mitigation bank,

¹ The PADEP has not issued any notices of proposed waterbody crossing or wetlands permits under 25 Pa. Code Chapter 105 either, further exacerbating the information gap. Likewise, the U.S. Army Corps of Engineers has not issued any notices of proposed Section 404 permits for the project.

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particularly because bog turtles are known to occur in the Cooks Creek Watershed wetlands.² CCWA's concerns about potentially-impacted wetlands are further discussed in its prior comment letters submitted to the Commission.

- b. **Table 4.3.2-2, p.4-39, and Appendix G-7** – Despite the fact that **Appendix G-7** lists four waterbody crossings in the Cooks Creek Watershed, none are listed in **Table 4.3.2-2**. This needs to be clarified because at the moment, neither CCWA nor the Commission is clear on exactly what is proposed within the Watershed. **Page 4-39** does not address this issue either. Based on the route map, it appears that the proposed route continues to run through the Watershed. The Commission needs to clarify this discrepancy, or seek clarification from PennEast.
- c. **Tables G-5 and G-7** – To the extent these tables are accurate, they list four crossings in the Cooks Creek Watershed. Three of the four are dry crossings of what the Commission has identified as intermittent or ephemeral streams. One crossing is proposed of what the Commission has identified as a perennial stream, but the type of crossing is listed as “N/A.” CCWA requests clarification on what “N/A” means as there is no explanation in the tables or the DEIS.

Beyond this, there is no information for CCWA to assess the following questions:

- i. Will crossings be done when the waterways are dry?
- ii. If so, will CCWA or other members of the public be informed of when the work will be done so that we can observe?
- iii. The Cooks Creek Watershed is an Exceptional Value wild trout stream. As such it is protected under Pennsylvania's water quality regulations (Chapter 93) and antidegradation policies. Will the Commission require that water quality monitoring be conducted before and after the work to prove that no change in water quality will occur as a result of the work?
- iv. This monitoring is particularly important given that right now, the Pennsylvania Department of Environmental Protection is considering listing the Watershed as impaired, confirming CCWA's concerns about the Watershed's fragility. Monitoring of

² See, e.g., 2011 Bucks County Natural Areas Inventory Update, http://www.naturalheritage.state.pa.us/CNAI_PDFs/Bucks_naiupdate2011.pdf, at p.78 (at Attachment A – Relevant Excerpts)

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a stream that is deserving of the highest protection under Pennsylvania law and that is struggling due to human-induced changes is absolutely crucial.

- v. The Cooks Creek Watershed is also protected under the Delaware River Basin Commission's Special Protection Waters Program, adding another reason for monitoring.
- d. **Page 2-15** – Discusses that no herbicides or pesticides will be sprayed within 100 feet of a water body; however, given runoff potential and the Watershed's Exceptional Value status, this impact is not addressed anywhere. Spraying has both short-term and long-term, cumulative impacts on water quality and the Watershed.
- e. **Section 4.3.2.4** – There is no discussion of how the pipeline will be repaired or maintained in riparian areas, if this is needed. There are no answers to the following questions:
 - i. Will the area be torn up again whenever needed?
 - ii. How will repair or maintenance in riparian areas occur?
 - iii. Is there any maintenance that is predictable/regular?
 - iv. Are those impacts considered by the Commission?

The Commission must consider these repeated, cumulative impacts on the Exceptional Value Cooks Creek Watershed, since they are foreseeable impacts due to the initial pipeline project. 42 U.S.C. § 4332(C)(iv); 40 C.F.R. §§ 1508.7, 1508.8; Del. Riverkeeper Network v. F.E.R.C., 753 F.3d 1304, 1319 (D.C. Cir. 2014). See also Section VII below.

3. Erosion and Sediment Control & Post-Construction Stormwater Management

- a. There is no stormwater management plan referenced or included anywhere in the DEIS or in PennEast's submissions. It is not appropriate to discount stormwater as a long-term impact from this project, both from impacts that occur during construction and over the pipeline's lifetime. **Page 4-48** seems to imply that a stormwater management plan exists, yet PennEast has provided no plan and there have not been any notices of proposed stormwater permits from the Pennsylvania Department of Environmental Protection ("PADEP"). Indeed, **Table 1.3-1** shows that PennEast *has not even applied for Chapter 102 permits yet*. Improper stormwater management can lead to significant, cumulative adverse impacts on the Watershed, including scouring of stream banks, sedimentation, thermal impacts, and alteration of aquatic life habitat (including that relied upon by native trout).

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- b. Further, the Erosion and Sediment Control Plan provided in Appendix D to the DEIS does not discuss post-construction stormwater management or impacts.
- c. In addition to lacking any post-construction stormwater analysis or management measures, PennEast appears to, in its erosion and sediment control plan, largely throw up its hands at trying to determine site-specific impacts from stormwater at any phase of the project (including construction) or afterward. This is a serious deficiency particularly given that it is crossing multiple HQ, EV, or otherwise Special Protection streams throughout the state, including the Cooks Creek Watershed. Every other would-be developer has to address stormwater impacts from a proposed project, and if PennEast wants to move its project forward, it needs to comply with the same standards. Further, as will be discussed later, the Cooks Creek Watershed cannot withstand further human-induced impacts, particularly from stormwater. Site-specific analysis must be completed.
- d. The lack of any site-specific stormwater analysis is also problematic because, by its own admission, PennEast has stated that the first line of defense in karst prone areas is to maintain the baseline stormwater runoff patterns. And yet, PennEast has also stated in various documents that it cannot calculate these rates because of the size and complexity of the project. Thus, CCWA questions how PennEast is actually going to protect water quality (surface or groundwater) in karst regions if it is not going to do the work necessary to engage in what it admits is the first line of defense against adverse impacts. Indeed, as further discussed in Subsections 4.c. and 4.d. below, there is no information on how PennEast would manage stormwater inflow into newly-formed sinkholes or areas of subsidence.

As a result, CCWA requests the Commission add to **Section 5.0** a requirement that PennEast perform stormwater baseline calculations in all karst-prone areas prior to any disturbance, clearing, or trenching. The stormwater volumes, rates and discharge points should be calculated and/or mapped so that proper prevention and mitigation for karst geology can actually be performed. Without this, PennEast will just be playing “catch up” mitigation and the motivation for covering up/denying karst features will be high.

- e. PennEast then brushes off any ability to install riparian buffers stating, rather oddly, that it does not own the land on which the disturbance is happening. **Section 8.1.4**. While CCWA does not presume to know what type of agreements PennEast has obtained with any particular landowners, CCWA finds this excuse self-serving particularly because PennEast could

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negotiate riparian buffer protections in any easement agreements and PennEast will likely be faced with condemning parts of its project area anyway through eminent domain.

- f. Beyond these issues, the Erosion and Sediment Control Plan has various information gaps, as further identified below:
- i. Will the Erosion and Sediment Control Plan be reviewed, approved and overseen by the Bucks County Conservation District for the work in Bucks County? What about other counties?
 - ii. **Section 4.1 of App. D:** There appears to be no local, third-party inspector identified for the project. Will the Bucks County Conservation District be overseeing the work? If not, what entity besides the Commission?
 - iii. **Section 5.0 of App. D:** How long will compost filter socks be left in place? Will cotton sleeves be used or polyethylene? If poly, will PennEast return to remove the plastic and dispose of it properly, or will it be left to photodegrade? CCWA's experience is that the poly sleeves do not actually degrade, but break up into small pieces which are ingested by wildlife. How often will the contractor be required to monitor the site and maintain the BMPs? How will invasive plants be controlled?

4. Geology/Karst; Blasting

- a. **Page ES-5, Paragraph 4** – No blasting plan has been completed. As CCWA has previously stated, the blasting plan provided in Appendix O of PennEast's application is completely blank as to where blasting will occur. Although it appears the *Commission* has provided information on where blasting will occur (**App. G, Table G-3**), oddly this information appears to be absent from PennEast's filings to date.

Further, the Commission acknowledges that protections in blasting situations are still in the works, and that even the table the Commission has provided in **Table G-3** is tentative. The DEIS states on **page 4-58**, "***If blasting in waterbodies is required***, there is a potential for permanent alterations of stream channels. PennEast proposes to develop site-specific blasting plans for each waterbody crossing where blasting is determined to be necessary." (emph. added).

Further, despite the Commission's blanket assurance on **page ES-5** that the Blasting Plan has measures to protect groundwater, there is *no* discussion in the blasting plan about groundwater impacts *at all*. As

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CCWA has previously noted, blasting in karst areas should not occur, and yet any analysis on this point is absent. Since the Commission's **Table G-3** would show that blasting is going to be done practically everywhere, including in karst areas (and the Cooks Creek Watershed), this is a serious oversight. Again, PennEast has left the Commission and the public in the dark about: 1) where blasting will actually occur; 2) what site-specific measures will be used, particularly in karst areas; and therefore 3) what the impacts will really be.

- b. **Page ES-3, Paragraph 5; p.4-10** – The Commission repeatedly references the Karst Mitigation Plan, and yet it is clear that this Plan is not finalized either. It is one thing for a company to merely have to incorporate minor additional Commission recommendations (i.e. tweaks to the plan); it is entirely another when the data underlying the plan and associated protective measures *are not even fully gathered* for the Commission's and public's consideration.

Despite the Commission's declaration that "The current Karst Mitigation Plan is a comprehensive, stand-alone document . . .," (**p.4-10**), the actual plan itself still lacks any site-specific measures or detail.

Further, the Commission itself notes that PennEast is still in the process of completing borings and surveys, meaning that further changes are still in the works. Given the various limestone geology regions that would be affected by the proposed project, including the Cooks Creek Watershed, the public deserves to be able to comment on a final plan *with site-specific details* prior to Commission approval.

CCWA is particularly concerned because in reviewing survey maps filed by PennEast in mid-May, there still have been no surveys done of the entire Cooks Creek Watershed areas being impacted, and it would appear that none are planned for the unsurveyed areas. This is yet another serious oversight, particularly given the frequency of mapped karst features, including potential closed depressions, in the area.

Another oversight is that there are no surveys planned for the banks of the Delaware River, or under the River itself. To ensure that activity in this area does not result in flooding of underground areas (such as old mining areas), surveys or other assessments must be conducted to determine the risks and potential mitigation measures. Because there are mapped karst features and surveyed anomalies within a short distance of the Pennsylvania bank of the Delaware River, such surveys must extend the length of the River to assess and address potential risks.

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- c. Further, as discussed earlier, PennEast claims that maintaining pre-construction stormwater runoff patterns is key way to prevent problems in karst areas, yet has said it is too difficult to figure out the runoff patterns. For the reasons discussed in Subsection 3.a through 3.d. above, the Commission should require this to be done.
- d. Equally lacking in any documents are details on any long-term monitoring of karst areas. There are no answers to the following questions:
 - i. How often will PennEast monitor?
 - ii. How will PennEast determine if subsidence has occurred? Pre/post survey comparisons or just by eye?
 - iii. If subsidence or a sinkhole is observed, how will stormwater in-flow be mitigated? There needs to be some plan for what happens when things go wrong – more than just “shoring up the pipe.”
- e. **Table 4.1.5-1** fails to mention Bucks County as an area with bedrock subject to sinkholes.
- f. See Subsection 6 below for a discussion on the Durham Caves.

5. Wildlife Impacts, including Threatened and Endangered Species

- a. **Page 4-89** (Birds); **Page 4-105** (T&E Species) – Bird surveys and threatened/endangered species surveys are not complete according to PennEast. No meaningful assessment or analysis of impacts and proposed avoidance, minimization, and mitigation measures can occur without complete surveys. Although the public deserves to understand these impacts, and the Commission is obligated to consider them, it would appear that the Commission is asking that the information be provided before construction. This information should *already be* in the DEIS for proper consideration of alternatives and impacts.
- b. As noted above, bog turtles are known to occur in wetlands in the Cooks Creek Watershed. Due to the lack of clarity over the pipeline’s impact to these wetlands, neither PennEast nor the Commission (or any other agency) can assess the impacts of the pipeline to these endangered species.

In fact, the bog turtle surveys are among the ones not even complete according to PennEast, exacerbating the inability to determine whether the species will be impacted and to what extent. (**Table 4.6-1**)

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- c. Indeed, the Commission’s discussion on **p.4-41** regarding waters supporting endangered or threatened species omits not just the Cooks Creek Watershed, but also any other watershed containing endangered and threatened species.
 - d. See Subsection 6 below for a discussion on the Durham Caves.
6. Durham Caves and Bat Populations. This can also be classified under Number 5 above.
- a. At the time the Commission released the DEIS, it claimed that there were “no caves within 0.25 miles of the PennEast pipeline.” (**Page 4-10**).
 - b. However, on **pp.4-97** and **4-98**, the Commission specifically noted that the “Project would be located within 0.25 mile of other known hibernacula and hibernating colonies at . . . Durham Cave 1 and Durham Cave 2 at MP 77.2.”
 - c. The caves do in fact exist, and are known to house various species of bats; indeed, the bat population may finally be on a rebound after white-nose syndrome substantially decreased the population several years ago.³
 - d. The caves are also designated as part of an Important Mammal Area (“IMA”); notably the pipeline would cut right through the IMA.⁴
 - e. This near-omission of the caves and the bats is significant, particularly given that the Commission recognizes that the caves are indeed inside the 0.25 mile zone, and “[t]he FWS has concluded that a 0.25-mile buffer around mines and caves provides adequate protection from indirect impacts (e.g., disturbance and disruption) to hibernacula and hibernating colonies (FWS 2015a), and that no clearing of trees is allowed within 0.25 mile of hibernacula and that any Project activity with the potential to impact bats such as filling, excavation, blasting, noise, or the production of smoke should be restricted within this 0.25-mile buffer area.” (**DEIS, p.4-97**).

³ <http://www.heritageconservancy.org/bat-count-at-heritage-conservancys-durham-township-bat-mine-offers-a-glimmer-of-hope/> The article also notes that the eastern small-footed bat, a Pennsylvania threatened species, was found in the caves. (Attachment B)

⁴ Pa. Game Commission – Important Mammal Areas
<http://www.pgc.pa.gov/Wildlife/HabitatManagement/Pages/ImportantMammalAreas.aspx> (see #43); see also Pa. Game Commission, IMA – Durham Mine (Scientific Map), <http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2043%20Durham%20Mine%20Scientific%20Map.pdf> (showing IMA boundary). (Both in Attachment C)

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- f. There is no information in the DEIS on how PennEast will avoid, minimize, and mitigate impacts to the bats and to the caves.
- g. PennEast filed a supplemental response on August 31, 2016, in which it appears to have only *recently* discussed with the U.S. Fish and Wildlife Service the potential for impacts to bats in the Durham Cave. (PennEast Aug. 31, 2016 Response, p.10 & Attachment 4).
- h. The fact that PennEast was seemingly unaware of the caves and the bats is quite concerning to CCWA, and demonstrates PennEast's continued lack of knowledge of the actual conditions on the ground.
- i. It may also call into question PennEast's bat surveys, which were apparently complete at the time of the DEIS's issuance.
- j. Further, although the Commission requested in the DEIS that PennEast explain how it will respect the 0.25 mile buffer, it appears from its supplemental response that PennEast plans to proceed with building the pipeline within 0.25 miles of the Durham Caves anyway.
- k. PennEast must do more than simply promise not to impact the caves and the bats. Despite this need, PennEast has provided no information from which to assess *what* the impact – both short-term and long-term – on the bats will be. For instance, PennEast has provided no information on how pipeline activities would alter the cave environment that the bats depend on through induced geologic or hydrogeologic changes in the karst environment in the area.
- l. Thus, in turn, neither the Commission (or any agency) nor the public can determine whether the impact would be unacceptable, including to whether increased susceptibility to white-nose syndrome will result.

7. Groundwater

- a. **Page 4-31 to -32** – PennEast has not completed surveys of water wells, groundwater springs and seeps, including those in karst terrain.
- b. **Page 4-35** – The Commission again references plans that are not complete (e.g. dated several months ago or more), or are based on incomplete information (e.g. incomplete surveys), including final Well Monitoring, Blasting, and Karst Mitigation Plans. The public, other agencies, and the Commission cannot fully evaluate a project with such a lack of full, complete information.

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8. Invasive Species

- a. **Page ES-8, Paragraph 2** and **Page 4-80** – PennEast has not provided any invasive species plans, and it would appear that the Commission does not plan to allow the public to comment on such plans despite the fact that proliferation of invasive species is very foreseeable impact from pipeline construction.
- b. Invasive species are a key issue of concern to the CCWA, and CCWA deserves the right to comment on PennEast’s proposals to avoid, minimize, and mitigate invasive species problems.
- c. Given that the DEIS and PennEast generally seem to brush over site-specific needs in favor of allowing the pipeline to proceed, CCWA believes that its knowledge of the area and its problems can be helpful to understanding what impacts may occur.
- d. Cutting off the ability to obtain this information undermines the adequacy of the Commission’s analysis of potential impacts.

9. Horizontal Directional Drilling (“HDD”)

- a. CCWA remains concerned about HDD impacts in other areas outside the Watershed due to a continued lack of information from PennEast.
- b. **p.2-11** – HDD site-specific plans are not prepared and available for public review and comment.
- c. **Section 4.1.7 & Table 4.1.7-1** – Field investigations are not final; HDD drilling plans are not final and available for public review and comment.
- d. **Table 4.1.7-1** has the Delaware River and Delaware Canal crossings in the wrong county – the crossings are in Bucks County, not Northampton County.
- e. CCWA seeks clarification on what kind of measures are proposed to avoid and minimize adverse impacts to steep slopes along the Delaware River, and what mitigation measures are proposed should impacts occur.

Due to the non-exhaustive examples listed above, the DEIS does not “fulfill and satisfy to the fullest extent possible the requirements established for final statements in section 102(2)(C) of the Act.” 40 C.F.R. § 1502.9(a). When “a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion.” 40 C.F.R. § 1502.9(a). The Commission is obligated to circulate revised drafts when

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PennEast finally provides all information for the project, although CCWA remains of the position that the DEIS should not have been issued until full information was provided.

III. Groundwater Risks Not Seriously Addressed in the DEIS by the Commission or PennEast

CCWA has previously expressed to the Commission its concerns about groundwater impacts from the proposed pipeline. Construction and operation of the pipeline can adversely affect groundwater quality and quantity, particularly given the Watershed's karst limestone geology. CCWA notes that other local entities, including Durham and Williams Townships, have expressed similar concerns due to the fact that most local citizens rely on groundwater for household and agricultural use. Also, alterations to groundwater flow and amount impact the Watershed by removing base flow in certain areas. Groundwater base flow is crucial to providing cooler water that cold-water species like trout rely upon. The Watershed is already struggling in this area due to decreased stormwater retention/groundwater recharge issues and droughts.

As a result, CCWA is not satisfied with the Commission's simple assurance on **p.ES-4, Paragraph 1** that drinking water is not at risk. "Alternative sources" is not a viable strategy for groundwater contamination, particularly in this area. Indeed, although there is a discussion on what might happen in areas of New Jersey with arsenic-heavy geology/soils, there is no discussion of the impacts in karst areas and what should be done in such situations. Further, CCWA is deeply concerned about what kind of "alternative water sources" PennEast would propose because, among other options, bottled water is not a viable solution. (**DEIS, p.4-12**).

As CCWA has already noted, PennEast's local investigations for water crossings in the Cooks Creek Watershed are nonexistent (to the extent waterbody crossings are occurring). Equally nonexistent are analyses of blasting impacts in the Watershed. The only thing CCWA has to look at is a high-level karst survey in many areas, and generic project-wide discussions on blasting and karst mitigation. It is well-documented that "The Cooks Creek landscape contains the most extensive area of dolomitic limestone in Bucks County."⁵ If PennEast and the Commission are truly serious about preventing severe environmental consequences, PennEast must do a site-specific blasting/karst plan *before* any approvals. Further, this site-specific plan must be done not just in the Cooks Creek Watershed, but throughout the entire karst/limestone area as PennEast approaches the Delaware, as groundwater concerns extend outside the Watershed.

In addition to all this, PennEast's stormwater analysis is absent. Stormwater, particularly in a karst area, can quickly become groundwater, and there is no analysis or contingency planning that CCWA has seen that addresses these issues. It is not unreasonable to assume that in a karst area, suddenly stormwater could dissolve the underlying rock and contaminate local

⁵ 2011 Bucks County Natural Areas Inventory Update, http://www.naturalheritage.state.pa.us/CNAI_PDFs/Bucks_naiupdate2011.pdf, at p.79 (Attachment A).

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groundwater.⁶ As CCWA highlighted earlier in Sections II.3 and II.4 above, PennEast itself recognizes the importance of maintaining pre-disturbance flow, but yet has done nothing to determine rate, volume, and direction of stormwater flows, or determine what else may be needed to prevent adverse impacts. Thus, neither PennEast nor the Commission has truly assessed the risks in the Watershed and other karst areas. No approval should occur without such considerations. Indeed, as CCWA has previously highlighted in its comment letters to the Commission, local property owners must comply with local ordinance requirements designed to protect and maintain the water quality of the Watershed, including residents' drinking water. These include: riparian and wetland buffer protection requirements; thorough karst analyses; stormwater measures; and others. See, e.g., 12-21-15 CCWA Letter to FERC, pp.3-4, 5-6. All other landowners must comply with these rules – PennEast is no exception. 40 C.F.R. § 1402.16(c).

Beyond these issues, the “Well Monitoring Plan” is extremely minimal, and – as with most things in PennEast’s application materials and the DEIS – assumes nothing will go wrong. Karst is extremely difficult to predict, and anyone proposing construction in such an area has to account for this. Meanwhile, PennEast proposes to blast, use heavy equipment, and run pipelines through this area without much second thought. As CCWA has stated previously, nothing in this process has instilled confidence that PennEast is capable of carrying forward its proposed project without significant problems to local citizens and the natural resources on which they rely. The DEIS only exacerbates that situation.

In addition, measuring turbidity in drinking water is not a sufficiently robust measure of drinking water quality. At a minimum, agricultural pollutants such as nitrates, bacteria, and agricultural chemicals should be monitored since the part of the watershed and surrounding area that PennEast is proposed to cross is primarily agricultural.

There should be site-specific, detailed plans in place to prevent contamination and other groundwater impacts. There equally should be permanent solutions to clean up or otherwise remedy any contamination or diminution that does occur, and without significant burden on individual citizens. Indeed, removing someone’s long-time groundwater supply due to lack of planning and foresight, or even mere happenstance, and replacing it with bottled water is not only wrong, but violative of Pennsylvania residents’ constitutionally-protected right to clean water under Article I, Section 27 of the Pennsylvania Constitution. Notably, the Commission is required to address “possible conflicts between the proposed action and the objectives of . . . State, and local . . . land use plans, policies and controls for the area concerned. 40 C.F.R. § 1402.16(c). Merely expressing an assurance that no groundwater impacts will occur, and that, if it does happen, people will get some sort of unidentified water replacement (e.g. bottled water

⁶ For a good illustration of just what can happen in a karst area, see the factual narrative in U.S. E.P.A. v. City of Green Forest, Ark., 921 F.2d 1394, 1399-1400 (8th Cir. 1990), discussing sewage treatment plant and pretreatment violations at a facility that received wastewater from a chicken-processing operation, and ultimately, impacts to water wells from sinkhole formation and contaminated chicken-waste-laden wastewater flowing into the sinkhole.

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shipments) shows a lack of considered analysis and a significant conflict with the protections Pennsylvania citizens receive under state law.

IV. Cooks Creek Watershed is a “Sensitive Waterbody” due to its “Exceptional Value” Classification, its Inclusion in the Delaware River Basin Commission Special Protection Waters Program, and its High Conservation Priority Status

As CCWA has repeatedly brought to the Commission’s attention, Cooks Creek and other tributaries in the Watershed are classified as “Exceptional Value” (“EV”) streams under Pennsylvania law, and as such, are supposed to receive the highest level of water quality protection of all streams. Cooks Creek and various tributaries (including Coon Hollow Run)⁷ are also Class A trout streams under Pennsylvania law, with Coon Hollow Run supporting brook trout. Still further, under the Delaware River Basin Commission’s water quality standards, the Cooks Creek Watershed qualifies as “Special Protection Waters,” as it drains into a portion of the Delaware River classified as “Significant Resource Waters.”⁸ Among other things, there can be no measurable changes in water quality in the Delaware River under the Special Protection Waters standards. The Special Protection Waters standards are *specifically incorporated into* Pennsylvania law, and therefore the Commission must address compliance with this standards beyond merely whether a waterbody is High Quality or Exceptional Value under Pennsylvania law. See, e.g., 25 Pa. Code §§ 93.2(b), 901.2. Lastly, the Cooks Creek Watershed is designated as a Conservation Priority 1 (with one being the highest number), including the area that will directly impacted by the proposed route, along with the Durham Mines.⁹

Thus, CCWA requests that the Commission confirm that the Cooks Creek Watershed is appropriately included as a sensitive waterbody under **Section 4.3.2.2** and throughout the DEIS not simply because of its EV status, but also because of its inclusion in the Delaware River Basin Commission’s Special Protection Waters classification. CCWA notes that, in past filings in this matter, Cooks Creek Watershed has been left off of these sensitive waterbody lists despite the Watershed’s Special Protection status in Pennsylvania.

⁷ PADEP documents refer to this stream as “Hollow Run.”

⁸ Del. River Basin Commission, Special Protection Waters Program, <http://www.nj.gov/drbc/programs/quality/spw.html>; Del. River Basin Commission, Map of Special Protection Waters and Drainage Area, <http://www.nj.gov/drbc/library/documents/maps/SpecialProtectionWaters.pdf> (Both in Attachment D)

⁹ 2011 Bucks County Natural Areas Inventory Update, http://www.naturalheritage.state.pa.us/CNAI_PDFs/Bucks_naiupdate2011.pdf, at pp.24, 73, 75 (Attachment A)

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V. New Information from PADEP on Water Quality in Cooks Creek Confirms Its Fragility and Need for Heightened Protection

The PADEP is currently undertaking its biennial analysis for its 2016 Integrated Water Quality Report, which includes updates to its impaired waterway lists. At the present time, the PADEP proposes to list a number of portions of the Cooks Creek Watershed as impaired, *largely due to stormwater and other human-induced impacts*.¹⁰ This is significant, as this potential action confirms the CCWA's concerns about the fragility of the Watershed, as well as the value of CCWA and other local efforts to protect the Watershed through habitat restoration, riparian buffer requirements, and other work. The proposed impairment listing is also significant for the Commission's analysis because the proposed PennEast route will, as CCWA has previously stated, cross one of the last undeveloped areas of the Watershed not otherwise protected through significant local investment in open space.¹¹ See also, 12-21-15 CCWA Letter to FERC, pp.1-3. The proposed impairment listing also confirms that CCWA's concerns about stormwater and habitat alteration induced by the PennEast pipeline are valid and must be addressed.

Given that the PADEP is still in the process of finalizing its new list of impaired waterways, the Commission must, at a minimum, keep the new listing in mind and revisit its analysis once the list is finalized. CCWA believes that, in addition to being listed as "sensitive waterbody," the Commission should include the Watershed in **Table 4.3.2-5** as a proposed impaired waterbody so that the Watershed gets the additional protection it deserves to bring it back to a healthy state. The proposed impaired listing confirms that the Watershed has very little assimilative capacity for pollution and human impacts. The Watershed's resiliency is currently taxed, and adding more impacts to it through the PennEast pipeline will only do further damage.

VI. The Cooks Creek Watershed – and All HQ, EV, and Special Protection Waters in Pennsylvania – Deserve Heightened Analysis and Protection to the Same Extent as New Jersey Waterways

CCWA believes that the Cooks Creek Watershed, as an Exceptional Value watershed and Special Protection Water, requires that special efforts be undertaken by PennEast to guard against degradation of water quality. As noted previously, the Watershed is fragile, and the PADEP's latest data confirms this, including the need to employ extra effort to bring the Watershed back to the water quality local citizens know it for. Water quality in the Watershed should be monitored before, during, and after work is performed in riparian areas to prove that no degradation resulted. A plan must also be in place to stop, modify, or mitigate for any

¹⁰ Pa. Dept. of Env't'l Prot., Draft 2016 Integrated Water Quality Report, Category 5 – Streams http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-113857/2016_Integrated_Report_Draft_Category5_Streams.pdf, pp.22-25. (Attachment E – Relevant Excerpts).

¹¹ See, e.g., 2011 Bucks County Natural Areas Inventory Update, http://www.naturalheritage.state.pa.us/CNAI_PDFs/Bucks_naiupdate2011.pdf, pp.77, 80 (Attachment A).

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changes in water quality. Exceptional Value stream crossings are not mentioned in this section of the plan. CCWA specifically requests that the Commission add conditions in **Section 5.0** to address these issues. See also Section 8.0 of App. D (Draft E&S Control Plan).

Further, CCWA is baffled by the Commission's decision to require "special construction procedures" and additional documentation of consultation for New Jersey streams, but not Pennsylvania streams, despite CCWA's comments on HQ and EV streams in Pennsylvania. **(DEIS, p.4-41)**. Indeed, Durham Township, the Durham Township Environmental Advisory Council, the Durham Township CCAP, and Williams Township (among others) have all raised concerns about water quality – both surface water and groundwater quality. The Commission offers no explanation for its differential treatment between Pennsylvania and New Jersey streams, and there is no logical basis for such differential treatment. The Commission must require the same level of protection in Pennsylvania as in New Jersey, and must require the same "special construction procedures" and other requirements from PennEast for Pennsylvania streams as it has done for New Jersey.

VII. The Commission's Cumulative Impacts Analysis Relies on Data and Mitigation Plans that are Absent or Unfinished, and Omits Other Foreseeable Impacts

In **ES-14 to -15**, the Commission relies on, among other things, "carefully developed resource protection and mitigation plans" to claim that cumulative impacts would be "effectively limited." However, as demonstrated throughout this letter, this conclusion rests on a significant amount of uncollected data and yet-unprepared surveys and other plans. It is unreasonable to make a determination on cumulative impacts without all the information available to support a determination.

Section 4.12.4.1 on Geology and Soils equally makes the same errors. First, the Commission claims that the "Project's effect on geology and soils would be highly localized and primarily limited to the construction period." **p. 4-279**. This is incorrect since blasting of bedrock is a fairly permanent impact to the local geology. Also, soil compaction inevitably occurs during construction, and unless this is addressed, is also a permanent impact. Soil compaction inhibits healthy vegetation growth, which in turn, negatively impacts water quality by removing plants that can filter sediment and nutrients from stormwater. Further, as noted repeatedly in this letter, given the lack of analysis around the impacts of blasting in karst, there could be extensive, permanent impacts to the local hydrology, landscape, and groundwater on which residents rely for drinking if blasting induced sinkholes or other changes in the karst. This, in turn, could have impacts on the local bat population that rely on the existing cave environment.

The Commission goes on to say that "Cumulative impacts would only occur if other projects are constructed during the PennEast Pipeline Project's construction period in a shared location." **p.4-279**. Again, for the reasons just discussed, this is incorrect. There are numerous chains of environmental challenges that can develop due to the project's location in the Cooks Creek Watershed.

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Sections 4.12.4.2 through 4.12.4.4 only repeat these same errors, and are again incorrect for the reasons already discussed throughout this letter. For example, as discussed in Section II.2.e above, there is no explanation or analysis of the cumulative impacts over time of maintenance and other work in the right-of-way, which may further disturb riparian buffers, increase the encroachment of invasive species, and disrupt stormwater flows.

Section 4.14.4.5 claims that there will be a positive socioeconomic benefit to Pennsylvania communities. However, given the significant lack of data and analysis behind this proposed pipeline project, there is a strong likelihood that such “benefit” will be lost in the face of costs borne by local residents due to adverse environmental consequences from the project. These include subsidence from impacts to karst; loss of drinking water; loss of aesthetics; and loss of recreational values.

Lastly, **Section 4.12.4.8** on climate change ignores the cumulative impact on native, cold-water trout populations of 1) rising water temperatures due to climate change; and 2) altering the riparian environment in the Cooks Creek Watershed to remove vegetation and other buffers that help maintain the cold-water environment. CCWA has brought this to the Commission’s attention previously, but there is no recognition of this issue.

Despite multiple assurances that everything will be fine as this project goes forward, the Commission’s statements ring hollow when they are based on a lack of data and analysis from the applicant, surveys and plans that are not complete, and failure to consider other foreseeable impacts from the project.¹²

VIII. Potential Re-Routing Outside of the Watershed Absent from Alternatives Analysis

CCWA has repeatedly requested that the proposed pipeline route avoid the Watershed entirely. Given its fragility, and the new data from PADEP, this is even more important than before. However, CCWA does not see any analysis of a route modification that moves the pipeline and its disturbance out of the Watershed. CCWA requests analysis and explanation for why PennEast has not addressed this issue.

IX. Water Withdrawals

Section 4.3.2.4 of the DEIS discusses hydrostatic testing, noting that approximately 18 million gallons of water are needed for such testing. First, CCWA does not consider 48 hours adequate notice for a surface water withdrawal because CCWA would like to comment on the

¹² The DEIS also does not consider the effect of adding more right-of-way to a watershed that (like other watersheds) has already been forced to host various utility easements over the years. These easement areas have, like PennEast would do, damaged riparian areas, increased stormwater flow, and led to habitat fragmentation and encroachment of invasive species. Adding more of these impacts amplifies the prior damage in an as-yet-unaffected area of the watershed and only further burdens the watershed despite the community’s extensive protection efforts. However, the DEIS does not address this issue at all.

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withdrawals and have a representative monitor them. **Section 9.5.9 of App. D.** (Draft E&S Control Plan – referring to 48 hours notice). Second, there appears to be a test water discharge location just outside the Cooks Creek Watershed in Riegelsville; although **Table 4.3.2-7** lists “potential sources,” CCWA remains concerned that PennEast will seek to remove water from the Cooks Creek Watershed given that the water sources are not finalized at this time. CCWA objects strenuously to any withdrawals being made from within the Cooks Creek Watershed as well as any discharges to the Cooks Creek Watershed – either from or to surface water or groundwater. As already noted, preservation of base flow is crucial in the Watershed, and any removal of potential base flow will only increase the burden that the Watershed is currently under. In addition, discharges of copious amounts of test water into karst areas, even adjacent to the Watershed boundary can, if not properly managed, result in cross-boundary impacts to groundwater and surface water in the Cooks Creek Watershed.

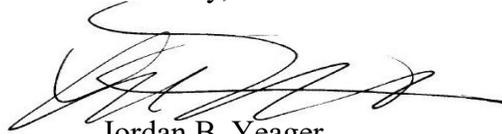
X. Conclusion

In closing, while CCWA is concerned about all the issues set forth in this letter, the interconnection between stormwater management and the integrity of the Watershed’s surface and groundwater quality (given the karst geology) is particularly crucial. Despite the fragility of the Watershed, the sensitive nature of working in a karst area, and the level of heavy surface and subsurface disturbance PennEast proposes (e.g. blasting, heavy equipment), no site-specific planning, much less full investigation into and analysis of local characteristics, has occurred. Without this, no one – not even the Commission – knows what will happen when PennEast, for example, blasts straight through karst areas and has not determined what stormwater flow patterns it must maintain. This type of approach in any environment is foolhardy to begin with; in karst, it is a recipe for substantial environmental damage. Calculating stormwater flow patterns may be hard, but remedying groundwater damage is even harder. Equally difficult is remedying surface water channel changes induced by such activity in a watershed already struggling to stay healthy.

CCWA hopes that the Commission takes these and the other concerns in this letter to heart and requires much more of PennEast than it has done thus far.

Thank you for your time and consideration.

Sincerely,



Jordan B. Yeager

Lauren M. Williams

For CURTIN & HEEFNER LLP

cc: All Parties
Delaware River Basin Commission
Heritage Conservancy
Riegelsville Borough

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National Chapter of the Sierra Club

U.S. Rep. Michael Fitzpatrick

Pennsylvania Department of Environmental Protection

Bucks County, Pennsylvania

Natural Areas Inventory Update



**Report prepared for the Bucks County Commissioners
March 2011**

**By
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*Cover: View of the Delaware River with Lynn Island in the foreground; lower left roseroot sedum.
Bald Eagle photograph by Howard Eskin*

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We thank Kristine S. Kern, Bucks County Open Space Coordinator, who has been supportive and helpful in many ways throughout the two years of this project.

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We also thank numerous landowners throughout the county for permitting us to explore their properties.

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Ann Rhoads and Tim Block
March 2011

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The photographs in this report were taken by the authors except as noted.

Executive Summary

Despite continuing development and resulting suburban sprawl, significant areas of open space remain in Bucks County. The 13 conservation landscapes identified in this report are located along riparian corridors and on rocky ridges. Each landscape includes a core area of protected land, but much more remains to be done to preserve the natural resources in these landscapes.

The landscapes were delineated using GIS technology to identify large forested tracts, stream corridors, wetlands, known sites of rare plants and animals, and areas of high natural biodiversity. All of the 19 highest priority sites from the 1999 Natural Areas Inventory are included in whole or in part.

This document will replace the earlier Bucks County Natural Areas Inventory (Rhoads and Block 1999) as the principal source for identifying the county's most significant ecological resources. It is intended to be used for allocating open space funds, preparing zoning, subdivision, land development regulations, comprehensive plans, Act 167 and Act 537 planning and management, and reviewing individual site plans.

Eighteen sites identified in the 1999 Bucks County Natural Areas Inventory fall outside the boundaries of the Conservation Landscapes delimited in this report. Although these sites are generally small and somewhat isolated, and as such are of limited conservation value countywide, they may continue to be sites of local concern.

Open space protects vital ecological functions that support human life such as oxygen production, ground water recharge, waste decomposition, mineral recycling, carbon storage, and biodiversity conservation. Biological diversity at all levels is the raw material for continued evolution by which life will adapt to changes such as global warming.

Large tracts of forest serve as source areas that support bird diversity throughout the county. Wetland habitats are critical to maintaining amphibian populations. Open space also contributes to human well being by providing recreational pastimes, aesthetic pleasures, opportunities to observe nature, and the peace-of-mind that results from a quiet walk in the woods.

The full value of open space will only be achieved through land protection followed by appropriate management. Deer overabundance is the most critical management challenge. Over browsing has devastated forest habitat throughout the county; wildflowers, shrubs, and tree seedlings have been especially hard hit. Forests are not regenerating because trees seedlings and saplings cannot grow beyond the browse line.

Invasive, non-native species of plants and animals have also impacted the integrity of natural habitats in Bucks County. While some invasives are widespread and have clearly become a permanent part of the landscape, others are in early enough stages of invasion that control efforts could be effective.

Meaningful protection of the conservation landscapes will require collaborative efforts involving county agencies, townships and boroughs, conservation groups, and private landowners. In the

case of the Unami Creek and Delaware River landscapes, cooperative efforts with adjacent counties would greatly increase the effectiveness of resource protection programs.

Accountability should be part of the County Open Space Program. The following list of indicators should provide a basis for evaluation of the success of the program in safeguarding natural resources and ecological functions.

Measures of Success

- Continued progress in the protection of natural habitats as indicated by increases in:
 - Acres of natural lands in public ownership
 - Acres of natural lands owned by conservation organizations
 - Acres of natural lands protected by conservation easements
- Decreased deer density, or more to the point, improvement in forest regeneration and vertical structure due to reduced browsing pressure
- Increases in miles of riparian buffers protected and/or restored
- Increased forested acreage and resulting increased carbon sequestration
- Stabilization or increase in populations of endangered, threatened or rare species and no increase in the number of locally extirpated species
- Improved water quality in lakes, streams, and rivers
- Water table stabilization and improvement

General Recommendations

Land protection and connectivity

- Protect large, uninterrupted forest blocks.
- Protect additional forested lands adjacent to currently protected forest areas.
- Establish protected corridors and buffers to connect forested blocks.
- Protect/restore riparian corridors.
- Identify critical ground water recharge areas and initiate protection.
- Implement a scenic roads program.

Land management

- Reduce deer density throughout.
- Control invasive species focusing on early stage infestations and other high profile targets (see specific recommendations for individual landscapes).
- Establish a travelling invasive species strike force within the Bucks County Parks and Recreation Department that can address invasive species problems within the county parks.
- Work with land trusts, conservancies, and individual land owners to encourage environmentally sensitive land management practices.
- Develop programs to educate landscape residents regarding preservation goals and encourage their voluntary cooperation; provide technical assistance.

- Encourage the formation of advisory groups of residents/stakeholders for each landscape to develop management goals and recruit volunteers to implement appropriate management on publicly-owned lands. Note that some areas already have established volunteer groups such as watershed associations.

Public education and interpretation

- Publish an updated countywide guidebook to publicly accessible natural areas. Such a publication could be available in hard copy and on the internet.
- Install informative panels at trailheads featuring natural and cultural history.
- Develop a system of cell phone-accessed and/or podcast interpretive messages at key locations.
- Expand the availability of site-specific bird and wild plant checklists to encourage visitors to look for species of interest. The checklists could be available at nature centers, major trailheads or other open space access points; they could also be posted on the internet.
- Install informative signs at all public access points asking people not to dump yard waste in the woods and explaining that non-native plants such as English ivy, periwinkle, and others that are often included in garden debris, can take root and become invasive weeds in natural areas. Similarly the public needs to understand the potential ecological harm that can result from dumping pet turtles and the contents of fish tanks in lakes and streams.
- Educate the public on the impact of domestic and feral cats and dogs on birds and other native wildlife.
- Develop appropriate trails and trail use standards to reduce landscape damage from off-trail riding.

Chapter 1. Introduction

Why it is Important to Preserve Open Space

Among the greatest contemporary environmental challenges is safeguarding the natural resources and processes that provide benefits for all of us such as clean air, clean water, waste decomposition, and nutrient recycling. In 1968 Garrett Hardin published a landmark paper entitled “The Tragedy of the Commons” in which he described the consequences of our failure to take individual or collective ownership of vital ecosystem components. The subsequent passage by the federal government of the Clean Air Act, the Clean Water Act, the Endangered Species Act, and the Environmental Quality Act in the late 1960s and early 1970s was an important regulatory step taken to protect these vital functions of the environment. However, the continuing reality of global warming, species extinctions, dwindling water supplies, depletion of fisheries, and collapse of ecosystems is compelling proof that stronger action is needed.

Our intention in this update of the Bucks County Natural Areas Inventory is to identify landscapes of several thousand acres each in which important ecological functions can be preserved and or restored.

Ecosystem Services

Open space protects the life support system for humans as well as wildlife. While we humans may not live directly in the fields, forests, or streams, we depend on those natural systems to carry out essential ecosystem services such as water purification, oxygen production, and waste decomposition. Other services provided by natural systems include ground water recharge, flood control, soil building, climate moderation, pollination, and mineral recycling. Natural systems also contain a reservoir of biological diversity in the myriad of organisms large and small, which are part of functioning ecosystems.

Evolutionary Potential

The highly tuned networks of life that characterize ecosystems have evolved over millions of years and continue to evolve today. A vitally important element of biological diversity is the genetic variability contained in populations of organisms. Genetic variation is the raw material for biological evolution by processes such as natural selection.

It is through natural selection and other evolutionary processes that the diversity of life as we know it has arisen, and it is through continued evolution that life will continue to adapt to changes in the environment. At a time of rapid environmental change including global warming, our best long term insurance policy is to maintain maximum biological diversity at all levels, from DNA to ecosystems.

Water Supply

Water is a basic resource. Worldwide, water supplies are diminishing as the needs of growing populations place more demand on finite resources. Pennsylvania has long enjoyed an adequate supply of fresh water, but even here in the humid east, an endless supply of water can no longer be taken for granted. Part of the problem is that we have short-circuited the hydrologic cycle by

withdrawing water from underground aquifers and discharging it after use into surface streams where it flows to the ocean.

Ground water recharge – Protecting open space insures that there are forested areas where rain and melting snow can soak into the ground thus maintaining the underground water table or aquifers. Soil permeability is greatest in forested land; with the loss of natural vegetation, runoff increases and ground water recharge is reduced. When too much of the land surface is covered with impermeable or less permeable surfaces such as roofs, paving, and even lawns, water cannot penetrate as well and the water table drops.

A lowered water table can impact water supply, aquatic habitats, and soil erosion. Reductions in the water table mean that wells may go dry, which could leave the 10 percent of Bucks County residents who depend on wells without a reliable water supply. Municipal water suppliers could also be affected to the extent that they depend on wells rather than surface water sources.

The health of our streams is also dependent on sufficient ground water to maintain stable minimum flow year round. Streams may have drastically reduced flow between storms, especially in the summer, which results in the loss of aquatic habitat. Furthermore, during rainstorms the rapid runoff from impervious surfaces results in frequent flooding accompanied by scouring that leave little life in the streams. Soil erosion is accelerated and suspended silt further degrades water quality.

Because the proper functioning of the water cycle is closely related to the existence of open space we must carefully manage the impact development is having on our streams so as to insure a reliable water supply and healthy stream ecosystems into the future. We also need to provide areas for ground water recharge and to treat storm water as a resource rather than a nuisance to be channeled into the nearest stream.

Water purification – We withdraw water from aquifers (sources of ground water), streams, and reservoirs, use it, and return it to the natural system for purification. Even after wastewater has passed through a sewage treatment facility and been discharged into a stream, more cleansing takes place as the flowing water is exposed to sun and oxygen from the atmosphere and the action of microorganisms. If a stream receives too much waste, its ability to restore water quality may be exceeded leading to algal blooms and fish kills. Flow in many reaches of the Neshaminy Creek, for example, can be more than 90 percent sewage treatment plant effluent during periods when base flow is low (EPA 2003).

Flood Control – Floodplains are an important part of the hydrological system. Formed by the action of streams over the millennia, floodplains are the system's safety valve. They provide a place for water to spread out during periods of high flow. The speed of water movement is slowed, and silt is deposited building up alluvial floodplain terraces. Floodplains have their own community of plants and animals that are adapted to occasional inundation.

Global Warming

Global increases in temperature, and resulting climate change, have been linked to increased levels of carbon dioxide in the atmosphere.

Carbon sequestration – Forests and other natural vegetation remove carbon dioxide from the atmosphere through the process of photosynthesis, and incorporate it into carbon-containing compounds contained in plant tissues and organic residues such as leaf litter. Less forest means less potential for carbon sequestration.

Pennsylvania was nearly completely forested when European settlers first arrived. Land clearance for towns, homesteads, and farms began to make inroads in the late 1600s. By the early 1900s large-scale timber harvesting had reduced forest cover from 90—95 percent to a low of 29 percent (deCoster 1995). Recovery followed, trees came back on cut-over lands and abandoned farmland, and by the late 1900s statewide forest cover stood at 59 percent.

However, a recent trend in land conversion in the northern Piedmont, which includes most of Bucks County, has resulted in a net decline in forest area between 1973 and 2000 of 1.5 percent (Drummond and Loveland 2010). The most significant causes were mechanical disturbance (timber removal) and development of forested land. The authors note that land use pressure has brought about a reversal of a long term trend toward greater forest cover in the region that had resulted from the growth of successional forests on abandoned agricultural lands. Now the loss of forest cover due to development exceeds the rate of reforestation.

Sea level rise – Another threat to biological diversity is the global issue of rising sea level caused by climate change. Global warming is currently causing a measurable rise in sea level of 0.4 inches per year (Rahmstorf 2010). Sea level is expected to increase by 8 to 24 inches by the end of this century, if polar ice sheets remain stable, or more than 3 feet if the ice sheets become unstable (Titus et al. 2009). A recent study examined vulnerability of land along the Atlantic coast that lies below 3 feet elevation. The authors concluded that in the Pennsylvania portion of the Delaware Estuary only 4 percent of the land less than 3 feet above mean sea level has been protected in a way that would allow for coastal ecosystems such as freshwater tidal marshes to migrate inland as sea level rises (see Chapter 2 for more information on freshwater tidal marshes).

Quality of Life

A network of open spaces also makes Bucks County a more desirable place to live, visit, and work through protection of its distinctive resources.

Recreation - The popularity of the multiuse trails, such as those at Delaware Canal State Park and Peace Valley County Park, is evidence of the demand for outdoor recreation opportunities such as bicycling and hiking. Natural areas also foster peace of mind, enjoyment, and recreation through such activities as bird watching, wild flower observation, nature photography, hunting, and fishing.

Bird watching, in particular, is a rapidly growing outdoor activity with many local adherents. Pennsylvania Audubon's designation of two Important Bird Areas (IBAs) in the county has further stimulated this interest.

In addition, wildflower diversity, which is especially high in the areas of diabase geology in the northern part of the county (see section on geology and physiography below), has long stimulated the interest of local amateur and professional botanists.

Economic – A recent study conducted for the GreenSpace Alliance and the Delaware Valley Regional Planning Commission documents multiple economic benefits from open space preservation including increased property values, higher levels of tourism, increased employment opportunities, and higher tax revenues. The study focused on the five county region of southeastern Pennsylvania (Economy League of Greater Philadelphia 2010). A case study in the report, using Peace Valley Park, revealed that homes within one-quarter mile have an estimated \$35,155 of additional value based on their proximity to the park.

Health - A quiet walk in the woods can provide a respite from the human-dominated landscape and restore one’s mental and spiritual health. Merely driving a scenic country road can provide relaxation and pleasure. In addition, outdoor active recreation provides health benefits by promoting physical activity such as walking, bicycling, and jogging. Health related cost savings resulting from physical activity utilizing Bucks County’s protected open space have been estimated at \$228,800,000 per year (Economy League of Greater Philadelphia at al. 2010).

Social/Cultural – Bucks County’s network of open space contributes to community building by linking communities along trails and greenways. It offers places where people see and interact with other members of the community. People may also build pride in their community assets such as heritage areas, farms, and rural areas. Or residents and visitors can chose to take advantage of educational opportunities that the out-of-doors may provide.

Study Methods

Designation of Landscapes

In undertaking a re-examination of natural areas in Bucks County, we took a “systems” approach focused on “sustainable landscapes.” Our first step was to examine aerial photography of the county looking for areas that retained a high percentage of forest cover. We used ArcGIS version 9.3 to analyze spatial data sets obtained from the Pennsylvania Spatial Data Access website (PASDA 2010) (Table 1.1). Additional data layers including preserved lands, 1999 NAI sites, and tax parcels were provided by the Bucks County Planning Commission. We created overlays of the highest priority sites from the 1999 Natural Areas Inventory, publicly owned land, forested areas, floodplains, and wetlands. We also took into consideration areas designated as Important Bird Areas (Pennsylvania Audubon 2010).

Estimated forest cover of the county was derived from the National Land Cover Database 2001 – Tree Canopy Layer for Pennsylvania and the Northeast produced by the U.S. Geological Survey (PASDA). These raster data, at 30 m resolution, were converted to ArcGIS shapefile format. Isolated forest area polygons of less than 2 acres were considered ecologically insignificant and were omitted from further analysis. A 50-meter buffer was applied to the inside boundary of the forest area polygons to represent edge forest. Interior forest areas were calculated by subtracting the resulting edge areas from the forest polygons.

Table 1.1 GIS Layers Used in the Bucks County Natural Areas Inventory Update

<i>GIS Layer</i>	<i>source</i>
Bedrock Geology of Pennsylvania, edition 1.0	Bureau of Topographic and Geologic Survey Harrisburg, PA 2001 http://www.dcnr.state.pa.us/topogeo/map1/bedmap.aspx#entirestate
Physiographic Provinces 1:100,000	Pennsylvania Bureau of Topographic and Geologic Survey Harrisburg, PA 1995 ftp://www.pasda.psu.edu/pub/pasda/dcnr/pags/pags_physprov1k.zip
Soil Survey Geographic (SSURGO) database for Bucks County, PA	U.S. Department of Agriculture, Natural Resources Conservation Service Fort Worth, Texas 2004 ftp://www.pasda.psu.edu/pub/pasda/soils/
Networked streams of Pennsylvania	Pennsylvania Department of Environmental Protection Harrisburg, PA 1998 http://www.pasda.psu.edu/data/netstreams/netstreams.zip PennDOT -
Pennsylvania State roads 2010	Pennsylvania Department of Transportation Harrisburg, PA 2010 ftp://www.pasda.psu.edu/pub/pasda/padot/state/
PennDOT - Pennsylvania local roads 2010	Pennsylvania Department of Transportation Harrisburg, PA 2010 ftp://www.pasda.psu.edu/pub/pasda/padot/state/
Water Resources, Water Discharge Data	Pennsylvania Department of Environmental Protection Harrisburg, PA 2010 ftp://www.pasda.psu.edu/pub/pasda/dep/
PennDOT - Pennsylvania County Boundaries 2010	Pennsylvania Department of Transportation Harrisburg, PA 2010 ftp://www.pasda.psu.edu/pub/pasda/padot/boundary_layers/
PennDOT - Pennsylvania Municipality boundaries 2010	Pennsylvania Department of Transportation Harrisburg, PA 2010 ftp://www.pasda.psu.edu/pub/pasda/padot/boundary_layers/
DCNR State Parks, park boundaries	Pennsylvania Department of Conservation and Natural Resources Harrisburg, PA 2009 ftp://www.pasda.psu.edu/pub/pasda/dcnr/
National Land Cover Database 2001 - Tree Canopy Layer -Pennsylvania and Northeast; Edition 1.0	U.S. Geological Survey, Sioux Falls, SD 2003 http://www.mrlc.gov
Aerial Photography, PAMAP Program - County Mosaics 2007	PA Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Middletown, PA 2007 ftp://pamap.pasda.psu.edu/pamap_imagery/cycle2/mosaics/
Aerial Photography, National Agricultural Imagery Program	USDA FSA APFO Aerial Photography Field Office, Salt Lake City, UT 2008 http://www.pasda.psu.edu/data/naip/NAIP2008
DVRPC 2005 Digital Orthoimagery - Bucks North Mr.SID Mosaic	BAE Systems, Mt. Laurel, NJ 2007 http://www.dvrpc.org/
Neshaminy Creek Watershed Conservation Plan Forested Stream Corridor Data	Heritage Conservancy, Doylestown, PA 2000 http://www.pasda.psu.edu/data/heritage_conservancy/nesh/
Riparian Buffers For Seven Counties In Pennsylvania (Berks, Bucks, Chester, Delaware, Montgomery, Northampton, Philadelphia)	Heritage Conservancy, Doylestown, PA 2000 http://www.pasda.psu.edu/data/heritage_conservancy/rba/

By drawing polygons that included areas of continuous, or nearly continuous, forest cover we identified 12 of the 13 conservation landscapes, each with a core area of protected land (Figure 1.1). Not surprisingly, most of the landscapes were either rocky areas of diabase geology or riparian corridors. One exception is the Atlantic Coastal Plain Conservation Landscape. Located along the Delaware River in the southern end of the county, the coastal plain is a very highly developed area. We decided to include the entire area in the conservation landscape;

because of the highly fragmented nature of the remaining natural features, almost any undeveloped land is likely to support rare coastal plain species.

Most of the landscapes include portions of more than one municipality (Table 1.2). All of the 19 highest priority sites from the previous Natural Areas Inventory were included, wholly or in part, in our landscapes as well as 86 percent (391 of 454) of the extant occurrences of Pennsylvania Natural Heritage Program species of special concern.

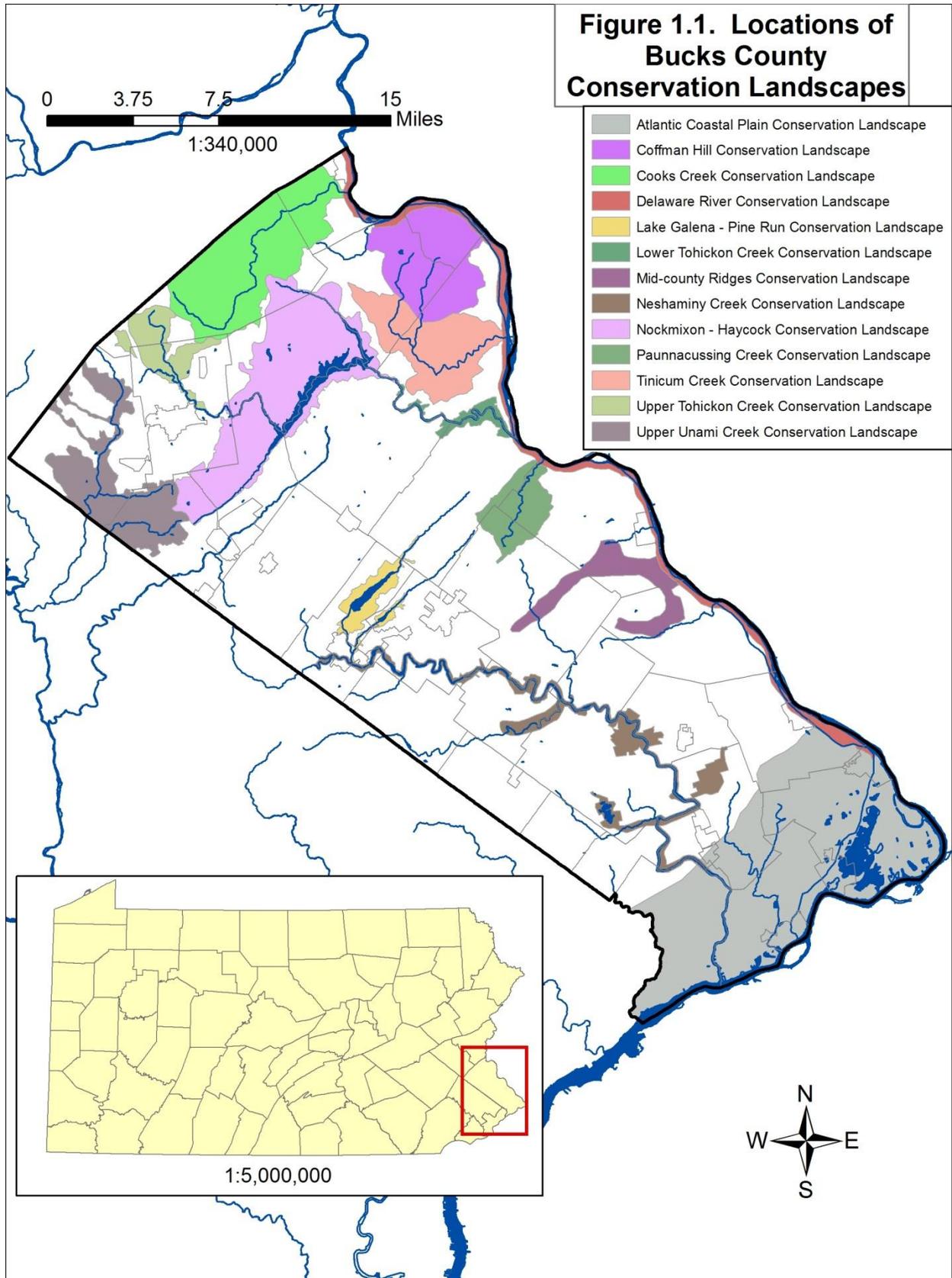
The intent of taking a landscape approach to open space preservation is to maximize the potential for long-term sustainability of individual sites by protecting the landscape context and enhancing connectivity. The landscapes, at several thousand acres each, are intended to be big enough to preserve important ecological functions critical to maintaining the life support system for the county as a whole. This approach will be implemented through a combination of public and private ownership, easements, and voluntary implementation of appropriate management strategies and techniques.

Riparian buffer information was extracted from data layers prepared by Heritage Conservancy and available from PASDA (Table 1.1). Full riparian buffers were defined as “at least 50 feet of woodland on both sides of a stream”.

Protected lands information was provided by the Bucks County Planning Commission.

Table 1.2 Municipalities Included in Each Conservation Landscape

<i>conservation landscape</i>	<i>municipalities included in whole or in part</i>
Atlantic Coastal Plain	Bensalem Twp., Bristol Borough, Bristol Twp., Falls Twp., Lower Makefield Twp., Morrisville Borough, Tullytown Borough
Coffman Hill	Bridgeton Twp., Nockamixon Twp., Tincum Twp.
Cooks Creek	Durham Twp., Springfield Twp.
Delaware River	Bridgeton Twp., Durham Twp., Lower Makefield Twp., New Hope Borough, Plumstead Twp., Riegelsville Borough, Solebury Twp., Tincum Twp., Upper Makefield Twp., Yardley Borough
Lake Galena/Pine Run	New Britain Twp.
Lower Tohickon Creek	Bedminster Twp., Plumstead Twp., Tincum Twp.
Mid-county Ridges	Buckingham Twp., Solebury Twp., Upper Makefield Twp.
Neshaminy Creek	Bensalem Twp., Bristol Twp., Buckingham Twp., Hulmeville Borough, Langhorne Borough, Middletown Twp., New Britain Borough, New Britain Township, Chalfont Borough, Newtown Twp. Northampton Twp., Southampton Twp, Warrington Twp., Warwick Twp., Wrightstown Twp.,
Nockamixon/Haycock	Bedminster Twp., East Rockhill Twp., Haycock Twp., Nockamixon Twp., Richland Twp., Springfield Twp., Tincum Twp., West Rockhill Twp.
Paunacussing Creek	Buckingham Twp., Plumstead Twp., Solebury Twp.
Tincum Creek	Nockamixon Twp., Tincum Twp.
Upper Tohickon Creek	Haycock Twp., Richland Twp., Springfield Twp.
Upper Unami Creek	Milford Twp., West Rockhill Twp.



Eighteen sites identified in the 1999 Bucks County Natural Areas Inventory fall outside the boundaries of the Conservation Landscapes delimited in this report (Table 1.3). Although these sites are generally small and somewhat isolated, and as such are of limited conservation value countywide, they may continue to be sites of local concern.

Table 1.3 1999 NAI Sites Not Included in Conservation Landscapes

<i>site</i>	<i>priority</i>	<i>acres</i>
Beaver Run woods	4	99.669
Bradford Reservoir	4	104.765
Burrell's Lake	3	32.430
David R. Johnson Natural Area	4	67.043
East Branch Meadow	2	29.438
East Branch Perkiomen Creek - between Sellersville and Route 309	3	111.598
Goldmine Cr. ravine	4	17.223
Ingham's Hill	4	52.196
Langhorne Spring Water Co.	4	60.093
Morgan Run	3	67.724
Poquessing Creek - Betz Labs. forest	3	38.312
Poquessing Creek - mature forest just below the railroad	2	36.556
Route 309 woods	4	30.845
Saba Tract - Township Line Road Wetlands	2	81.802
Timber Knolls Wetlands	3	72.484
Tohickon Creek - vicinity of West Thatcher Road	3	33.085
Washington Crossing - Marazzo tract along Delaware Canal	4	23.246
Woodborne wooded area along RR and Mill Cr. 0.25 mi. WSW	4	89.573

Field Surveys

Field Surveys were conducted of selected tracts within each landscape to document elements of biological diversity including plants, plant communities, reptiles, amphibians, and birds. Of necessity, surveys were focused on publicly owned land and private lands where permission to enter could be obtained. Two years is not enough time to conduct a complete inventory; an ongoing program is needed to examine additional sites and continue to monitor conditions.

Plant diversity – Vegetation surveys were carried out by Drs. Ann F. Rhoads and Timothy A. Block assisted by interns. The plant lists were derived from surveys of core areas in each landscape during 2008—2010. Most sites were visited several times at different seasons to record the maximum number of species. Botanical searches employed random walk techniques as well as targeted searches of each habitat type present at a site. Plant identification and nomenclature follow *The Plants of Pennsylvania: An Illustrated Manual*, 2nd edition (Rhoads and Block 2007). Herbarium specimens were collected of selected plants and deposited in the herbarium of the Morris Arboretum of the University of Pennsylvania. Occurrences of state-listed plants were reported to the Pennsylvania Natural Heritage Program.

Plant communities – Because of the relative ecological importance of the Atlantic Coastal Plain, quantitative data on forest composition were collected at Delhaas Woods, the largest remaining example of that physiographic province in Pennsylvania. Data on forest composition were obtained by placing 100-meter transects at selected locations throughout the landscapes. These transects were used to sample the composition of the canopy, shrub, and seedling layers of the forest using the point quarter method for canopy trees, three 100 meter square shrub plots and ten 1 meter square plots for herbaceous plants. The relative importance value (RIV) for each species observed was calculated with a formula that uses data on cover, frequency, and abundance of each species. RIV data were used to assign specific forest types to each community and to assess the extent of deer browse and its impact on the forest composition and structure.

Reptiles and amphibians - Surveys of reptiles and amphibians were conducted by Marlin Corn, naturalist, who was a subcontractor employed by the Morris Arboretum. Surveys were conducted of selected areas in each of the conservation landscapes using standard survey techniques including General Herpetological Collecting and Anuran Calling Surveys during breeding seasons. General collecting included traveling through the survey areas on foot observing exposed animals and searching under cover objects such as logs, rocks and other debris, searching wetlands at night with a flashlight, and driving roads near areas of probable habitat at night during wet weather during amphibian breeding seasons. Turtles were also searched for using binoculars or a spotting scope and by canoe and/or kayak. A global positioning system (GPS) receiver was used to record locations and all finds were also documented with photographs.

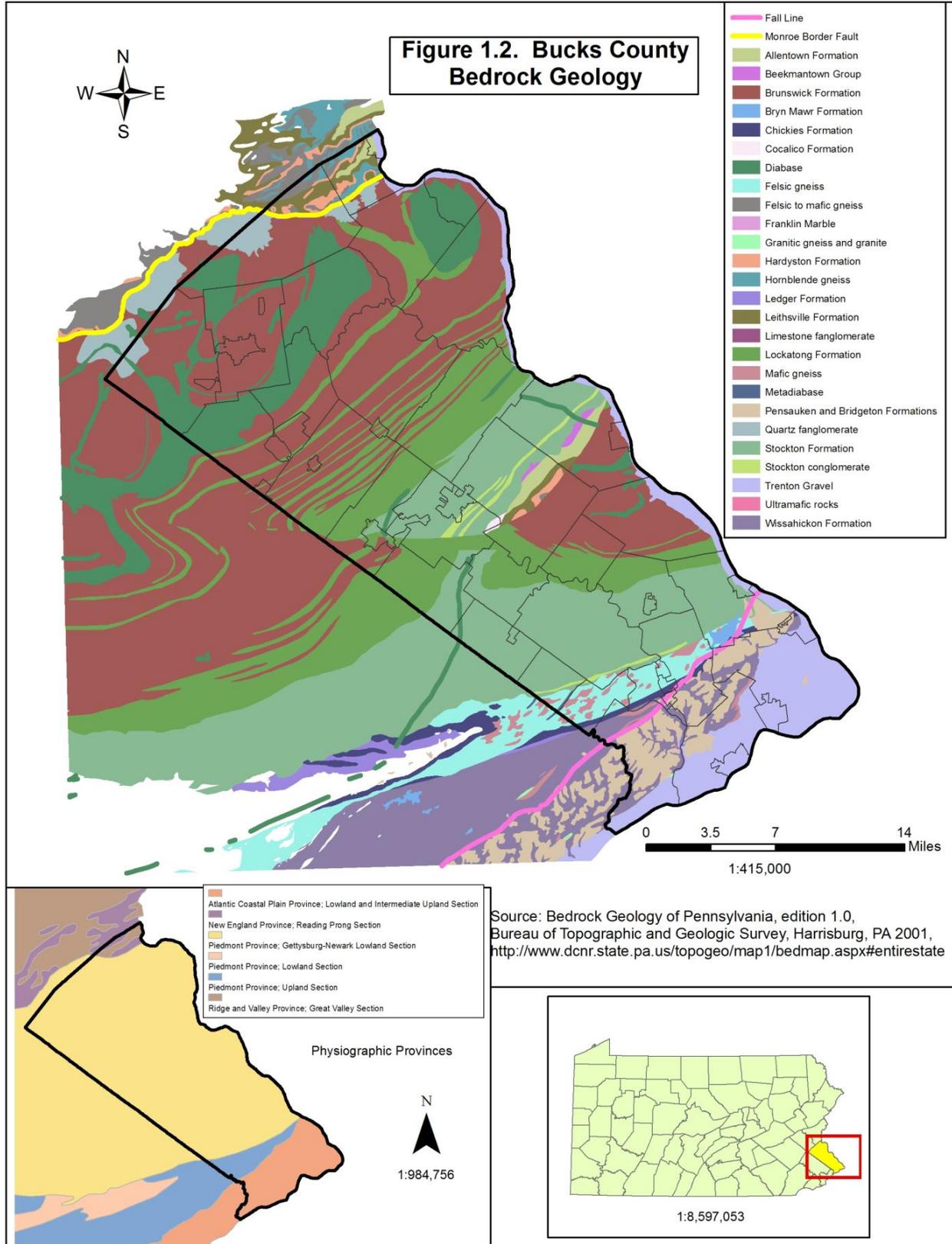
The Setting

Geology and Physiography

Bucks County spans four physiographic provinces. The Atlantic Coastal Plain forms a band along the southeastern end of the county. Unconsolidated sand and gravel deposits of Quaternary age characterize this zone which is separated from the rest of the county by the Fall Line (Figure 1.2).

North of the Fall Line is a narrow wedge of Piedmont Uplands with its characteristic metamorphic rocks of Cambrian and Precambrian age. The central part of the county is dominated by Newark Basin with its sedimentary rocks of Triassic and early Jurassic origin which comprise the Piedmont Lowlands (Figure 1.2). From south to north the Stockton Formation sandstones, give way to a band of argillite and shale of the Locketong Formation and finally Brunswick Formation consisting of red shale, mudstone, and siltstone.

The northern part of the Piedmont is also marked by a series of diabase dikes and sills that were intruded as molten magma into the Brunswick shale during the early Jurassic period. Subsequent erosion of the softer overlying shale has created ridges and uplands where the more resistant diabase is exposed.



Diabase intrusions are generally bordered by a zone of hornfels, partially metamorphosed shales created by the heat of the intruded magma. These boulder-strewn diabase landscapes are often erroneously assumed to have been created by glaciers; however, Bucks County is well south of the southernmost extent of glaciation in Pennsylvania.

Why the Rocks Ring

Diabase boulder fields with rocks that ring with a clear bell-like tone when tapped with a hammer exist at two sites in Bucks County: Ringing Rocks County Park and Haycock Mountain. The boulder fields are characterized by open expanses of rocks lacking intervening vegetation. The ringing is due to weathering of the outer layer of the boulders, which creates tension on the core. Strain resulting from the tension alters the resonant frequency of the rock. Similar rocks in the shade of adjacent woodlands do not ring, nor do all of the rocks in the open areas. Apparently even partial shading by lichens or adjacent boulders is enough to alter the weathering process such that the inner tension does not develop (Gibbons and Schlossman 1970).

Diabase boulder fields in which the rocks ring when tapped with a hammer are present at two sites in Bucks County. The boulder fields are characterized by an open expanse of rocks lacking intervening vegetation.

The northeastern corner of Bucks County is underlain by metamorphic felsic and gabbroic gneiss that make up a portion of

the Reading Prong Section of the New England Physiographic Province. In addition, a band of dolomitic limestone and quartzite along Cooks Creek comprises a portion of the Great Valley Section of the Ridge and Valley Physiographic Province (Figure 1.2).

Five geological features in the county are identified as outstanding scenic geological features of Pennsylvania: The Lookout, Monroe Border Fault, Nockamixon Cliffs, Ringing Rocks (the

boulder field in Ringing Rocks County Park), and Sentinel Rock in Nockamixon State Park (see further discussion of these features under the appropriate conservation landscapes). We suggest that the rings of diabase that surround the Quakertown basin in

Rings of Diabase Rock

A circular formation several miles in diameter consisting of diabase ridges surrounds the Quakertown basin in Upper Bucks County. A similar formation exists around the Pennsburg/Red Hill/East Greenville area in Montgomery County. These unusual geologic formations are thought to have originated when diabase sheets were intruded into the existing Brunswick shale about 200 million years ago. As the diabase layer spread horizontally it responded to variations in the overlying topography. Where there was a hill, greater downward pressure created a depression in the diabase sheet. Subsequent erosion exposed the rim, but shale continues to cover the diabase within the basins. The only other place that formations like these have been identified is in South Africa (Meyboun and Wallace 1978).

Bucks County and similar areas in Montgomery County should also be designated as an outstanding scenic geologic feature of Pennsylvania (Figure 1.2).

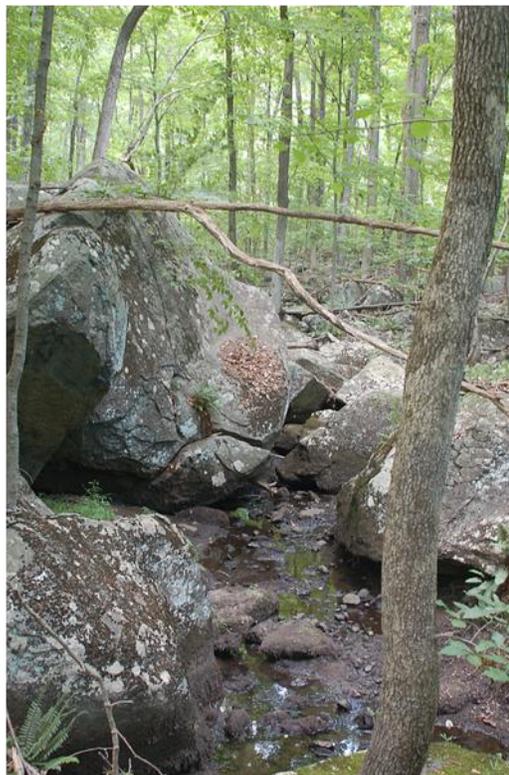
Commercial development of the mineral resources of Bucks County has included iron mines at Durham that operated from 1736 to 1912 and sand and gravel quarrying along the Delaware River.

Another early enterprise involved clay pits where the raw material for a ceramics industry centered in Quakertown was obtained. Gneiss and schist were quarried for building stone.

Evidence of surface cutting of diabase boulders (also known as trap rock) for building stone, cobblestones, and curbs (Belgian blocks) is visible in the woods at several locations in upper Bucks County. Quarrying of argillite and hornfels for construction aggregate continues today.

Climate

Bucks County is subject to a humid continental climate featuring warm, humid summers and moderately cold winters. Rainfall is distributed throughout the year. Monthly average temperatures for the period 1971—2000 ranged from 31.3° F in January to 75.9° F in July. Average annual precipitation was 50.8 inches. On average, precipitation exceeds the loss of moisture through evapotranspiration except in the warmest months (June, July, and August). The average length of the growing season is 160 days (Cuff et al. 1989; NOAA 2010).



Diabase boulders

Watersheds and Hydrology

Most of central and southern Bucks County is within the Delaware River watershed directly or is drained by the Neshaminy Creek, a tributary of the Delaware. The Tohickon, Tinicum, and Cooks Creeks, also Delaware River tributaries, drain large portions of Upper Bucks County. The Unami Creek and its tributaries, part of the Perkiomen Creek watershed, drain the northwestern corner of Bucks County (Figure 1.3).

Of the county's waterways, only two, Cooks Creek and Tinicum Creek, are classified by The Pennsylvania Department of Environmental Protection (DEP) as an exceptional value (EV) streams (Table 1.4). A 1997 petition to upgrade the Unami Creek to EV status was rejected by DEP; it is designated as HQ-TSF (high quality, trout stocked fishery). Paunacussing Creek, Cutalossa Creek, and Aquetong Creek are also HQ streams (Commonwealth of Pennsylvania 2010).

The main stem of the Neshaminy Creek, along with the West Branch, most of the North Branch, Little Neshaminy, and Pine Run have been classified as "impaired" by the Environmental Protection Agency on the basis of macro-invertebrate surveys conducted by the Pennsylvania Department of Environmental Protection. During critical low flow periods, sewage treatment plant effluent and other discharges make up more than 90 percent of total stream flow in many reaches (EPA 2003).

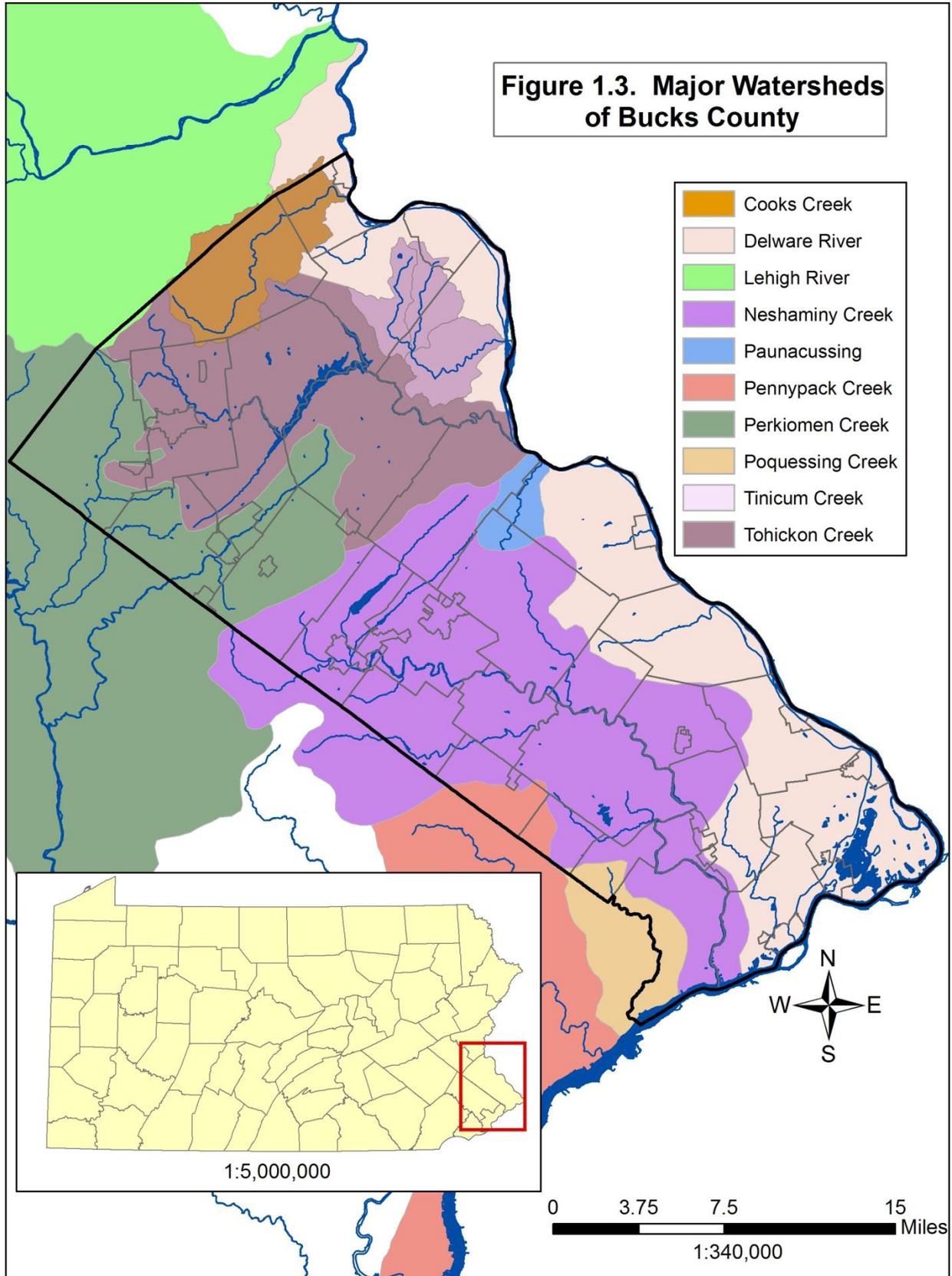
Table 1.4 Water Quality Classifications for Bucks County Streams

Stream	DEP classification*
Aquetong Creek	HQ-CWF, MF
Buck Creek	WWF, MF
Cooks Creek (tributary of Delaware River)	EV, MF
Cooks Creek (tributary of Neshaminy Creek)	WWF, MF
Core Creek above Lake Luxembourg	CWF, MF
Core Creek below Lake Luxembourg	WWF, MF
Country Club Creek	WWF, MF
Cuttalossa Creek	HQ-CWF, MF
Dark Hollow Run	TSF, MF
Deep Run	WWF, MF
Delaware Estuary	WWF, MF
Delaware River	WWF, MF
Dyers Creek	WWF, MF
East Branch Perkiomen Creek	TSF, MF
Gallows Run	CWF, MF
Hickory Creek	TSF, MF
Houghs Creek	WWF, MF
Jericho Creek	WWF, MF
Little Neshaminy Creek	WWF, MF
Martins Creek	WWF, MF
Mill Creek (tributary of Delaware River)	WWF, MF
Mill Creek (tributary of Neshaminy Creek)	TSF, MF
Mill Creek (tributary of Watson Creek)	WWF, MF
Neshaminy Creek, main stem above RM 26.84	TSF, MF
Neshaminy Creek, main stem below RM 26.84	WWF, MF
Neshaminy Creek, North Branch	TSF, MF
Neshaminy Creek, West Branch	WWF, MF
Newtown Creek	WWF, MF
Paunacussing Creek	HQ-CWF, MF
Pennypack Creek	TSF, MF
Pidcock Creek	WWF, MF
Poquessing Creek	WWF, MF
Rabbit Run	TSF, MF
Tinicum Creek	EV, MF
Tohickon Creek, Lake Nockamixon dam to mouth	CWF, MF
Tohickon Creek, source to L. Nockamixon	TSF, MF
Unami Creek	HQ-CWF, MF
Watson Creek	CWF, MF

* CWF=cold water fishery, EV=exceptional value, HQ=high quality, MF=migratory fishes,
 TSF= trout stocked fishery, WWF=warm water fishery.
 Source: Commonwealth of Pennsylvania 2010



Tohickon Creek at Richlandtown Road



Biological Resources

Plant Diversity

Bucks County has the most diverse flora of any county in Pennsylvania. The presence of the most extensive representation of coastal plain flora in the state adds a significant element. Habitat diversity is further increased by the fact that the county includes parts of four physiographic provinces and their characteristic geologic formations.

Documentation of the flora of Bucks has continued over the past 300 years. Early botanists who published on aspects of the Bucks County Flora included Constantine Rafinesque, Isaac S. Moyer, John and Harvey Ruth, and Thomas C. Porter. Moyer provided a list of 1,166 species that was included in Davis' History of Bucks County (Thomas and Moyer 1876). Clayton D. Fretz revised Moyer's list, raising the total to 1,581 for the second edition (Fretz 1905).

In 1932 Walter Benner published a flora of Bucks County that drew on the cumulative work of more than 50 field botanists whose specimens had been deposited in herbarium collections in Philadelphia institutions (Benner 1932). It included 1,879 species and varieties.

The *Atlas of the Flora of Pennsylvania* (Wherry et al. 1979) contained distribution maps of all native and naturalized species known from Pennsylvania. In the 1980s computerization of plant records for the state was begun at the Morris Arboretum of the University of Pennsylvania resulting in establishment of the Pennsylvania Flora Database. The database was the basis for publication of an annotated checklist and atlas (Rhoads and Klein 1993) followed by a manual of the plants of Pennsylvania (Rhoads and Block 2000, 2007).

Documenting the flora of Bucks County is an ongoing process; the Pennsylvania Flora Database currently includes records of 2,005 species of native and naturalized plants that have been documented in Bucks County (Morris Arboretum 2010). Of those, 1,395 species are native and 610 (30.5 percent) are non-native species that have become established since European settlement (Table 1.5). The full list, including scientific names, is included in Appendix A.

Table 1.5 Summary of Plant Diversity in Bucks County

	<i>native</i>	<i>introduced</i>	<i>total</i>
Aquatic plants	122	18	140
Ferns and other spore-bearing plants	76	1	77
Grasses, sedges, and rushes	297	78	375
Wildflowers and other herbaceous species	639	381	1020
Trees, shrubs, and woody vines	261	132	393
<i>totals</i>	1395	610	2005

Species of special concern – Two hundred and eighty-two (282) species of plants classified as endangered, threatened, rare, extirpated, undetermined, special populations, or watch list in Pennsylvania have been found in Bucks County over the years (Appendix A). Thirty-five of those are considered extirpated in Pennsylvania; 101 have not been collected in Bucks County in over 50 years and are probably no longer present. Of the 146 remaining listed plants, 39 species

occur at Delhaas Woods Preserve in Bristol Township. Fact sheets on 80 of the highest profile listed species that are currently known to be present in the county are in Appendix G.

Forest types

Bucks County lies within the Eastern Broadleaf Forest (Oceanic) Province, which is characterized by a winter deciduous forest with an early spring ground cover of wildflowers (Bailey 1995). Lucy Braun included all of southeastern Pennsylvania in her Oak – Hickory Forest Region (Braun 1950).

When European settlers arrived the area was almost entirely forested except for herbaceous wetlands and clearings created and maintained by Native Americans. Common canopy trees included red oak (*Quercus rubra*), white oak (*Q. alba*), beech (*Fagus grandifolia*), American chestnut (*Castanea dentata*), hickory (*Carya* spp.), red maple (*Acer rubrum*), and white ash (*Fraxinus americana*). Sugar maple (*Acer saccharum*) and tuliptree (*Liriodendron tulipifera*) were, and still are, common on diabase and gneiss geology. On north-facing slopes and ravines hemlock (*Tsuga canadensis*) was prominent and on dry upper slopes chestnut oak (*Q. montana*), black oak (*Q. velutina*), sourgum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), and formerly American chestnut, were the dominant species. Floodplain forests are characterized by sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), and box elder (*Acer negundo*).

The southeastern corner of the county has a distinctive flora that early botanists recognized as reminiscent of the coastal plain regions of southern New Jersey. Forests in the Atlantic Coastal Plain are characterized by sweetgum (*Liquidambar styraciflua*), willow oak (*Quercus phellos*), and sweetbay magnolia (*Magnolia virginiana*). Many plants of the coastal plain are found nowhere else in the state.

Since the arrival of European settlers, many changes have occurred in the county's forests; today forests cover only 37 percent of the land area. The loss of American chestnut, decline of oaks due to preferential feeding by gypsy moth caterpillars and deer, and the rise of red maple have resulted in shifts in species abundance. Further change may result from the spread of additional invasive, non-native insects and diseases such as the hemlock woolly adelgid which has already devastated hemlocks in several areas of the county. Further change may come about due to the emerald ash borer, which has killed millions of ash trees in the Midwest and has recently reached central Pennsylvania (DCNR 2010).

Reptiles and Amphibians

The statewide Herpetological Atlas Project carried out between 1996 and 2002 resulted in records for 39 species in Bucks County, four of which were previously not known to occur in the county (Hulse 2002).

Our knowledge of the full range of species of reptiles and amphibians present in Bucks County continues to expand. Herpetological surveys conducted by Marlin Corn, and others, since the 1999 Natural Areas Inventory have confirmed the presence of 44 species in Bucks County (Table 1.6). Profiles of all species and management recommendations are included in Appendix B.

Table 1.6 Reptiles and Amphibians of Bucks County, Pennsylvania

common name	scientific name	status*
salamanders		
Spotted Salamander	<i>Ambystoma maculatum</i>	
Marbled Salamander	<i>Ambystoma opacum</i>	G5/S3S4
Red-spotted Newt	<i>Notopthalmus viridescens viridescens</i>	
Northern Redback Salamander	<i>Plethodon cinereus</i>	
Northern Slimy Salamander	<i>Plethodon glutinosus</i>	
Northern Dusky Salamander	<i>Desmognathus fuscus fuscus</i>	
Northern Red Salamander	<i>Psuedotriton ruber ruber</i>	
Northern two-lined Salamander	<i>Eurycea bislineata</i>	
Four-toed Salamander	<i>Hemidactylum scutatum</i>	G5/S4
Longtail Salamander	<i>Eurycea longicauda longicauda</i>	
frogs and toads		
Eastern Spadefoot Toad	<i>Scaphiopus holbrookii holbrookii</i>	G5/S1/PE
American Toad	<i>Anaxyrus americanus americanus</i>	
Fowler's Toad	<i>Anaxyrus fowleri</i>	
Spring Peeper	<i>Pseudacris crucifer</i>	
New Jersey Chorus Frog	<i>Pseudacris triseriata kalmi</i>	G5T4/S1/PE
Northern Cricket Frog	<i>Acris crepitans crepitans</i>	G5/S1/PE
Gray Treefrog	<i>Hyla versicolor</i>	
Wood Frog	<i>Lithobates sylvaticus</i>	
Southern Leopard Frog	<i>Lithobates sphenoccephalus utricularius</i>	GNR/S1/PE
Pickerel Frog	<i>Litjlobates palustris</i>	
Green Frog	<i>Lithobates clamitans melanota</i>	
Bullfrog	<i>Lithobates catesbeianus</i>	
turtles		
Common Snapping Turtle	<i>Chelydra serpentina serpentina</i>	
Common Musk Turtle	<i>Sternotherus odoratus</i>	
Eastern Mud Turtle	<i>Kinosternon subrubrum subrubrum</i>	G5T5/ S1/PX
Spotted turtle	<i>Clemmys guttata</i>	G5/S3
Bog Turtle	<i>Glyptemys muhlenbergii</i>	G3/S1S2/PE/LT
Wood Turtle,	<i>Glyptemys insculpta</i>	G4/S3S4
Eastern Box Turtle	<i>Terrapene carolina carolina</i>	
Map Turtle	<i>Graptemys geographica</i>	
Yellowbelly Slider	<i>Trachemys scripta scripta</i>	introduced
Red-eared Slider	<i>Trachemys scripta elegans</i>	introduced
Redbelly Turtle	<i>Pseudemys rubriventris</i>	G5/S2S3/PT/CA
Eastern Painted Turtle	<i>Chrysemys picta picta</i>	
Eastern Spiny Softshell Turtle	<i>Apalone spinifera spinifera</i>	
skinks		
5-Lined Skink	<i>Plestiodon fasciatus</i>	
snakes		
Northern Water Snake	<i>Nerodia sipedon sipedon</i>	
Northern Brown Snake	<i>Storeria dekayi dekayi</i>	
Eastern Garter Snake	<i>Thamnophis sirtalis sirtalis</i>	
Northern Ringneck Snake	<i>Diadophis punctatus edwardsii</i>	
Northern Black Racer	<i>Coluber constrictor constrictor</i>	
Eastern Rat Snake	<i>Elaphe alleghaniensis</i>	
Eastern Milksnake	<i>Lampropeltis triangulum</i>	
Northern Copperhead	<i>Agkistrodon contortrix mokasen</i>	

*Global ranks: G3=vulnerable globally, G4=apparently secure, G5=secure; State ranks: S1=critically imperiled, S2=imperiled, S3=vulnerable, S4=apparently secure; PNHP categories: PE=endangered in Pennsylvania, PX=extirpated in Pennsylvania, CA=candidate at risk; LT=threatened under the Federal Endangered Species Act
Source: PNHP 2010

Species of special concern – The bog turtle, for which there are several documented sites in Bucks County, is listed as threatened under the Federal Endangered Species Act and endangered by the Pennsylvania Natural Heritage Program. The eastern spadefoot toad, New Jersey chorus frog, northern cricket frog, and southern leopard frog are also listed as endangered in Pennsylvania. The redbelly turtle is listed as threatened (PNHP 2010). In addition, an extant population of eastern mud turtle was documented; this species was believed to be extirpated in Pennsylvania, its status is now being re-evaluated.

Two species are thought to be extirpated in Bucks County: hognose snake (*Heterodon platyrhinos*) and eastern earth snake (*Virginia valeriae valeriae*) have not been documented in more than 60 years. The red-eared slider and yellowbelly slider are introduced species.

Birds

The first checklist of birds of Bucks County, which appeared in 1876, included 229 species (Thomas and Moyer 1876). By 1998, *Birds of Bucks County* by Ken Kitson included 329 species (Kitson 1998). A current list of 359 species of birds recorded in Bucks County is included in Appendix C. It was developed by August Mirabella and Ken Kitson of Bucks County Birders using data from the large network of active birders in the county as well as Christmas Bird Counts and Breeding Bird Atlas records.

Statewide, the Pennsylvania Breeding Bird Atlas Project has just completed its second round (Carnegie Museum of Natural History 2010). We drew on Pennsylvania Breeding Bird Atlas records and other sources to develop lists of breeding birds for some individual landscapes in this study.

Two sites in Bucks County have been designated by Pennsylvania Audubon as Important Bird Areas (IBAs): Peace Valley Park and Quakertown Swamp (Pennsylvania Audubon 2010).

Species of special concern - Of the birds known from Bucks County, 37 species have current or proposed status under the Pennsylvania Natural Heritage Program (PNHP 2010) (Table 1.7).

In addition to the listed species, several groups of birds, including forest interior species, birds of riparian areas, and grassland birds, are of concern because of their dependence on declining habitats. See sections on sources and sinks, grassland management, and riparian corridors below for additional discussion.

Mammals

Thirty-five (35) species of mammals were listed in Davis's History of Bucks County (Thomas and Moyer 1905). No new mammal inventories were conducted as part of this project. Status of the Durham Mine bat hibernaculum is discussed in Chapter 4.

Table 1.7 Pennsylvania Natural Heritage Program-listed Birds of Bucks County

	<i>PNHP status*</i>
American Bittern	PE
American Coot	CR proposed
Bald Eagle	PE, PT proposed
Barn Owl	CR proposed
Black Tern	PE
Black-crowned Night-Heron	PE proposed
Blackpoll Warbler	PE proposed
Common Moorhen	CA proposed
Common Tern	PE
Dickcissel	PE proposed
Great Egret	PE
Green-winged Teal	CR proposed
King Rail	PE
Least Bittern	PE
Loggerhead Shrike	PE
Long-eared Owl	CU proposed
Marsh Wren	CR proposed
Northern Bobwhite	CA proposed
Northern Goshawk	CR proposed
Northern Harrier	CA proposed
Olive-sided Flycatcher	PX proposed
Osprey	PT
Peregrine Falcon	PE
Pied-billed Grebe	CR proposed
Pine Siskin	CU proposed
Piping Plover	LE
Prothonotary Warbler	CR proposed
Red Crossbill	CU proposed
Sedge Wren	PT, PE proposed
Short-eared Owl	PE
Sora	CR proposed
Summer Tanager	CR proposed
Swainson's Thrush	CR proposed
Upland Sandpiper	PE
Wilson's Snipe	CR proposed
Yellow-bellied Flycatcher	PT, PE proposed
Yellow-crowned Night-heron	PE

* *PE=endangered in Pennsylvania, PT=threatened in Pennsylvania. PX=extirpated in Pennsylvania*
CA= candidate at risk, CR=candidate rare, CU=candidate undetermined
LT=listed as threatened under Endangered Species Act
Source: PNHP 2010

Historical and Current Land Use Patterns

Bucks County was one of the three original counties of Pennsylvania established by William Penn in 1682. The county was settled primarily by German and English immigrants beginning in the late 1600s. Following initial clearing of native vegetation, the area became an agricultural landscape with scattered villages centered on streamside mills that served the farms.

The Delaware Canal, which opened in 1832, stimulated the development of a commercial corridor. New towns sprang up and new markets opened to county farmers. The arrival of coal from upstate areas stimulated industry. Agricultural use remained dominant through the early 1900s, but by the mid-1900s industry began to dominate the local economy. United States Steel Corporation began operations in 1954 on a 3,900 acre tract along the Delaware River south of

Morrisville. Other industry followed and with it came the development of tract housing such as Levittown and Fairless Hills. The first shopping center, the Levittown Shop-a-Rama, opened in 1953.

With the ascendancy of the automobile as the predominant transportation mode, the southern half of Bucks County became an urban/suburban landscape. Historical aerial photography from 1938, 1958, and 1971 (Penn Pilot 2010) documents this change as farms were converted to suburban neighborhoods. This trend continues to spread north along major highways including Interstate 78, which lies just north of the county line. According to the Bucks County Planning Commission, agricultural land (parcels greater than 20 acres and actively farmed) and undeveloped land (including rural residential parcels greater than 5 acres, but not agricultural) dropped from 65 percent of the land area in 1970 to 37 percent in 2009.

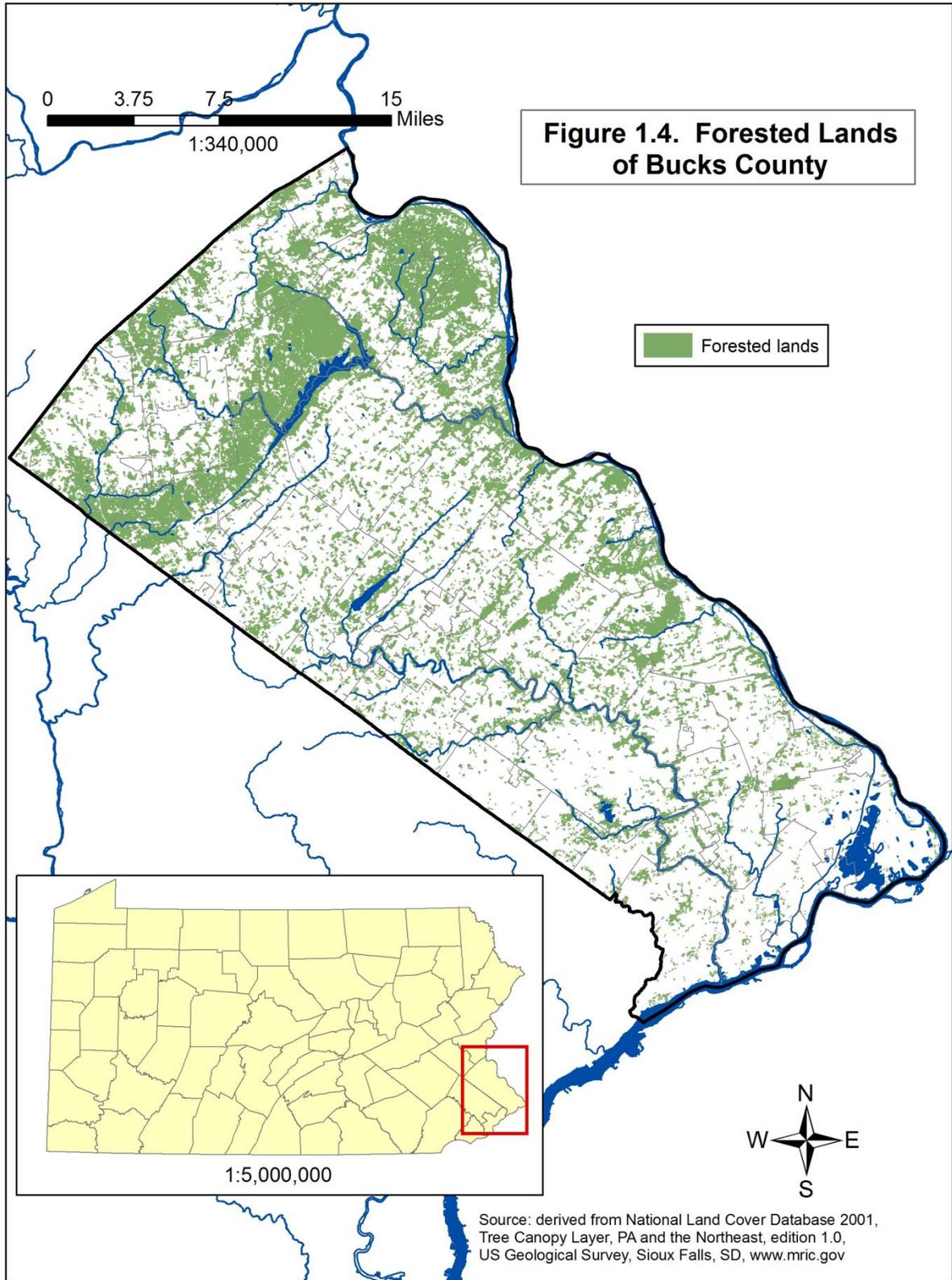
Location and Overall Condition of Remnants of Natural Vegetation

Land that could be farmed easily is also land that can be developed most readily for residential, commercial, or industrial uses. Consequently it is no surprise that the areas that remain forested in Bucks County today are associated with environmental conditions such as steep slopes, extremely rocky land, floodplains, and wetlands. Current aerial photography shows that areas of forest cover in upper Bucks County match areas of diabase geology. Stream corridors and associated steep slopes, floodplains, and wetlands also stand out as ribbons of green. Today forest covers 37 percent of the county's land surface (Figure 1.4).

Although there are a few large forest expanses remaining, many of the forest remnants are small patches representing farm woodlots left to grow on marginal or poorly drained sites or narrow strips along streams. Their small size and exposure to adjacent disturbed landscapes leaves them vulnerable to invasion by non-native species that have become part of the naturalized flora and fauna.

Some of the most damaging of these newcomers included gypsy moth (introduced at Medford MA in 1869), hemlock woolly adelgid, chestnut blight (introduced in New York in 1904), dogwood anthracnose, starling, house sparrow, and red fox. Invasive plants that have become widespread include multiflora rose (*Rosa multiflora*), Japanese knotweed (*Fallopia japonica*), mile-a-minute weed (*Persicaria perfoliata*), tree-of-heaven (*Ailanthus altissima*), Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*L. morrowii*), Japanese honeysuckle (*L. japonica*), Oriental bittersweet (*Celastrus orbiculatus*), porcelain-berry (*Ampelopsis brevipedunculata*), lesser celandine (*Ranunculus ficaria*), Japanese stiltgrass (*Microstegium vimineum*), Japanese barberry (*Berberis thunbergii*), garlic mustard (*Alliaria petiolata*), arthraxon grass (*Arthraxon hispidus*), and purple loosestrife (*Lythrum salicaria*). See further discussion of the ecological impacts of invasive species below.

Our largest extant native herbivore, the Virginia white-tailed deer, has also become a serious threat to the diversity and structure of native vegetation. Overabundance of deer developed after deer were restored to Pennsylvania following their near extirpation about 1900. The elimination of large predators followed by the enactment of overly protective hunting regulations has allowed the herd to grow to levels exceeding the carrying capacity of native ecosystems.



The result is forests stripped of herbaceous plants, shrubs, and seedling and sapling trees as well as constant damage to agricultural and residential plantings. See further discussion of the ecological implications of deer overabundance below.

Open Space Programs

Federal – The northern part of Bucks County is included in a region designated as the Highlands by the United States Forest Service. The region, which extends from southern New York across New Jersey to eastern Pennsylvania, has remained largely forested and serves as an important source of water and other natural benefits. The Highlands Coalition, composed of federal, state and local organizations, has the goal of protecting and enhancing the sustainability of the Highlands region (Barnes 2010). In Bucks County the following sites have been identified as critical treasures of Pennsylvania’s Highlands: Cooks Creek Watershed, Durham Mine/Mine Hill/Rattlesnake Hill, Haycock Mountain, Quakertown Swamp, Rapp Creek Watershed, Rock Hill, Tincum Creek Watershed, Tohickon Creek Watershed, and Unami Creek/Ridge Valley Creek.

Regional – The Regional Green Plan produced by Green Space Alliance identified four areas in Bucks County for the preservation of large areas of contiguous open space including the Delaware River, Neshaminy Headwaters, Neshaminy Corridor, and the Bucks County Agricultural Heritage Area (Green Space Alliance 2010).

Bucks County – In 1997 Bucks County voters approved \$59 million bond referendum, which set the stage for a 10-year program to preserve open space. Municipalities were required to develop open space plans and the first Natural Areas Inventory was prepared (Rhoads and Block 1999). The inventory identified and ranked locations of rare plants, animals, and natural communities for preservation. The 18 priority #1 sites from the earlier inventory are listed in Table 1.8, locations are shown in Figure 1.5.

Table 1.8 Highest Priority Sites from 1999 Natural Areas Inventory

Site name	municipality
Black Ditch County Park	Bristol Twp.
Braided channel Islands	Tincum Twp.
Buckingham Mountain	Buckingham Twp.
Cooks Creek watershed	Springfield and Durham Twps.
Delhaas Woods	Bristol Twp.
Durham Mine/Mine Hill/Rattlesnake Hill	Durham Twp.
Five Mile Woods	Lower Makefield Twp.
Head of the Estuary	Falls Township
Money Island	Falls Twp.
Neshaminy State Park	Bristol and Bensalem Twps.
Nockamixon Cliffs	Nockamixon Twp.
PennRyn Woods/Delaware River Access	Bensalem Twp.
Quakertown Swamp	East Rockhill, West Rockhill, and Richland Twps.
Rapp Creek/Lake Warren/Coffman Hill	Nockamixon and Bridgeton Twps.
Ridge Valley Creek	West Rockhill Twp.
Rohm and Haas Woods	Bristol Twp.
Tincum Creek watershed	Tincum and Nockamixon Twps.
Lower Tohickon Creek	Bedminster, Tincum, and Plumstead Twps.

A second bond referendum, approved by the voters in 2007, added \$87 million to the open space protection effort. The program has four areas of land preservation: natural areas, municipal open space, farmland preservation, and parkland. As of December 2010 a total of 19,420 acres has been protected (Table 1.9, Figure 1.6).

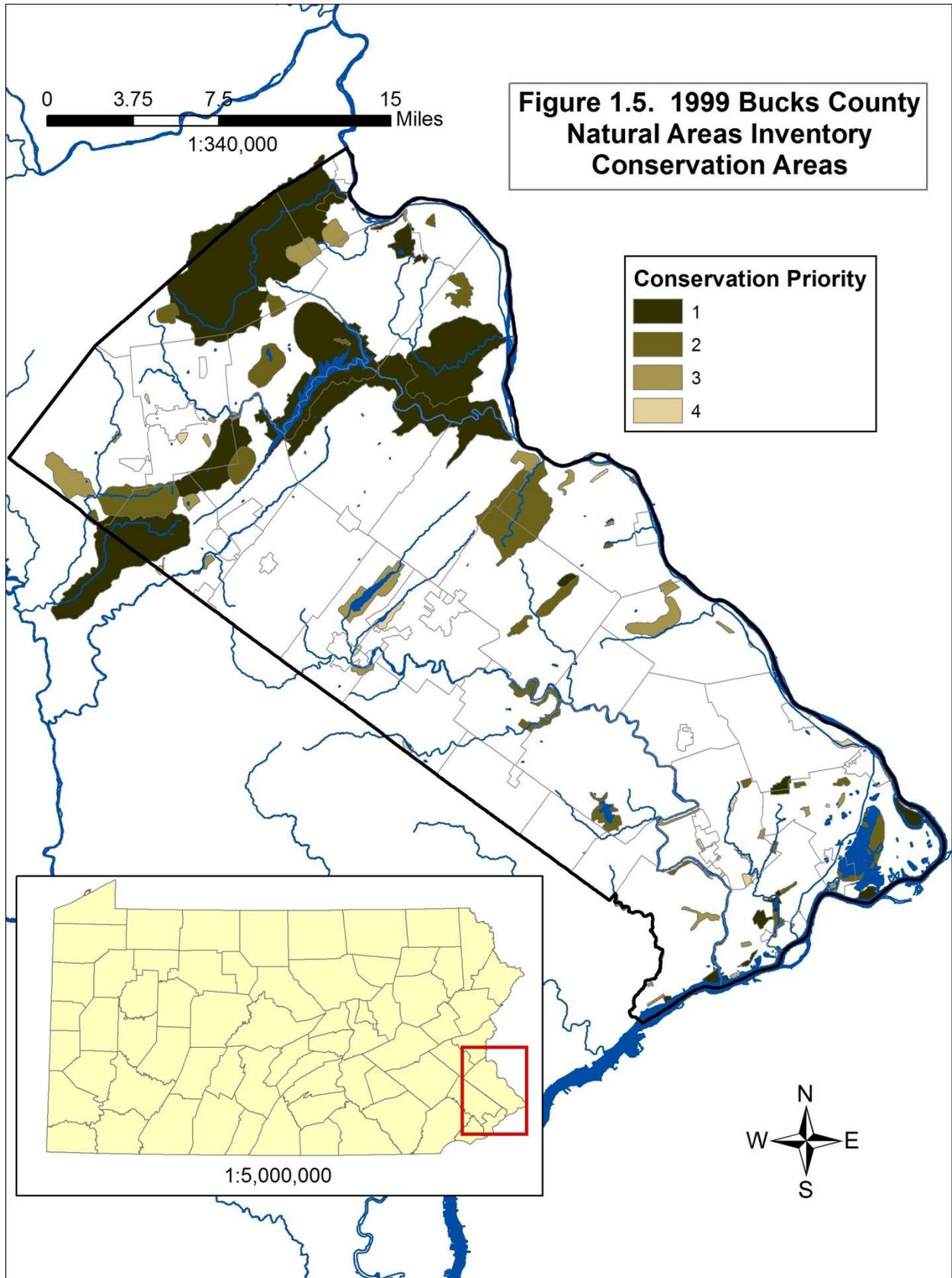
Bucks County ranks second in amount of open space protected in the 5-county southeastern Pennsylvania region (Economy League of Greater Philadelphia 2010). The report cites 79.4 square miles protected out of a total area of 607.4 square miles, or 13.1 percent. Chester County is first with 19.1 percent (144.7 square miles) protected.

Table 1.9 Acres Protected by the Bucks County Open Space Program 1997-2010

<i>category</i>	<i>acres</i>
natural areas	3,608
municipal open space	2,883
farmland preservation	11,729
parkland	1,200
total	19,420



Photo by Allison Hamilton, BCPC



Ecological Concepts

Forest Fragmentation and Habitat Islands

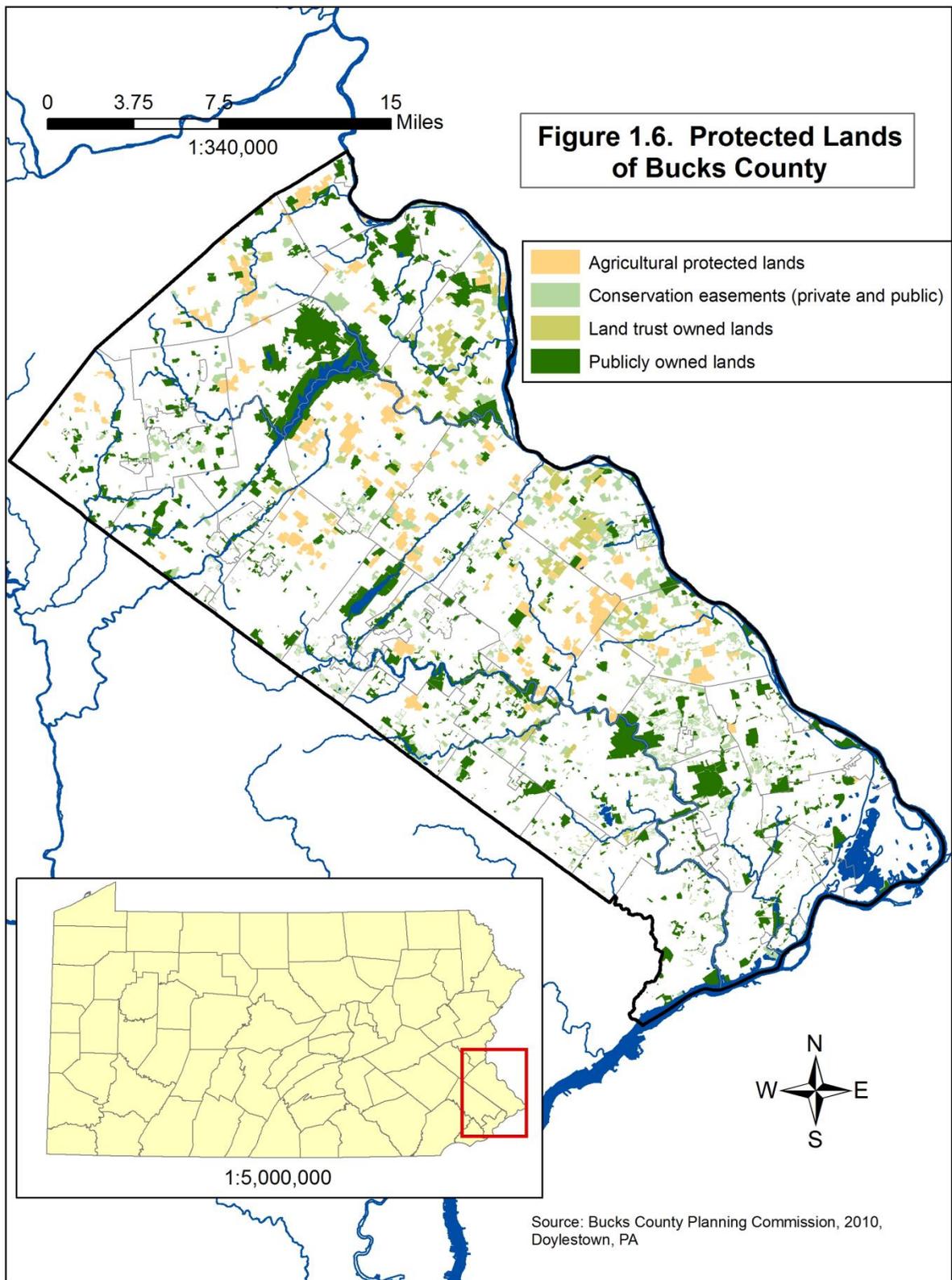
The land surface of Bucks County was at one time nearly completely covered with forest. Native Americans cleared small fields adjacent to their villages to grow corn and other crops and burned the forest undergrowth to facilitate hunting. But it wasn't until the arrival of European settlers that forest removal began in earnest, driven by the need for wood for building material and fuel, as well as land clearance for agriculture. By the early 1800s, forest cover remained only in areas unsuitable for farming. Aerial photography from 1937—1947 (Penn Pilot 2010) shows an agrarian landscape with forest cover restricted to stream valleys, steep slopes, and boulder-strewn areas of diabase geology. Isolated farm woodlots representing localized areas of poor drainage or high water table are also visible. That pattern continues today (Figure 1.4).

The pattern is similar to that described in a study of suburban areas surrounding Wilmington, Delaware. The only forests older than 100 years were on rock fields and steep slopes. Successional growth on marginal lands on which agriculture had been abandoned accounted for an increase in forest cover from only 5 percent in 1890 to 22 percent by 1990 (Matlack1997). Close examination of historical aerial photography of Bucks County also reveals abandonment of agriculture and subsequent re-vegetation of marginal lands (Penn Pilot 2010).

However, as agricultural land in the County continues to be converted to housing and/or commercial uses, the potential for restoration of extensive areas of forest on well-drained uplands decreases. The resulting pattern of land use continues to restrict forest cover to riparian strips and steep or rocky areas. The influence of diabase geology on land use in upper Bucks County is readily visible in current aerial photography. Even though scattered houses have been built in the woods, extensive forest cover remains in areas of diabase rock such as Haycock Mountain, Coffman Hill and parts of the Unami Creek watershed (Figures 1.2, and 1.4).

Forest fragmentation leads to the isolation of small populations of plants and animals in habitat islands. Reduced breeding opportunities and restricted gene flow are serious problems that can result, especially in organisms with restricted mobility. Plants with limited seed dispersal and/or localized pollen movement are also vulnerable, as are reptiles, amphibians, and small mammals such as shrews.

Furthermore, the theory of island biogeography (McArthur and Wilson 1967) demonstrates that island size and proximity to similar habitat islands affect the number of species an area will support. The smaller the island and the more isolated, the fewer species present.



Edge Effects

Forest edges differ from true forest interior habitat in several ways. For example, more light and wind reach the forest floor causing warming and drying. Soil moisture and relative humidity are lower as a result. Snow loads and wind throw are greater. Invasive plant species penetrate the boundary and are often concentrated in the forest edge where they compete with native species (Cadenasso and Pickett 2000; Brothers and Springarn 1990). On the other hand, some native species benefit from the greater light availability at the forest edge; for example, flowering dogwood (*Cornus florida*) blooms more prolifically at the edge although it also occurs throughout the forest understory.

How far the edge effect extends into the forest varies with the type of forest, the age of the forest, the exposure, and the time since the edge was created. Old edges where understory plants have created a wall of foliage from the ground to the lowest branches of the canopy trees, have less impact than newly created edges. North-facing edges are less impacted by light penetration than south or west-facing edges.

Estimates of the depth of penetration of edge-related changes in habitat range from 500 meters (1500 feet) to 5 m (15 feet). We calculated forest interior areas for each landscape using aerial photography to delineate forested areas and applying a 50-meter (164 feet) buffer from the forest edge. In interpreting those numbers, it must be kept in mind that a parcel completely surrounded by forest may be 100% forest interior, but if surrounding lands are cleared, the forest interior area will shrink accordingly.

Another question arises as to what constitutes a significant break in forest continuity. A house surrounded by an acre or two of mowed and landscaped grounds within a large forest matrix may not be a serious interruption for forest birds. However, that could change if domestic cats were present. Furthermore, landscape plants such as winged euonymus or discarded garden residue can serve as sources of invasion. A narrow country road with trees overarching is not a barrier to birds, but could be a serious impediment to salamanders, which need to travel to and from vernal pools where they breed.

Sources and Sinks

Birds are affected by forest area. The Brown-headed Cowbird, a nest parasite of many songbird species, preferentially inhabits forest edges. Other generalist predators including domestic cats, raccoons, opossums, and crows are also more abundant near edges. The forest interior on the other hand, provides favorable habitat for birds such as Scarlet Tanager, Wood Thrush, American Redstart, Black-and-white Warbler, Worm-eating Warbler, Eastern Wood Pewee, Pileated Woodpecker, and Barred Owl (Crossley 1999).

Sources and Sinks

“For a given species, good quality habitats yield a demographic excess (natality > mortality), and are designated as ‘source’. Lower quality habitats yield a demographic deficit (mortality > natality); these are designated as ‘sink’ and may not persist without immigration from sources.

It is important to identify source habitats for conservation or management, even if they represent but a small fraction of the landscape. Preserving only sink habitats will probably produce population extinction.”

Dias 1996

Large tracts of interior forest such as Coffman Hill, Haycock Mountain, and the Unami Creek landscape serve as source areas that support bird populations throughout the region. Due to high rates of breeding success, young birds from these “source” areas spread out into the surrounding landscape seeking breeding territories of their own. Often they must settle for less favorable sites, referred to as “sinks,” where they experience higher mortality. Only because of the continual outflow from large forested source areas can residents throughout the county continue to experience high bird diversity in their neighborhoods.

Bats are also area sensitive, requiring large forest tracts for foraging and summer roosting habitat.

Corridors and Connectivity

One way of mitigating some of the isolating effects of forest fragmentation is to connect smaller tracts with a network of wildlife corridors. Corridors can achieve several purposes: allowing daily or seasonal movement of wildlife to and from breeding and/or feeding areas, allowing genetic exchange among small populations in fragmented habitats, allowing movement in response to environmental change or natural disasters, and allowing replenishment of populations from other areas. Recent research has documented increases in plant species richness, pollen movement and fruit set, pollen transfer by butterflies, and seed dispersal by birds in habitat patches connected by corridors compared to isolated patches of the same size (Tewkesbury et al. 2002; Levey et al. 2005; Townsend and Levey 2005;)

A recent study found that corridors could be effective in promoting dispersal of butterflies even if the corridors did not support resident populations (Haddad and Tewkesbury 2005). Research on the movements of winter resident bird species revealed that chickadees were equally likely to travel through forest habitat or hedgerows (corridors), but less likely to cross openings (St. Clair et al. 1998).

It has been suggested that corridors might also serve as dispersal channels for invasive plants. However, in the study on species richness mentioned above, although the number of native species increased in connected patches, there was no detectable effect on the number of exotic species.

Rivers, streams, and associated riparian areas often form natural corridors linking larger habitat patches while at the same time protecting water quality and providing recreation opportunities. Other landscape features that can serve to enhance connectivity include roadside vegetation, fencerows, trail corridors, greenways, and greenbelts.

While ideally a corridor should provide habitat continuity, in some situations it may be desirable to design a corridor to meet the needs of a specific organism or group of organisms. An example of this type could be a culvert under a busy road designed to allow amphibians to move between upland forest and lowland breeding areas.

Riparian corridors as habitat - Riparian corridors are also habitat for a variety of plants and animals. Floodplain trees such as sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), box-elder (*Acer negundo*), honey-locust (*Gleditsia triacanthos*), and slippery elm (*Ulmus rubra*) line streambanks throughout the county.

Floodplains are also the setting for a seasonal succession of wildflowers from the early spring display of trout lilies (*Erythronium americanum*) to the graceful flowering stems of lizard's-tail (*Saururus cernuus*) along the water's edge, and finally the brilliant red of cardinal flower (*Lobelia cardinalis*).

Birds that are dependent on riparian habitat along the larger streams and rivers include several species that are rare in the county. Back-crowned Night-heron and Yellow-crowned Night-Heron are rare riparian specialists. Yellow-throated Warbler nests in large sycamore trees along rivers and streams. Green Heron, Great Blue Heron, Belted Kingfisher, Wood Duck, and Warbling Vireo are other species that are found in riparian habitats.

Invasive Species

Among the changes that have occurred in the natural landscapes of Bucks County are those brought about by the deliberate or accidental introduction of non-native species. Chestnut blight, caused by a fungus, was first found in Bronx, NY in 1904. It spread rapidly, soon reaching Pennsylvania. Efforts to stop it were unsuccessful and the American chestnut (*Castanea dentata*), once the most abundant forest tree in Pennsylvania (Ilick 1923), was reduced to minor status. Sprouts from old root crowns still can be found, but usually fall victim to the disease before reaching flowering or fruiting age.

Insects and Other Invertebrates

The gypsy moth entered North America at Medford, Massachusetts in 1869. It too, spread quickly and continues to go through periodic cycles of abundance in which serious defoliation leading to death of trees can occur. Oaks, hemlocks, and hickories are particularly susceptible. Another introduced insect pest that is affecting forest composition is the hemlock woolly adelgid, a sucking insect that is causing mortality of hemlock trees throughout eastern Pennsylvania. Other introduced insect pests that threaten to impact us locally are the emerald ash borer and the Asian longhorn beetle. The emerald ash borer has reached central Pennsylvania in is spreading eastward (DCNR 2010).

Earthworms, once considered indicators of healthy soil, have become too abundant in many areas (Hendrix et al. 2008). The problem has arisen where non-native earthworms have invaded floodplains and spread into all but the driest upland areas. Accidentally introduced beginning with the arrival of the earliest colonists and subsequently by fishermen when they discarded unused bait, the worms churn the soil and deplete the leaf litter, reducing opportunities for seeds to germinate and increasing erosion. Salamanders, which feed on soil invertebrates that normally inhabit leaf litter, are affected due to reductions in their food source. Bare soil with a surface layer of 2—3 inches of worm castings has become commonplace, especially on floodplains and adjacent lower slopes. Forest soils are normally important sinks for carbon, but when earthworms consume all the leaf litter that function, too, decreases.

The rapid consumption of forest floor leaf litter by non-native worms is altering soil chemistry as well as soil structure. Forest ecosystems normally depend on fungi to gradually break down litter and release nutrients. Worms shift the microbial component of the soil away from a

system based on fungi to one in which bacteria dominate. Soil pH is raised in the process. Research in New Jersey has linked higher densities of non-native earthworms and two invasive plants (Japanese stiltgrass and Japanese barberry) to alterations in nitrogen cycling in the soil.

Plants

Invasive, non-native plants are another serious environmental problem. Introduced species such as Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), mile-a-minute (*Persicaria perfoliata*), Japanese knotweed (*Fallopia japonica*), Japanese stiltgrass (*Microstegium vimineum*), Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*L. morrowii*), Japanese honeysuckle (*L. japonica*), Norway maple (*Acer platanoides*), winged euonymus (*Euonymus alatus*), tree-of-heaven (*Ailanthus altissima*), arthraxon grass (*Arthraxon hispidus*), and many more are found throughout the county.

A recent study revealed that disturbance (especially loss of canopy cover) and propagule pressure are the most important predictors of invasion (Eschtruth and Battles 2009). Riparian areas are especially 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 and a constant source of seeds and other propagules that are carried in from upstream sources and spread by floodwaters.

Ecological impacts - Invasive plants compete with native species for space and resources. They 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 sugar maple (Wyckoff and Webb 1996; Webb et al. 2000). 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 (Schmidt and Whelan 1999).

A butterfly, the West Virginia white, is threatened by the abundance of the non-native garlic mustard, which competes with toothwort (*Cardamine concatenata*), 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 (Plant Conservation Alliance 2010).

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 princess tree (*Paulownia tomentosa*), all non-native terrestrial species, resulted in reduced survival in mayfly nymphs compared to litter of white ash, hickory, and American beech (Sweeny 1993). 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 (Kourtev et al. 1998; 1999). Garlic mustard has recently been found to suppress the growth of forest trees by inhibiting fungi in the soil that form beneficial associations with the trees' roots known as mycorrhizae (Wolfe and Kironomos 2005; Stinson et al. 2006).

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 (*Rubus phoenicolasius*). In addition deer have been shown to serve as dispersers of seed of non-native species including autumn olive (*Elaeagnus umbellata*) and honeysuckle (Williams and Ward 2006).

Management strategies - Management of invasive plants must take into consideration such issues as the ability of seeds to remain viable in the soil for a number of years (the seed bank), as well as the constant influx of seeds or other propagules from outside the target area. The most effective strategy is to target species that have just begun to invade an area, removing them before a local seed bank can build up.

Another important consideration is the importance of maintaining an intact forest canopy. Although some invasives can grow in the shade, most will decline and eventually disappear if the canopy remains intact.

The dumping of garden refuse in forested areas is the source of some invasions. Garden waste often contains seeds, plant fragments, or even entire plants that can take root and compete with native forest species. Groundcovers such as Japanese pachysandra (*Pachysandra terminalis*), English ivy (*Hedera helix*), or periwinkle (*Vinca minor*) can be particularly damaging, as they are shade tolerant and spread aggressively. We recommend signs at access points to publicly owned open space to educate people about this problem and discourage the practice of discarding garden refuse in the woods.

Some non-native invasive plants are so widespread and pervasive that control in all but a very limited area is impossible. Lesser celandine, garlic mustard, and Japanese stiltgrass are in this category. There are signs that multiflora rose, which also grows everywhere, may be on the decline due to rose rosette, a lethal virus disease that is spread by mites.

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 local residents to view wildlife, it also brings problems. The lack of large predators, and limited hunting opportunities have allowed deer to multiply in suburban areas. Damaged crops and nibbled home landscaping are frequent sights. Increased incidence of Lyme disease is another result of deer overabundance. Lyme disease is caused by the bite of deer ticks; approximately 20 percent of all deer ticks carry the bacteria which causes Lyme disease.

The impact of overabundant deer on forested areas is more than a backyard nuisance; it constitutes a serious ecological problem. Throughout the county, forested areas show the effects of depletion (or even elimination) of shrub layers and forest floor plants. Some especially vulnerable species, including showy wildflowers, have been lost completely. At many sites a browse line is visible, resulting from severe browsing of all vegetation below a height of five

feet. The forest canopy is also affected; while mature trees are out of reach of hungry deer and continue to produce seeds, seedling and sapling trees, which represent the future of the forest, are very vulnerable to both browsing and buck rub (damage caused by mature male deer scraping their antlers against saplings). Many Bucks County forests currently show little or no regeneration of canopy or understory trees as a result. Very rocky areas that are relatively inaccessible to deer, such as those that exist on some diabase ridges, may continue to support diversity that has been lost in more accessible forest areas.

Vivid demonstrations of what is being lost in forest structure and species diversity are provided by sites at which fences have been erected to exclude deer. At Bowman's Hill Wildflower Preserve a fence was built in 1993 to protect the collection of native plants. The contrast between the condition of the vegetation inside and outside the fence is dramatic. Similar contrasts are present on several private properties where landowners have erected deer enclosure fences.

Loss of forest structure and regeneration potential also affect the ability of forest stands to sequester carbon. More carbon is stored in forest communities that retain maximum vertical complexity including well-developed understory, shrub, and ground-level herbaceous layers.

Overbrowsing 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 overbrowsing was shown to affect the diversity of birds in a ten-year study in northwestern Pennsylvania (deCalesta 1994). Birds that nest on the ground (such as Ovenbirds) or in the shrub or understory layers are most vulnerable.

In addition, over browsing by deer is thought to be the cause of decline of the Baltimore checkerspot butterfly due to reduction in turtlehead (*Chelone glabra*) plants, the larval food plant of the butterfly (Fairhill Nature Center 2010). Turtlehead also grows along stream banks and in wetlands throughout Bucks County.

Reducing deer numbers is critical to preserving forest habitat and the diversity of species in Bucks County and throughout the region and the state. Several recent publications address current options for managing deer in suburban areas:

Latham, Roger Earl, Jan Beyea, Merlin Benner, Cindy Adams Dunn, Mary Ann Fajvan, Ronald R. Freed, Marrett Grund, Stephen B. Horsley, Ann Fowler Rhoads, and Bryon P. Shissler. 2005. *Managing White-tailed Deer in Forest Habitat from an Ecosystem Perspective, Pennsylvania Case Study*. Report by the Deer Management Forum for Audubon Pennsylvania and the Habitat Alliance, Harrisburg, PA.
http://pa.audubon.org/deer_report.html.

Rosenberry, C. S., J. T. Fleegle, and B. D. Wallingford. 2009. *Management and Biology of White-tailed Deer in Pennsylvania 2009-2018*. Pennsylvania Game Commission, 2001 Elmerton Ave., Harrisburg, PA 17110.
<http://www.portal.state.pa.us/portal/server.pt/community/deer/11949>.

Curtis, P. D. and J. R. Boulanger. 2010. Cornell University Integrated Deer Research and Management Study, 2007-2010 Progress Report. Cornell University, Ithaca, NY.
<http://wildlifecontrol.info/deer/Documents/2010%20IDRM%20Progress%20Report.pdf>.

Forest Management

While there may be a few old trees scattered on steep slopes, there is no true old growth forest remaining in Bucks County. The county's forest resources have been tapped again and again for timber and firewood. Existing forests represent second- or third-growth forests that have regenerated following partial or complete cutting or land clearance. Timber harvesting continues to be an option open to owners of forested land.

There are several approaches to harvesting trees. One is a **clearcut** that removes all trees at once. Another approach is **highgrading** in which the largest and most commercially valuable trees are cut. This can change the species composition over time, as few seed trees of desirable species remain to restock the forest. In a third option, known as a **selection cut**, selected larger canopy trees are removed and the understory is thinned to allow shade intolerant species, such as oaks, to regenerate.

Regardless of the method used, current conditions that affect the ability of the forests to regenerate must be considered. Deer overabundance is a major factor. Deer are consuming seedling and sapling trees, leaving little opportunity for replacement plants to reach the understory or the canopy. On some sites sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*), which are less preferred by deer, are the only species able to grow past the browse line. This will cause a shift in species composition from the mixed hardwood canopy now present in many areas.

At the same time that native species are being inhibited by deer, invasive species, which deer generally do not eat, benefit from canopy openings created when mature trees are harvested. Dense thickets of Oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*) and wineberry (*Rubus phoenicolasius*) have resulted in some areas, further interfering with tree regeneration. Japanese stiltgrass (*Microstegium vimineum*) often colonizes haul roads and staging area.

On large tracts, branches and other debris left on the ground when trees are harvested may provide some temporary shelter for tree seedlings and saplings. While this may permit regrowth of some fast growing trees, it does not address the long-term concerns about forest structure and species diversity. Shrubs and wildflowers never outgrow the reach of deer.

Grassland Management

Populations of grassland birds are present at sites included in two of the conservation landscapes selected as focal areas in this study, and efforts are underway to establish habitat in two more.

Declining populations of grassland birds is a problem throughout the eastern United States according to a study by the National Audubon Society. Eastern meadowlark has declined 72 percent since 1967. Field Sparrow and grasshopper Sparrow are down 68 percent and 65 percent respectively; Horned lark has declined 56 percent in the same time interval. While most grassland species are centered in the prairie states of the Midwest, local populations have persisted in habitats ranging from native grasslands to pastures, hayfields, and early successional old fields (Table 1.10).

Table 1.10 Grassland Birds of Pennsylvania

(sources: McWilliams and Brauning 2000; Cornell Laboratory of Ornithology 2010; Mass. Audubon 2010, Pennsylvania Natural Heritage Program 2010)

	Breeding habitat	Status
Barn owl	Farm buildings	declining
Bobolink	Short, dense cool season grasses <18"	
Eastern Meadowlark	Short, dense cool season grasses <18"	USFWS Management Concern
Dickcissel	Hayfields; stripmines	
Field Sparrow	Overgrown fields and pastures	
Grasshopper Sparrow	Mixture of warm season grasses	declining
Henslow's Sparrow	Meadows; uncut hayfields	Audubon watchlist, USFWS Mgt. Concern
Horned Lark	Bare ground or sparse vegetation	
Loggerhead Shrike	Open fields and pastures with hedgerows or scattered trees	declining
Northern Bobwhite	Grass; croplands; abandoned fields	declining
Savannah Sparrow	Mixture of warm season grasses; hayfields	
Upland Sandpiper	Short, thin vegetation	State imperiled,, proposed threatened in PA, Audubon watchlist
Vesper Sparrow	Bare ground or sparse vegetation	Declining

Grasslands types in Pennsylvania

Pennsylvania, located in the eastern deciduous forest zone, is primarily a forested state. Natural grasslands are limited to sites such as serpentine barrens, limestone barrens, scoured riverine flats, and marshes where conditions for tree growth are limited by low nutrient availability, droughty soils, constant disturbance, or standing water. There is historical evidence that frequent burning by Native Americans increased the extent of open habitat. Early successional old fields, another source of grassland bird habitat, are a temporary stage in the re-colonization of abandoned farmland by forest. In the absence of repeated disturbance such as mowing, grazing, or burning, they will succeed to forest. With the exception of a few wetland areas, Bucks County does not contain naturally occurring grasslands.

Drawing on herbarium records and field experience, Dr. Roger Latham has produced a list of over 400 native grasses and forbs (wildflowers) historically found in grasslands and meadows across Pennsylvania (Latham and Thorne 2007).

Warm season grasses - In recent years there has been a great deal of interest among natural resource managers in the establishment of native warm season grasses on former agricultural fields and pastures. Warm season grasses have evolved physiological adaptations that allow them to grow most vigorously under the intense sunlight and hot, dry conditions characteristic of mid-summer. These species grow slowly early in the growing season, and do not reach their full

development until late summer. Of the 255 species of grasses known to occur in Pennsylvania, 100 are warm season grasses and 65 of those are native species. Of the 155 species of cool season grasses, 100 species are native.

The Natural Lands Trust has developed effective methods for establishing robust stands of warm season grasses at several sites. However, it is not clear that these stands are good grassland bird habitat. Most grassland birds require openings where they can forage, perform mating displays, or move quickly to avoid predators. A dense stand of tall grass may not meet those needs. Efforts to introduce wildflowers into the plots have not been successful due to the high stem density of grasses. Part of the problem may be that former agricultural fields are just too fertile and too moist to produce the type of grassland that would develop naturally on more nutrient-limited sites.

Many pastures and hayfields in our area contain a mixture of cool season grasses, warm season grasses, and forbs. In order for hayfields to be good bird habitat though, mowing schedules must be adjusted to avoid the nesting season. In pastures, although light grazing probably helps to maintain openings that provide habitat structure needed by birds, heavy grazing would be destructive.

At present, meadows and hayfields at several locations in Bucks County support small, marginal breeding populations of Eastern Meadowlarks, Bobolinks, and Grasshopper Sparrows.

Habitat Size Considerations

Just as some forest species are dependent on forest interior conditions, grassland birds too, are sensitive to the size of tracts of grassland habitat. Nearby hedgerows, adjacent woodlots, or even individual trees provide perches for raptors such as Cooper's Hawks, which are frequent predators of grassland birds.

Grassland birds can be divided into two breeding types based on habitat, bare ground breeders and grassy meadow breeders. Those that require bare or sparsely vegetated ground generally need larger blocks of land since their primary defense against predators is camouflage. Hawks can spot and attack a bird from a greater distance on bare ground than in a grassy field where a bird can drop out of sight into the vegetation. Therefore, bare ground breeders like the Upland Sandpiper, Horned Lark and the Vesper Sparrow need larger fields than grassy meadow breeders like the Savannah Sparrow, Grasshopper Sparrow, Field Sparrow, Eastern Meadowlark, and Bobolink. To provide security from attack by a hawk for bare ground breeders, the safe part of the field should be at least 300 yards from the nearest tree.

Less than ideal grassland tracts may serve as marginal habitat, but over the long run populations will be dependent on immigration from more favorable source areas. More research is needed to determine what constitutes good grassland bird habitat in our area and how to establish and maintain it.

Conclusions

The thirteen conservation landscapes identified in this report are described in Chapters 2—14. Together they comprise a total of 162,996 acres, 41 percent of the area of Bucks County. The high number of acres reflects the inclusion of the entire area of the Atlantic Coastal Plain and two complete exceptional value (EV) watersheds, Tinicum Creek and Cooks Creek. Most of the landscapes are located along riparian corridors and on rocky diabase ridges in areas that retain extensive forest cover. Each landscape includes a core area of protected land, but much more remains to be done to preserve the natural resources in these landscapes.

The landscapes include large forested tracts, stream corridors, wetlands, known sites of rare plants and animals, and areas of high natural biological diversity. This report includes several significant additions to the list of reptiles and amphibians known to occur in Bucks County. Surveys conducted by Marlin Corn and associates documented the presence of three species not previously known to be present in Bucks County: eastern spadefoot toad, eastern mud turtle, and yellowbelly slider. They found extant populations of eastern mud turtle and New Jersey chorus frog, species that were thought to be extirpated from Pennsylvania.

Although we have done our best to characterize the landscapes and document the important natural resources they contain, much more remains to be done. Surveys of additional areas are needed as well as ongoing monitoring to determine the effectiveness of management actions.

References

- Barnes, Martina C., compiler. 2010. Highlands Regional Study: Connecticut and Pennsylvania, 2010 Update. United States Department of Agriculture, Forest Service, Northeast Area State and Private Forestry, Newtown Square, PA.
- Bailey, Robert G. 1995. *Descriptions of the Ecoregions of the United States*, second edition. Miscellaneous Publication 1391. United States Department of Agriculture, Washington, DC
- Benner, Walter M. 1932. *The Flora of Bucks County*. Published by the author, Philadelphia, PA.
- Braun, E. Lucy. 1950. *Deciduous Forests of Eastern North America*. The Blakiston Company, Philadelphia, PA.
- Brauning, Daniel W. 1992. *Atlas of Breeding Birds in Pennsylvania*. University of Pittsburgh Press, Pittsburgh, PA.
- Brothers, Timothy S. and Arthur Springarn. 1990. Forest fragmentation and alien plant invasion of Central Indiana old-growth forests. *Conservation Biology* 6(1): 91-100.
- Butcher, Gregory S. and David K. Niven. 2007. Combining data from the Christmas Bird Count and the Breeding Bird Survey to determine the continental status and trends of North American birds. National Audubon Society, <http://stateofthebirds.audubon.org/cbid/>, website accessed 6/15/2007.

Caldenasso, M. L. and S. T. A. Pickett. 2000. Effect of edge structure on the flux of species into forest interiors. *Conservation Biology*. 15(1): 91-97.

Carnegie Museum of Natural History, Powder Mill Preserve. Second Pennsylvania Breeding Bird Atlas. <http://www.carnegiemnh.org/powdermill/atlas/index.html>, website accessed 10 November 2010.

Commonwealth of Pennsylvania. 2006. Pennsylvania Code Title 25. Environmental Protection, Chapter 93. Water Quality Standards. Department of Environmental Protection, Harrisburg, PA. Accessed on line at www.pacode.com 5 December 2010.

Cornell Laboratory of Ornithology. 2010. <http://www.birds.cornell.edu/allaboutbirds/birdguide/>. Website accessed 5 December 2010.

Crossley, Gary J. 1999. *A Guide to Critical Bird Habitat in Pennsylvania*. Pennsylvania Audubon Society, Harrisburg, PA.

Cuff, David J., William J. Young, Edward K. Muller, Wilbur Zelinsky, and Ronald F. Abler. 1989. *The Atlas of Pennsylvania*. Temple University Press, Philadelphia, PA.

Damschen, Ellen I., Nick M. Haddad, John L. Orrock, Joshua J. Tewkesbury, and Douglas L. Levey. 2006. Corridors increase plant species richness at large scales. *Science* 313: 1284-1286.

Day, Gordon M. 1953. The Indian as an ecological factor in the northeastern forest. *Ecology* 34(2): 329-346.

DeCalesta, D. S. 1994. Impact of white-tailed deer on songbirds within managed forests in Pennsylvania. *Journal of Wildlife Management* 58: 711-718.

deCoster, L. A. 1995. *The Legacy of Penn's Woods, a History of the Pennsylvania Bureau of Forestry*. Pennsylvania Historic and Museum Commission, Harrisburg, PA.

Department of Conservation and Natural Resources, Bureau of Forestry, Harrisburg, PA. Emerald Ash borer website, http://www.dcnr.state.pa.us/forestry/fpm_invasives_eab.aspx, website accessed 9 December 2010.

Dias, Paula C. 1996. Sources and sinks in population biology. *Trends in Ecology and Evolution* 11(8): 326-330.

Drummond, Mark A. and Thomas R. Loveland. 2010. Land use pressure and a transition to forest-cover loss in the eastern United States. *BioScience* 60(4): 286-298.
Economy League of Greater Philadelphia. 2010. The Economic Value of Protected Open Space in Southeastern Pennsylvania. Report submitted to GreenSpace Alliance and Delaware Valley Regional Planning Commission, Philadelphia, PA.

EPA - Environmental Protection Agency. 2003. Total Maximum Daily Load (TMDL) Assessment for the Neshaminy Creek Watershed in Southeast Pennsylvania, revised December 2003.

http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/NeshaminyCreek/NeshaminyCreekReport.pdf, website accessed 8 December 2010.

Eschtruth, Anne K. and John J. Battles. 2008. Acceleration of exotic plant invasion in a forested ecosystem by a generalist herbivore. *Conservation Biology* 32(2): 388-399.

Eschtruth, Anne K. and John J. Battles. 2009. Assessing the relative importance of disturbance, herbivory, diversity, and propagules pressure in exotic plant invasion. *Ecological Monographs* 79(2): 265-280.

Fairhill Nature Center. 2010. Baltimore Checkerspot Fact Sheet <http://www.fairhillnature.org/BaltCkspotFactSheet.pdf>, website accessed 10 December 2010.

Fike, Jean. 1999. *Terrestrial and Palustrine Plant Communities of Pennsylvania*. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Harrisburg, PA.

Fretz, Clayton D. 1905. Flora, Appendix pp. 3-54 in *History of Bucks County Pennsylvania*, 2nd edition, Vol. II. By W. W. H. Davis. A.E. Lear, Inc. Pipersville, PA.

Geyer, Alan R. and William H. Bolles. 1979. *Outstanding Scenic Geological Features of Pennsylvania*, Environmental Geology Report 7. Bureau of Topographic and Geologic Survey, Harrisburg, PA.

Geyer, Alan R. and J. Peter Wilshusen. 1982. *Engineering Characteristics of the Rocks of Pennsylvania*, Environmental Geology Report 1. Bureau of Topographic and Geologic Survey, Harrisburg, PA.

Gibbons, John F. III and Steven Schlossman. 1970. Rock Music. *Natural History* 79(10): 36-41.

Green Space Alliance, 1315 Walnut Street, Philadelphia, PA 19107. Regional Green Plan, <http://www.greenspacealliance.org/home/rgp.asp>, website accessed 7 December 2010.

Haddad, Nick M. and Joshua J. Tewkesbury. 2005. Low-quality habitat corridors as movement conduits for two butterfly species. *Ecological Applications* 15(1): 250-257.

Hardin, Garrett. 1968. The tragedy of the commons. *Science* 162: 1243-1248.

Hendrix, Paul F., Mac A. Callahan, Jr., John M. Drake, Ching-Yu Huang, Sam W. James, Bruce A. Snyder, and Weixin Zhang. 2008. Pandora's box contained bait: the global problem of introduced earthworms. *Annual Review of Ecology, Evolution, and Systematics* 39: 593-613.

- Hilty, Jodi A., William Z. Lidicker, Jr., and Adina M. Merenlender. 2006. *Corridor Ecology, The Science and Practice of Linking Landscapes for Biodiversity Conservation*. Island Press, Washington, DC.
- Hulse, Arthur C. 2002. *Final Report of the Pennsylvania Herpetological Atlas Project*. Wild Resources Conservation Program, Harrisburg, PA
- Ilick, Joseph S. 1923. *Pennsylvania Trees*, Bulletin 11. Pennsylvania Department of Forestry, Harrisburg, PA.
- Important Bird Areas Program. 2010. <http://pa.audubon.org/iba/>, website accessed 15 November 2010.
- Kitson, Kenneth. 1998. *Birds of Bucks County*. Bucks County Audubon Society, New Hope, PA.
- Kourtev, P. S., J. C. Ehrenfeld, and W. Z. Huang. 1998. Effects of exotic plant species on soil properties in hardwood forests of New Jersey. *Water, Air, and Soil Pollution* 105: 493-501.
- Kourtev, P. S., W. Z. Huang, and J. G. Ehrenfeld. 1999. Differences in earthworm densities and nitrogen dynamics in soils under exotic and native plant species. *Biological Invasions* 1: 237-245.
- Latham, Roger and James F. Thorne. 2007. *Keystone Grasslands, restoration and reclamation of native grasslands, meadows, and savannahs in Pennsylvania State Parks and State Game Lands*. Report submitted to the Wild Resources Conservation Program, Harrisburg, PA.
- Latham, Roger Earl, Jan Beyea, Merlin Benner, Cindy Adams Dunn, Mary Ann Fajvan, Ronald R. Freed, Marrett Grund, Stephen B. Horsley, Ann Fowler Rhoads, and Bryon P. Shissler, 2005. *Managing White-tailed Deer in Forest Habitat from an Ecosystem Perspective: A Pennsylvania Case Study*. Report by the Deer Management Forum for Audubon Pennsylvania and the Habitat Alliance, Harrisburg, PA.
- Levey, Douglas J., Benjamin M. Bolker, Joshua J. Tewkesbury, Sarah Sargent, and Nick M. Haddad. 2005. Effects of landscape corridors on seed dispersal by birds. *Science* 309: 146-148.
- MacArthur, R.H. and E.O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, NJ.
- Massachusetts Audubon. http://www.massaudubon.org/Birds_&_Beyond/grassland/index.php, website accessed 15 November 2010.
- Matlack, Glen R. 1994. Vegetation dynamics of the forest edge – trends in space and successional time. *Journal of Ecology* 82: 113-123.
- Matlack, Glenn R. 1997. Land use and forest habitat in the hinterland of a large city. *Journal of Biogeography* 24: 297-307.

McWilliams, Gerald M. and Daniel W. Brauning. 2000. *The Birds of Pennsylvania*. Cornell University Press, Ithaca, NY.

Meyboom, A. F. and R. C. Wallace. 1978. Occurrence and origin of ring-shaped dolerite outcrops in the Easter Cape Province and Western Transkei. *Transactions of the Geological Society of South Africa* 81: 95-99.

NOAA – National Oceanic and Atmospheric Administration. 2010. National Weather Service records for Neshaminy Falls, PA (366194).

National Park Service. 2010. Plant Conservation Alliance, Alien Plant Working Group, Garlic mustard Fact Sheet. <http://www.nps.gov/plants/alien/fact/alpe1.htm>, website accessed 10 December 2010.

PASDA - Pennsylvania Spatial Data Access, The Pennsylvania Geospatial Data Clearinghouse, Pennsylvania State University, University Park, PA. <http://www.pasda.psu.edu/>.

Penn Pilot, Pennsylvania Geological Survey. Historical Aerial Photographs of Pennsylvania. <http://pennpilot.psu.edu/>.

Pennsylvania Audubon, 100 Wildwood Way, Harrisburg, PA 17110. Pennsylvania's Important Bird Areas Program, <http://iba.audubon.org/iba/viewState.do?state=US-PA>, website accessed 5 November 2010.

Pennsylvania Fish and Boat Commission. 2007. http://sites.state.pa.us/PA_Exec/Fish_Boat/shad_schu.htm, website accessed 9 December 2010.

Pennsylvania Flora Database. 2010. Morris Arboretum of the University of Pennsylvania <http://paflora.org>.

PNHP - Pennsylvania Natural Heritage Program. <http://naturalheritage.state.pa.us>, website accessed 10 December 2010.

Rahmstorf, Stefan. 2010. A new view on sea level rise. *Nature reports climate change* 4: 44-45. <http://www.nature.com/climate/2010/1004/pdf/climate.2010.29.pdf>.

Rhoads, Ann Fowler and William McKinley Klein, Jr. 1993. *The Vascular Flora of Pennsylvania, Annotated Checklist and Atlas*. American Philosophical Society, Philadelphia, PA.

Rhoads, Ann Fowler and Timothy A. Block 1999. *Natural Areas Inventory of Bucks County, PA*. Bucks County Commissioners. Doylestown, PA.

Rhoads, Ann Fowler and Timothy A. Block 2000. *The Plants of Pennsylvania, an Illustrated Manual*. University of Pennsylvania Press, Philadelphia, PA.

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania, an Illustrated Manual, 2nd edition*. University of Pennsylvania Press, Philadelphia, PA.

Schmidt, Kenneth A., and Christopher J. Whelan. 1999. Effects of exotic *Lonicera* and *Rhamnus* on songbird nest predation. *Conservation Biology* 13(6): 1502-1506.

Second Pennsylvania Breeding Bird Atlas <http://bird.atlasing.org/Atlas/PA/Main>, website accessed 3 December 2010.

Shultz, Charles H. 1999. *The Geology of Pennsylvania*. Pennsylvania Geological Survey, Harrisburg, PA.

Socolow, Arthur A. 1980. *Geologic Map of Pennsylvania*. Bureau of Topographic and Geologic Survey, Harrisburg, PA.

St. Clair, Colleen Cassady, Marc Belisle, Andre Desrochers, and Susan Hannon. 1998. Winter responses of forest birds to habitat corridors and gaps. *Conservation Ecology [online]* 2(2): 13, www.consecol.org/vol2/iss2/art13/.

Stinson, Kristina A., Stuart A. Campbell, Jeff R. Powell, Benjamin E. Wolfe, Ragan M. Callaway, Giles C. Telen, Steven G. Hallett, Daniel Prati, and John N. Klironomos. 2006. *Public Library of Science Biology* 4(5): 1-5.

Sweeney, Bernard W. 1993. Effects of streamside vegetation on macroinvertebrate communities of White clay Creek in Eastern North America. *Proceedings of the Academy of Natural Sciences of Philadelphia* 144: 291-340.

Tewkesbury, Joshua J., Douglas J. Levey, Nick M. Haddad, Sarah Sargent, John L. Orrock, Aimee Weldon, Brent J. Danielson, Jory Brinkerhoff, Ellen I. Damschen, and Patricia Townsend. 2002. Corridors affect plants, animals, and their interactions in fragmented landscapes. *Proceedings National Academy of Sciences* 99(20): 12923-12926.

Thomas, Joseph. and I. S. Moyer. 1876. Plants Birds, and Mammals, Appendix pp. 3-62 in *History of Bucks County*, Vol. II. by W. W. H. Davis. W. W. H. Davis, Printer, Doylestown, PA.

Titus, J. G., D. E. Hudgens, D. L. Trescott, M. Craghan, W. H. Nuckols, C. H. Hershner, J. M. Kassakian, C. J. Linn, P.G. Merritt, T. M. McCue, J. F. O'Connell, J. Tanski, and J. Wang. 2009. State and local governments plan for the development of most land vulnerable to rising sea level along the U.S Atlantic coast. *Environmental Research Letters* 4 (doi:10.1088/1748-9326/4/4/044008).

Townsend, Patricia and Douglas J. Levey. 2005. An experimental test of whether habitat corridors affect pollen transfer. *Ecology* 86(2): 466-475.

United States Forest Service. 2006. www.na.fs.fed.us/highlands/, website accessed 10 December 2010.

Vickery, Peter D. and Peter W. Dunwiddie. 1997. *Grasslands of Northeastern North America*. Massachusetts Audubon Society, Lincoln, MA.

Webb, Sara L., Marc Dwyer, Christina K. Kaunzinger, and Peter H. Wyckoff. 2000. The myth of the resilient forest: case study of the invasive Norway maple. *Rhodora* 102(911): 332-354.

Wherry, Edgar T., John M. Fogg, and Herbert A. Wahl. 1979. *Atlas of the Flora of Pennsylvania*. Morris Arboretum of the University of Pennsylvania, Philadelphia, PA.

Williams, Scott C. and Jeffrey S. Ward. 2006. Exotic seed dispersal by white-tailed deer in southern Connecticut. *Natural Areas Journal* 26(4): 383-390.

Wolfe, Benjamin E. and John N. Klironomos. 2005. Breaking new ground: soil communities and exotic plant invasion. *BioScience* 55(6): 477-487.

Wyckoff, Peter H. and Sara L. Webb. 1996. Understory influence of the invasive Norway maple (*Acer platanoides*). *Bulletin of the Torrey Botanical Club* 123(3): 197-205.

Chapter 4

Cooks Creek Conservation Landscape

This conservation landscape includes the Bucks County portion of the watershed of Cooks Creek. Occupying an area of 17,107 acres, it extends across northern Bucks County from the mouth of Cooks Creek at Durham west to The Lookout (Figure 4.1). The Cooks Creek Landscape connects with the Delaware River Conservation Landscape.

While most of the Cooks Creek Landscape is within the Piedmont Physiographic Province, the northeastern corner of Bucks County includes portions of the Great Valley Section of the Ridge and Valley Physiographic Province and the Reading Prong Section of the New England Province (PASDA 2010; Figure 1.2).

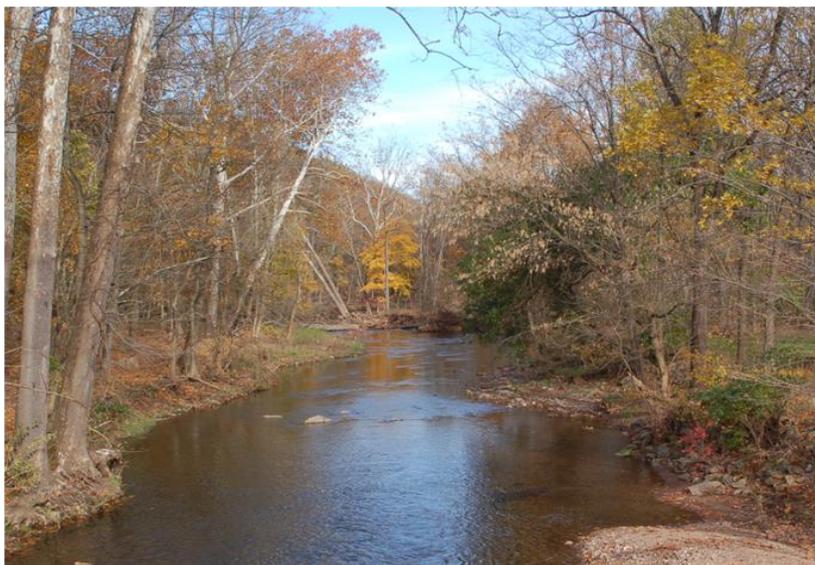
Description

Location

The Cooks Creek Conservation Landscape includes most of Durham and Springfield Townships (Figure 4.1). It incorporates the following sites from the 1999 Natural Areas Inventory: Cooks Creek, priority #1; Durham Mine, Mine Hill and Rattlesnake Hill, priority #1; and parts of The Lookout, priority 2; Buckwampum Mountain, priority #3; and Chestnut Hill, priority #3 (Figure 4.2).

Geology

The Monroe Border Fault, which was formed about 250,000 years ago, marks the boundary between the Triassic era Newark Basin to the south and much older rocks to the north (Shultz 1999). The fault is exposed in the road cut along Route 611 just south of Lehnenberg Road at the village of Monroe where there is a plaque on the rock marking the feature as a National Natural Landmark (Geyer and Bolles 1987).

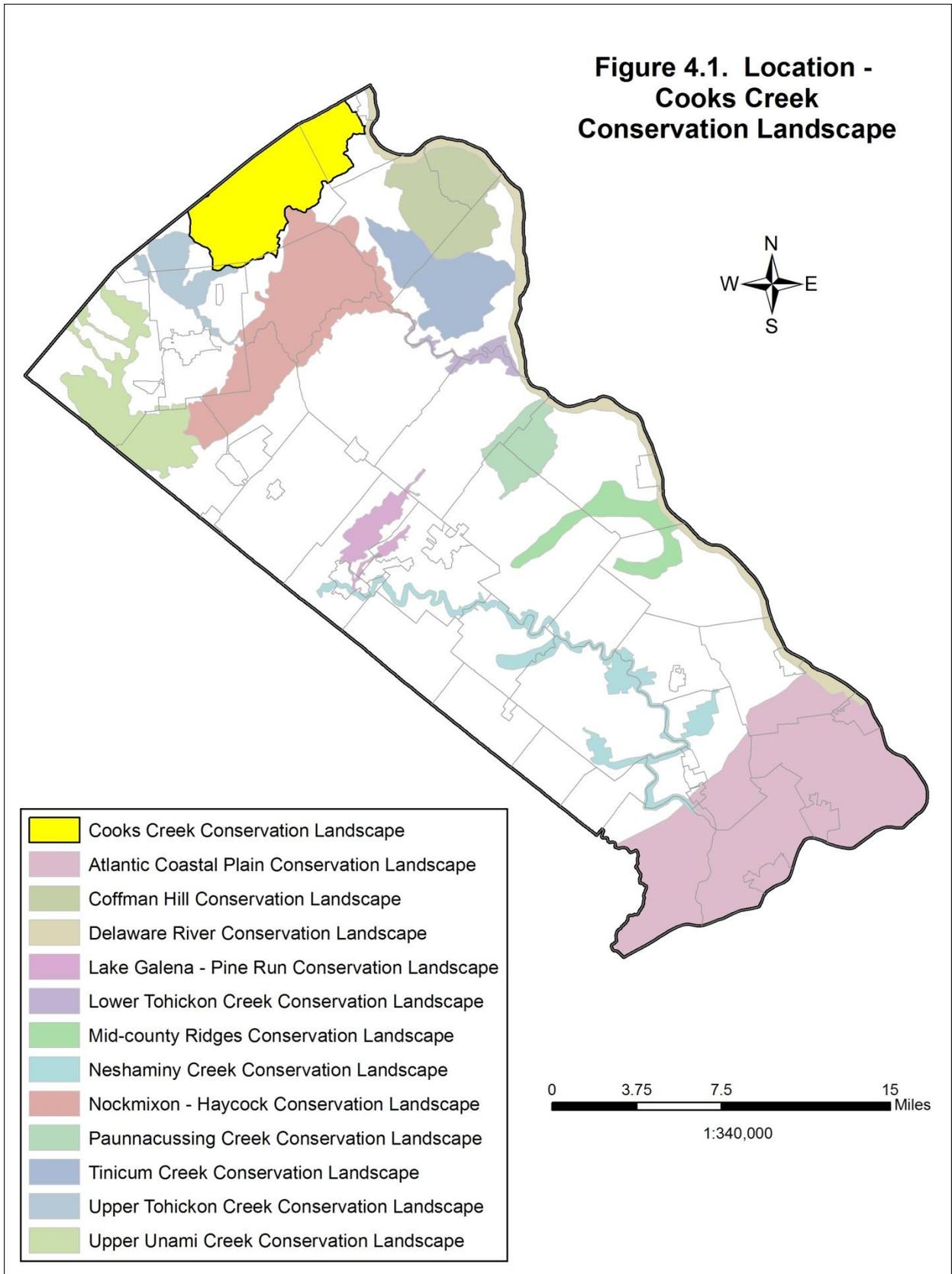


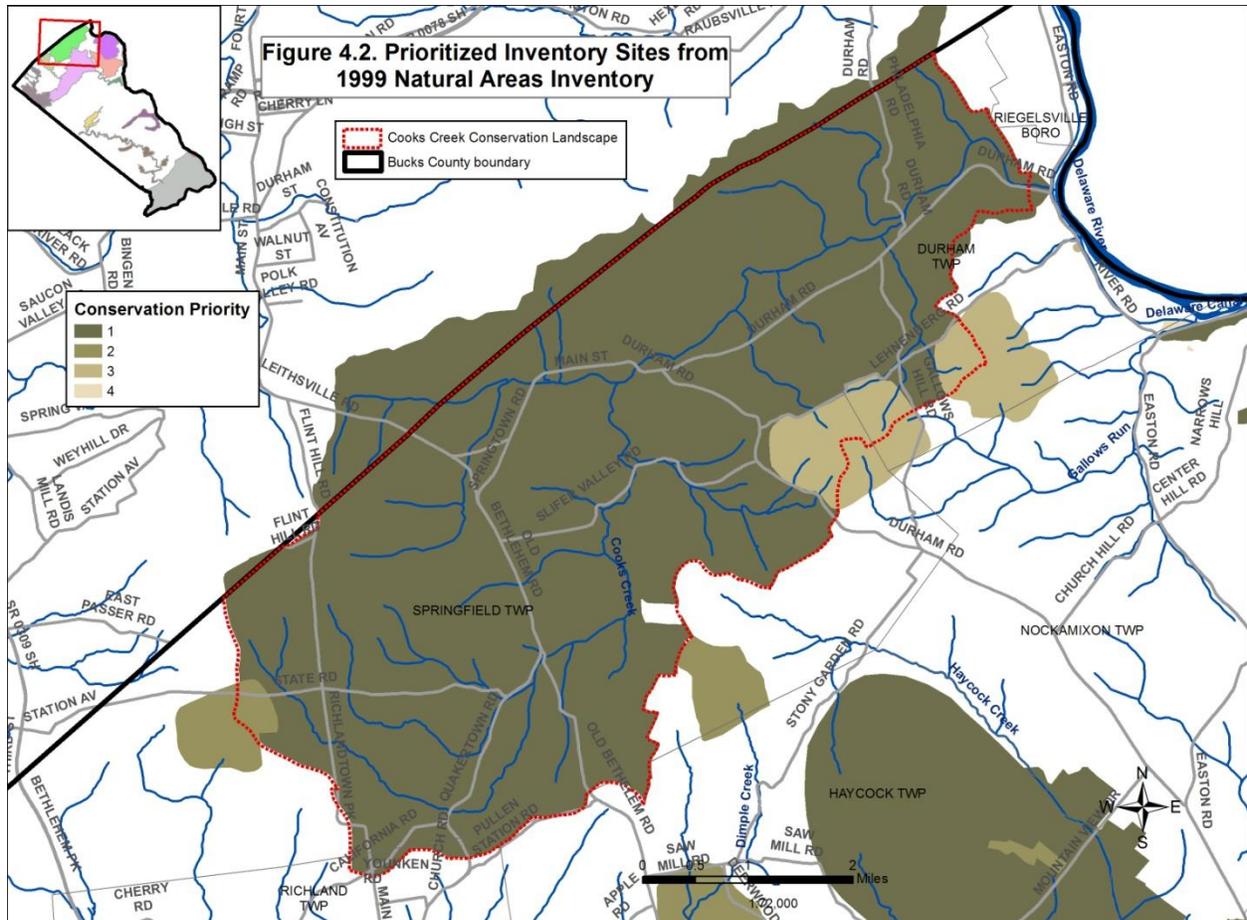
Cooks Creek looking downstream at Springtown

From the river valley the fault arcs across the northeastern corner of Bucks County crossing the border into Northampton County just west of Springtown.

South of the Border Fault the geology consists of Brunswick Formation, diabase, and Quartz fanglomerate typical of the northern Piedmont. To the north, the Reading Prong is characterized by metamorphic rocks including Hornblende gneiss, Felsic to mafic gneiss, and Hardyston Formation quartzite. The Great Valley section, by contrast, consists of dolomitic limestone of the Leithsville Formation (PASDA 2010; Figure 4.3).

**Figure 4.1. Location -
Cooks Creek
Conservation Landscape**

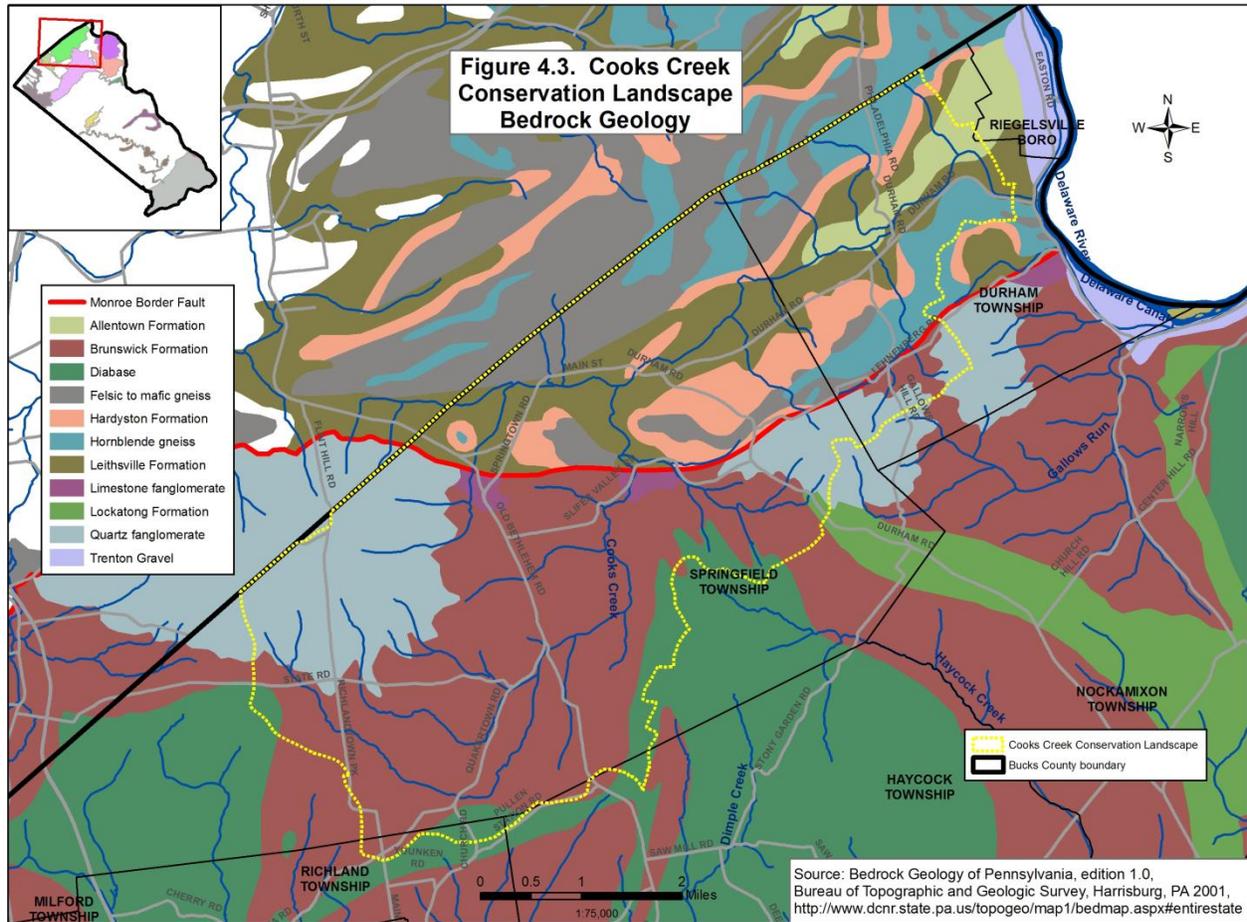




Rattlesnake Hill and Mine Hill, located along the Monroe Border Fault, were the sites of the iron mines which provided ore to Durham Furnace. Since the cessation of mining, the largest of these mines, Durham Mine in Rattlesnake Hill, has become what is thought to be the second largest bat hibernaculum in Pennsylvania. The mine entrance was gated in 2001 to prevent human recreational users from disturbing the hibernating bats.

Hydrology

Cooks Creek and its tributaries, a total of 47.8 stream miles, drain this landscape. Cooks Creek is classified as exceptional value, migratory fishes (EV, MF) by the Pennsylvania Department of Environmental Protection (Commonwealth of Pennsylvania 2010). Cooks Creek originates on the slopes of the diabase and Quartz fanglomerate hills along the border with Lehigh and Northampton Counties and flows east crossing into the dolomitic limestone of the Great Valley at Springtown. Springtown, which dates from the late 1700s, has long been recognized for its ample water resources arising from springs which contribute to the flow of Cooks Creek (McReynolds 1976). East of Springtown, numerous small streams that emanate from the gneiss hills of the Reading Prong further increase the flow of water in the creek.



Land Use

Although active agriculture has declined, land use patterns in Springfield Township still reflect its agrarian past. Today many of the farms in the valley of Cooks Creek have been converted to country estates. Areas of suburban-type residential development are few, despite the proximity to interstate highways such as I-78.



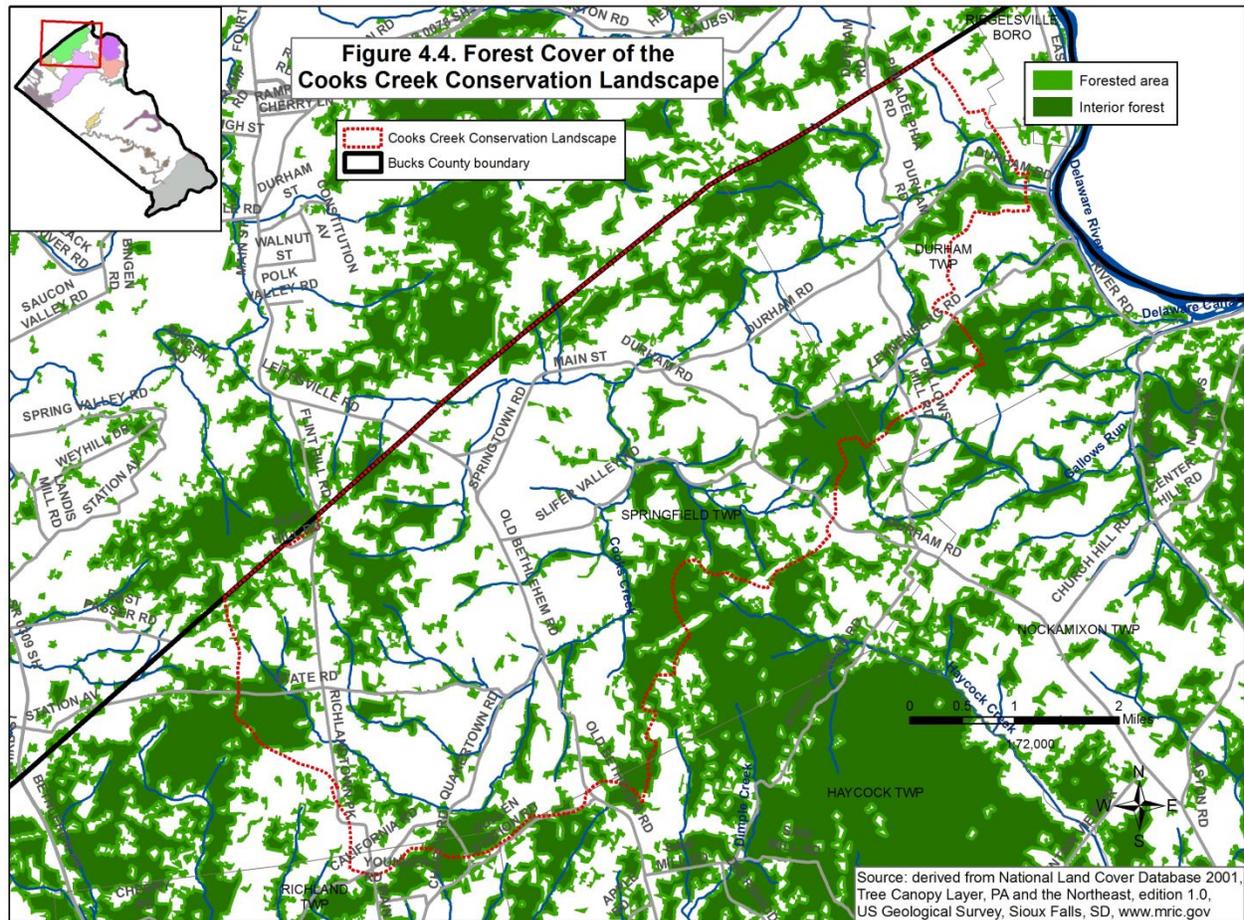
View of Cooks Creek valley from Funks Mill Road

The village of Durham, located along Cooks Creek in Durham Township, was the site of iron furnaces that operated from 1726 to 1912. The iron ore came from Durham Mine; limestone (dolomite), required for the processing of the ore, was quarried nearby. Durham Cave, located just north of the mouth of Cooks Creek, which was known as a natural wonder and tourist attraction in the early 1800s

(McReynolds 1976), was destroyed in the process. Although several subsequent industrial facilities have occupied the Durham furnace site at the mouth of Cooks Creek, today industry is a minor component of the local economy.

Vegetation

Forty-three percent of the Cooks Creek Landscape is covered with forest (Figure 4.4). Most of the valley of Cooks Creek was cleared for farming early on and remains in pasture and meadow. Forested areas are primarily on hilly or rocky lands that could not be farmed; however even these forests were cut repeatedly to provide charcoal to fuel the iron furnaces prior to the switch to anthracite coal in the mid 1800s.



Diabase, quartzite, and fanglomerate areas in the southern and western parts of the landscape are characterized by *red oak – mixed hardwood forest*. On slopes formed by gneiss geology of the Reading Prong, mid-successional forests dominated by tuliptree (*Liriodendron tulipifera*) are prominent.

At several locations along Cooks Creek and some of the tributaries there are extensive areas of *tussock sedge marsh* which are habitat for birds, reptiles, amphibians, and rare plants. Connectivity via the stream corridor is a critical feature of this habitat.

Birds

Two breeding colonies of Great Blue Herons were documented in the Cooks Creek Conservation Landscape in 2010.



Great Blue Heron Nest, Cooks Creek.

Reptiles and Amphibians

Several small populations of the federally threatened, state endangered bog turtle are known in the Cooks Creek Conservation Landscape. Maintenance of riparian corridors is essential to habitat connectivity. Other reptiles and amphibians documented in the area include 6 species of salamanders, 7 species of frogs and toads, 4 species of turtles, and 5 species of snakes (Table 4.1).

Table 4.1 Reptiles and Amphibians of the Cooks Creek Conservation Landscape

salamanders		PNHP status
Spotted Salamander	<i>Ambystoma maculatum</i>	
Red-spotted Newt	<i>Notophthalmus viridescens viridescens</i>	
Northern Redback Salamander	<i>Plethodon cinereus</i>	
Northern Dusky Salamander	<i>Desmognathus fuscus fuscus</i>	
Northern Red Salamander	<i>Psuedotriton ruber ruber</i>	
Northern two-lined Salamander	<i>Eurycea bislineata</i>	
frogs and toads		
American Toad	<i>Anaxyrus americanus americanus</i>	
Spring Peeper	<i>Pseudacris crucifer</i>	
Gray Treefrog	<i>Hyla versicolor</i>	
Wood Frog	<i>Lithobates sylvaticus</i>	
Pickerel Frog	<i>Lithobates palustris</i>	
Green Frog	<i>Lithobates clamitans melanota</i>	
Bullfrog	<i>Lithobates catesbeianus</i>	
turtles		
Common Snapping Turtle	<i>Chelydra serpentina serpentina</i>	
Bog Turtle	<i>Glyptemys muhlenbergii</i>	endangered in PA, threatened under Endangered Species Act
Eastern Box Turtle	<i>Terrapene carolina carolina</i>	
Painted Turtle	<i>Chrysemys picta /marginata</i>	
snakes		
Northern Water Snake	<i>Nerodia sipedon sipedon</i>	
Eastern Garter Snake	<i>Thamnophis sirtalis sirtalis</i>	
Northern Ringneck Snake	<i>Diadophis punctatus edwardsii</i>	
Northern Black Racer	<i>Coluber constrictor constrictor</i>	
Eastern Milksnake	<i>Lampropeltis triangulum</i>	

Critical Features

The Cooks Creek landscape contains the most extensive area of dolomitic limestone in Bucks County. Cooks Creek is classified as an exceptional value stream by DEP (Commonwealth of Pennsylvania 2010); The Fish and Boat Commission list it as a Class A trout fishing stream due to the presence of a native population of brown trout. Wetlands along the stream corridor provide habitat for several rare elements of the flora and fauna (Table 4.2).

Table 4.2 Critical Resources of the Cooks Creek Conservation Landscape

<i>feature</i>	<i>location</i>	<i>status*</i>
bog turtles	several small populations	G3/S1S2/PE/LT
Great Blue Heron rookeries	two	S3S4B, S4N
bat hibernaculum	Durham Mine	second largest in PA
native brown trout population	Cooks Creek	Class A waters - PAFBC
Cooks Creek	headwaters to mouth	Exceptional Value stream
Monroe Border Fault	geological boundary	National Natural Landmark
PNHP-listed plants		
<i>Carex crinita</i> var. <i>brevicrinus</i>	wetland nr. Springtown	S1, PE
<i>Carex prairea</i>	wetland nr. Springtown	S2, PT
<i>Carex tetanica</i>	wetland nr. Springtown	S2, PT

*PAFPC=Pennsylvania Fish and Boat Commission
 S1=critically imperiled in Pennsylvania, S2=imperiled in Pennsylvania,
 PE=Pennsylvania endangered, PT=Pennsylvania threatened;
 LT=listed as threatened under the Endangered Species Act
 Source: PNHP 2010, Commonwealth of PA 2010

Durham Mine – Durham Mine is the site of a bat hibernaculum believed to be the second largest in the state. It is located on a forested slope close to the Delaware River corridor. A check of the bats at Durham Mine on April 5, 2010 found that white nose syndrome, a fungal disease that has devastated bat populations throughout the northeast, was present. The biologists estimated that approximately 50 percent of the 8,000—10,000 bats had succumbed to the disease (Clark 2010). Four species of bats have been documented at Durham Mine: little brown bat, long-eared bat, pipistrel, and small-footed bat.

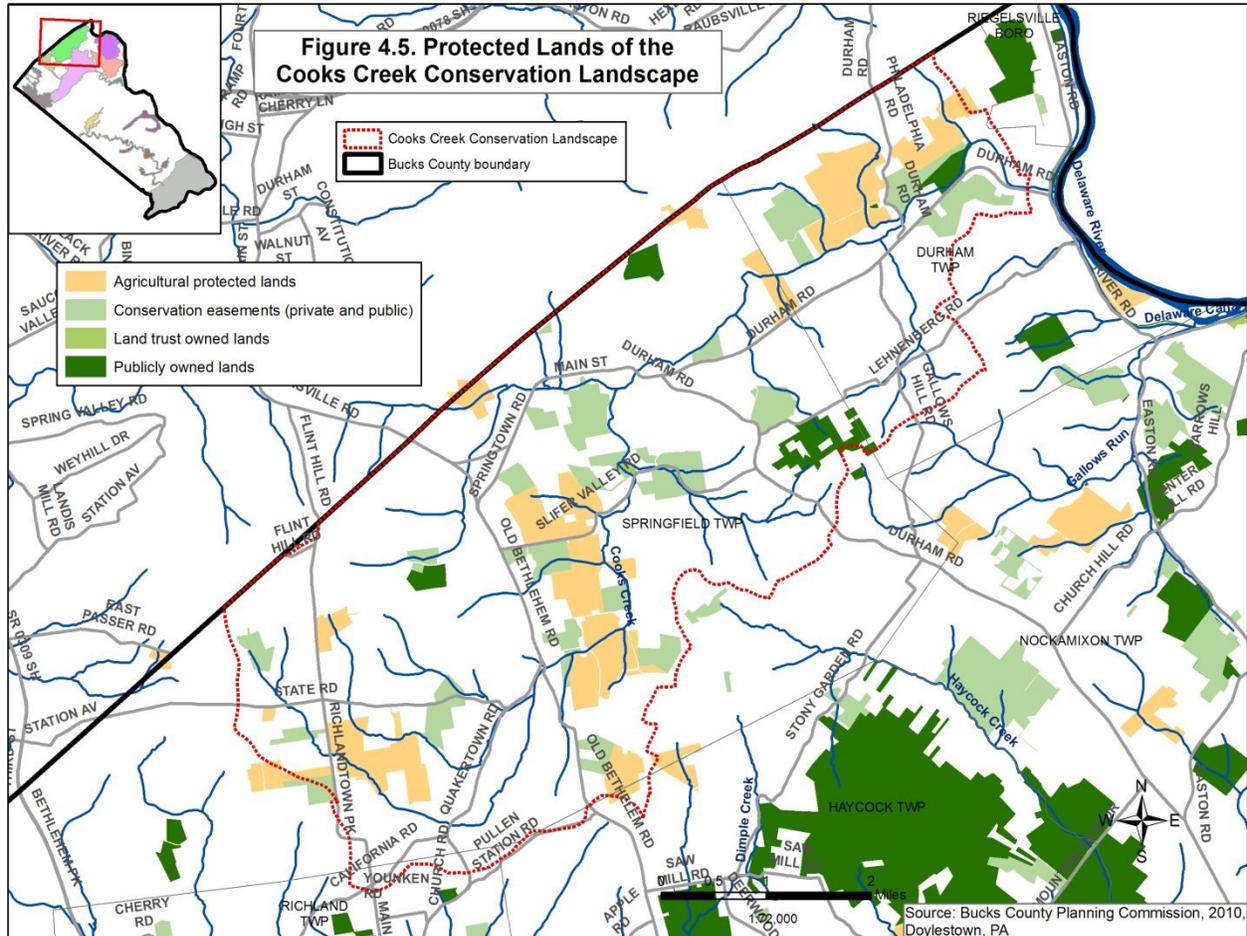
White-nose Syndrome

In the four years since was first detected in bat populations in New York State, white nose syndrome has caused extensive mortality in hibernacula throughout the northeast. A recent study concluded that there is a 99 percent probability that little brown bat, our most common species, will become regionally extinct within the next 16 years (Frick et al. 2010).

Recommendations

Land protection

Preservation of the Cooks Creek watershed is a high priority for Heritage Conservancy of Doylestown. The conservancy has succeeded, with the help of state, county, and township funding, in placing almost 1,000 acres under conservation easements (Figure 4.5).



Currently there is very little publicly-accessible land in the Cooks Creek Landscape. Bucks County owns a 56-acre parcel that includes 0.56 mile along Cooks Creek in Durham Township, but there are no facilities for public access. Limited access to Cooks Creek is available at the mouth from Delaware Canal State Park. Bucks County also owns 142 acres on Buckwampum Mountain but it is largely landlocked with no formal public access (Figure 4.5).

Springfield Township's recently updated Open Space Plan emphasized protection of significant natural features, open space, farmland, and scenic resources (Marshall 2010). The township has protected 1,900 acres of land in the past ten years, in part with funds from a \$5 million township open space bond.

We recommend that the highest priority for land protection within the landscape be on riparian areas and adjacent wetlands. The continuity of riparian habitat is important to maintaining stream quality and habitat connectivity. Providing public access to Cooks Creek should also be encouraged. The 15-acre property on the west side of Route 611 at Cooks Creek is a brownfield site that should be cleaned up and added to Delaware Canal State Park to improve access to Cooks Creek.

Management

At present 68 percent of stream miles in the landscape have forested buffers at least 50 feet wide on both sides. Protection of existing riparian buffers should be a high priority. Encouraging landowners to restore forested buffers where they are lacking should also be a goal.

References

Clark, Kathryn Finegan. Durham bats are back on the prowl for insects. Bucks County Herald, 15 April 2010, Doylestown, PA.

Commonwealth of Pennsylvania, Pennsylvania Code, Chapter 93. Water Quality Standards. <http://www.pacode.com/secure/data/025/chapter93/chap93toc.html> , accessed 19 November 2010.

Frick, W. F., J. F. Pollock, A. C. Hicks, K. E. Langwig, D. S. Reynolds, G. G. Turner, C. M. Butchkowski, T. H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. *Science* 329: 679-682.

Geyer, Alan R. and William H. Bolles. 1987. Outstanding Scenic Geologic Features of Pennsylvania, Environmental Geology Report 7, Part 2. Commonwealth of Pennsylvania. Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Harrisburg, PA.

McReynolds, George. 1976. *Place Names in Bucks County*, 2nd edition. The Bucks County Historical Society, Doylestown, PA.

Marshall, Jeffrey L. 2010. Springfield Township Open Space Plan Update. Heritage Conservancy, Doylestown, PA.

PASDA - Pennsylvania Spatial Data Access, The Pennsylvania Geospatial Data Clearinghouse, Pennsylvania State University, University Park, PA. <http://www.pasda.psu.edu/>.

Pennsylvania Natural Heritage Program, Department of Conservation and Natural Resources, Harrisburg, PA. <http://www.naturalheritage.state.pa.us/AllSpecies.aspx>, accessed 7 December 2010.



Northern red salamander

Appendix A Native and Naturalized Plants of Bucks County

Source: Pennsylvania Flora Database, Botany Department, Morris Arboretum of the University of Pennsylvania.
Philadelphia, PA

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Abutilon theophrasti</i>	Malvaceae	Butter-print	I	none	UPL	HA
<i>Acalypha gracilens</i>	Euphorbiaceae	Slender mercury	N	none	N	HA
<i>Acalypha rhomboidea</i>	Euphorbiaceae	Three-seeded mercury	N	none	FACU-	HA
<i>Acalypha virginica</i>	Euphorbiaceae	Three-seeded mercury	N	none	FACU-	HA
<i>Acanthopanax sieboldianus</i>	Araliaceae	Fiveleaf aralia	I	none	N	SD
<i>Acer campestre</i>	Sapindaceae	Hedge maple	I	none	N	SD
<i>Acer negundo</i>	Sapindaceae	Box-elder	N	none	FAC+	TD
<i>Acer nigrum</i>	Sapindaceae	Black maple	N	none	FACU	TD
<i>Acer pensylvanicum</i>	Sapindaceae	Moosewood	N	none	FACU	TD
<i>Acer platanoides</i>	Sapindaceae	Norway maple	I	none	UPL	TD
<i>Acer pseudoplatanus</i>	Sapindaceae	Sycamore maple	I	none	N	TD
<i>Acer rubrum</i>	Sapindaceae	Red maple	N	none	FAC	TD
<i>Acer saccharinum</i>	Sapindaceae	Silver maple	N	none	FACW	TD
<i>Acer saccharum</i>	Sapindaceae	Sugar maple	N	none	FACU	TD
<i>Acer spicatum</i>	Sapindaceae	Mountain maple	N	none	FACU-	SD
<i>Achillea millefolium</i>	Asteraceae	Common yarrow	I	none	FACU	HP
<i>Acorus calamus</i>	Acoraceae	Sweet flag	I	none	OBL	HP
<i>Actaea pachypoda</i>	Ranunculaceae	Doll's-eyes	N	none	UPL	HP
<i>Actaea racemosa</i>	Ranunculaceae	Black snakeroot	N	none	N	HP
<i>Adiantum pedatum</i>	Polypodiaceae	Northern maidenhair	N	none	FAC-	HP
<i>Adlumia fungosa</i>	Papaveraceae	Allegheny-vine	N	none	N	VB
<i>Aegopodium podagraria</i>	Apiaceae	Goutweed	I	none	FACU	HP
<i>Aesculus flava</i>	Sapindaceae	Yellow buckeye	N	none	N	TD
<i>Aesculus hippocastanum</i>	Sapindaceae	Horse-chestnut	I	none	N	TD
<i>Aethusa cynapium</i>	Apiaceae	Fool's parsley	I	none	N	HA
<i>Agalinis auriculata</i>	Orobanchaceae	Eared false-foxglove	N	PE/PE	N	HA
<i>Agalinis purpurea</i>	Orobanchaceae	False-foxglove	N	none	FACW-	HA
<i>Agalinis tenuifolia</i>	Orobanchaceae	Slender false-foxglove	N	none	FAC	HA
<i>Agastache nepetoides</i>	Lamiaceae	Yellow giant-hyssop	N	none	FACU	HP
<i>Agastache scrophulariifolia</i>	Lamiaceae	Purple giant-hyssop	N	none	N	HP
<i>Ageratina altissima</i> var. <i>altissima</i>	Asteraceae	White-snakeroot	N	none	N	HP
<i>Agrimonia gryposepala</i>	Rosaceae	Agrimony	N	none	FACU	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Agrimonia microcarpa</i>	Rosaceae	Small-fruited agrimony	N	none	N	HP
<i>Agrimonia parviflora</i>	Rosaceae	Southern agrimony	N	none	FACW	HP
<i>Agrimonia pubescens</i>	Rosaceae	Downy agrimony	N	none	N	HP
<i>Agrimonia rostellata</i>	Rosaceae	Woodland agrimony	N	none	FACU	HP
<i>Agrimonia striata</i>	Rosaceae	Roadside agrimony	N	none	FACU-	HP
<i>Agrostemma githago</i>	Caryophyllaceae	Corn cockle	I	none	N	HA
<i>Agrostis canina</i>	Poaceae	Brown bent	I	none	FACU	HP
<i>Agrostis capillaris</i>	Poaceae	Rhode Island bent	I	none	N	HP
<i>Agrostis eliottiana</i>	Poaceae	Bentgrass	I	none	N	HA
<i>Agrostis gigantea</i>	Poaceae	Redtop	I	none	FACW-	HP
<i>Agrostis hyemalis</i>	Poaceae	Hairgrass	N	none	FAC	HP
<i>Agrostis perennans</i>	Poaceae	Autumn bent	N	none	FACU	HP
<i>Agrostis scabra</i>	Poaceae	Fly-away grass	N	none	FAC	HP
<i>Agrostis stolonifera</i> var. <i>palustris</i>	Poaceae	Carpet bentgrass	I	none	FACW	HP
<i>Ailanthus altissima</i>	Simaroubaceae	Tree-of-heaven	I	none	FACU-	TD
<i>Albizia julibrissin</i>	Fabaceae	Mimosa	I	none	N	TD
<i>Aletris farinosa</i>	Melanthiaceae	Colic-root	N	TU/PE	FAC	HP
<i>Alisma subcordatum</i>	Alismataceae	Broad-leaved water-plantain	N	none	OBL	HP
<i>Alisma triviale</i>	Alismataceae	Broad-leaved water-plantain	N	PE/PE	OBL	HP
<i>Alliaria petiolata</i>	Brassicaceae	Garlic-mustard	I	none	FACU-	HB
<i>Allium canadense</i>	Alliaceae	Wild onion	N	none	FACU	HP
<i>Allium oleraceum</i>	Alliaceae	Field garlic	I	none	N	HP
<i>Allium sativum</i>	Alliaceae	Garlic	I	none	N	HP
<i>Allium tricoccum</i>	Alliaceae	Ramp	N	none	FACU+	HP
<i>Allium vineale</i>	Alliaceae	Field garlic	I	none	FACU-	HP
<i>Alnus glutinosa</i>	Betulaceae	Black alder	I	none	FACW-	TD
<i>Alnus serrulata</i>	Betulaceae	Smooth alder	N	none	OBL	SD
<i>Alopecurus aequalis</i>	Poaceae	Short-awned foxtail	N	N/PT	OBL	HP
<i>Alopecurus carolinianus</i>	Poaceae	Carolina foxtail	N	none	FACW	HA
<i>Alopecurus pratensis</i>	Poaceae	Meadow foxtail	I	none	FACW	HP
<i>Amaranthus albus</i>	Amaranthaceae	Tumbleweed	N	none	FACU	HA
<i>Amaranthus blitoides</i>	Amaranthaceae	Prostrate pigweed	I	none	N	HA
<i>Amaranthus blitum</i>	Amaranthaceae	Amaranth	I	none	N	HA
<i>Amaranthus cannabinus</i>	Amaranthaceae	Salt-marsh water-hemp	N	PR/PR	OBL	HA
<i>Amaranthus caudatus</i>	Amaranthaceae	Love-lies-bleeding	I	none	N	HA
<i>Amaranthus cruentus</i>	Amaranthaceae	Blood amaranth	I	none	N	HA

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Amaranthus hybridus</i>	Amaranthaceae	Pigweed	I	none	N	HA
<i>Amaranthus powellii</i>	Amaranthaceae	Amaranth	I	none	N	HA
<i>Amaranthus retroflexus</i>	Amaranthaceae	Green amaranth	I	none	FACU	HA
<i>Amaranthus spinosus</i>	Amaranthaceae	Spiny amaranth	I	none	FACU	HA
<i>Ambrosia artemisiifolia</i>	Asteraceae	Common ragweed	N	none	FACU	HA
<i>Ambrosia trifida</i>	Asteraceae	Giant ragweed	N	none	FAC	HA
<i>Amelanchier arborea</i>	Rosaceae	Shadbush	N	none	FAC-	TD
<i>Amelanchier canadensis</i>	Rosaceae	Shadbush	N	N/PE	FAC	SD
<i>Amelanchier laevis</i>	Rosaceae	Smooth serviceberry	N	none	N	TD
<i>Amelanchier obovalis</i>	Rosaceae	Coastal juneberry	N	TU/PE	FACU	SD
<i>Amelanchier stolonifera</i>	Rosaceae	Low juneberry	N	none	FACU	SD
<i>Amianthium muscaetoxicum</i>	Melanthiaceae	Fly-poison	N	none	FAC	HP
<i>Ammannia coccinea</i>	Lythraceae	Tooth cup	N	PE/PT	OBL	HA
<i>Amorpha fruticosa</i>	Fabaceae	False-indigo	N	none	FACW	SD
<i>Ampelopsis brevipedunculata</i>	Vitaceae	Porcelain-berry	I	none	N	VW
<i>Amphicarpaea bracteata</i>	Fabaceae	Hog peanut	N	none	FAC	VP
<i>Anagallis arvensis</i>	Myrsinaceae	Scarlet pimpernel	I	none	UPL	HA
<i>Anaphalis margaritacea</i>	Asteraceae	Pearly everlasting	N	none	N	HP
<i>Andropogon gerardii</i>	Poaceae	Big bluestem	N	none	FAC-	HP
<i>Andropogon glomeratus</i>	Poaceae	Broom-sedge	N	TU/PR	FACW+	HP
<i>Andropogon gyrans</i>	Poaceae	Elliott's beardgrass	N	N/PR	N	HP
<i>Andropogon virginicus</i>	Poaceae	Broom-sedge	N	none	FACU	HP
<i>Anemone americana</i>	Ranunculaceae	Liverleaf	N	none	N	HP
<i>Anemone quinquefolia</i>	Ranunculaceae	Wood anemone	N	none	FACU	HP
<i>Anemone virginiana</i>	Ranunculaceae	Tall anemone	N	none	FACU	HP
<i>Anethum graveolens</i>	Apiaceae	Dill	I	none	N	HA
<i>Angelica venenosa</i>	Apiaceae	Deadly angelica	N	none	N	HP
<i>Antennaria howellii</i>	Asteraceae	Howell's pussytoe	N	none	N	HP
<i>Antennaria neglecta</i>	Asteraceae	Overlooked pussytoe	N	none	UPL	HP
<i>Antennaria parlinii</i>	Asteraceae	Parlin's pussytoe	N	none	N	HP
<i>Antennaria plantaginifolia</i>	Asteraceae	Plantain-leaved pussytoe	N	none	N	HP
<i>Anthemis arvensis</i>	Asteraceae	Corn chamomile	I	none	N	HA
<i>Anthemis cotula</i>	Asteraceae	Mayweed	I	none	FACU-	HA
<i>Anthoxanthum odoratum</i>	Poaceae	Sweet vernalgrass	I	none	FACU	HP
<i>Anthriscus sylvestris</i>	Apiaceae	Chervil	I	none	N	HB

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Antirrhinum majus</i>	Plantaginaceae	Snapdragon	I	none	N	HP
<i>Apios americana</i>	Fabaceae	Ground-nut	N	none	FACW	VP
<i>Aplectrum hyemale</i>	Orchidaceae	Puttyroot	N	PR/PR	FAC	HP
<i>Apocynum androsaemifolium</i>	Apocynaceae	Pink dogbane	N	none	N	HP
<i>Apocynum cannabinum</i>	Apocynaceae	Indian hemp	N	none	FACU	HP
<i>Aquilegia canadensis</i>	Ranunculaceae	Wild columbine	N	none	FAC	HP
<i>Aquilegia vulgaris</i>	Ranunculaceae	Columbine	I	none	N	HP
<i>Arabidopsis thaliana</i>	Brassicaceae	Mouse-ear cress	I	none	N	HA
<i>Arabis canadensis</i>	Brassicaceae	Sicklepod	N	none	N	HB
<i>Arabis glabra</i>	Brassicaceae	Towercress	N	none	N	HB
<i>Arabis laevigata</i> var. <i>laevigata</i>	Brassicaceae	Smooth rockcress	N	none	N	HB
<i>Arabis lyrata</i>	Brassicaceae	Lyre-leaved rockcress	N	none	FACU	HB
<i>Arabis shortii</i> var. <i>shortii</i>	Brassicaceae	Toothed rockcress	N	none	N	HB
<i>Aralia elata</i>	Araliaceae	Japanese angelica-tree	I	none	N	SD
<i>Aralia hispida</i>	Araliaceae	Bristly sarsaparilla	N	none	N	HP
<i>Aralia nudicaulis</i>	Araliaceae	Wild sarsaparilla	N	none	FACU	HP
<i>Aralia racemosa</i>	Araliaceae	Spikenard	N	none	N	HP
<i>Aralia spinosa</i>	Araliaceae	Hercules'-club	N	none	FAC	TD
<i>Arctium lappa</i>	Asteraceae	Great burdock	I	none	N	HB
<i>Arctium minus</i>	Asteraceae	Common burdock	I	none	FACU-	HB
<i>Arenaria serpyllifolia</i> ssp. <i>leptoclados</i>	Caryophyllaceae	Thyme-leaved sandwort	I	none	FAC	HA
<i>Arenaria serpyllifolia</i> ssp. <i>serpyllifolia</i>	Caryophyllaceae	Thyme-leaved sandwort	I	none	N	HA
<i>Argemone mexicana</i>	Papaveraceae	Mexican poppy	I	none	N	HA
<i>Arisaema dracontium</i>	Araceae	Green-dragon	N	none	FACW	HP
<i>Arisaema triphyllum</i> ssp. <i>pusillum</i>	Araceae	Small jack-in- the-pulpit	N	none	FACW-	HP
<i>Arisaema triphyllum</i> ssp. <i>stewardsonii</i>	Araceae	Jack-in-the- pulpit	N	none	FACW-	HP
<i>Arisaema triphyllum</i> ssp. <i>triphyllum</i>	Araceae	Jack-in-the- pulpit	N	none	FACW-	HP
<i>Aristida dichotoma</i> var. <i>dichotoma</i>	Poaceae	Povertygrass	N	none	UPL	HA
<i>Aristida longespica</i> var. <i>longespica</i>	Poaceae	Slender threeawn	N	N/WA	UPL	HA
<i>Aristida oligantha</i>	Poaceae	Prairie threeawn	N	none	N	HA
<i>Aristida purpurascens</i>	Poaceae	Arrow-feather	N	PT/PT	N	HP
<i>Aristolochia serpentaria</i>	Aristolochiaceae	Virginia snakeroot	N	none	UPL	HP
<i>Armoracia rusticana</i>	Brassicaceae	Horseradish	I	none	N	HP
<i>Arnoglossum atriplicifolium</i>	Asteraceae	Pale Indian- plantain	N	none	N	HP

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<i>Arrhenatherum elatius</i> var. <i>biaristatum</i>	Poaceae	Tall oatgrass	I	none	FACU	HP
<i>Arrhenatherum elatius</i> var. <i>elatius</i>	Poaceae	Tall oatgrass	I	none	FACU	HP
<i>Artemisia annua</i>	Asteraceae	Sweet wormwood	I	none	FACU	HA
<i>Artemisia ludoviciana</i>	Asteraceae	Western mugwort	I	none	UPL	HP
<i>Artemisia pontica</i>	Asteraceae	Roman wormwood	I	none	N	HP
<i>Artemisia vulgaris</i>	Asteraceae	Common mugwort	I	none	N	HP
<i>Arthraxon hispidus</i>	Poaceae	Grass	I	none	FAC	HA
<i>Asarum canadense</i>	Aristolochiaceae	Wild ginger	N	none	FACU-	HP
<i>Asclepias amplexicaulis</i>	Apocynaceae	Blunt-leaved milkweed	N	none	N	HP
<i>Asclepias exaltata</i>	Apocynaceae	Poke milkweed	N	none	FACU	HP
<i>Asclepias incarnata</i> ssp. <i>incarnata</i>	Apocynaceae	Swamp milkweed	N	none	OBL	HP
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Apocynaceae	Swamp milkweed	N	none	OBL	HP
<i>Asclepias purpurascens</i>	Apocynaceae	Purple milkweed	N	none	FACU	HP
<i>Asclepias quadrifolia</i>	Apocynaceae	Four-leaved milkweed	N	none	N	HP
<i>Asclepias syriaca</i>	Apocynaceae	Common milkweed	N	none	FACU-	HP
<i>Asclepias tuberosa</i>	Apocynaceae	Butterfly-weed	N	none	N	HP
<i>Asclepias variegata</i>	Apocynaceae	White milkweed	N	TU/PE	FACU	HP
<i>Asclepias verticillata</i>	Apocynaceae	Whorled milkweed	N	none	N	HP
<i>Asclepias viridiflora</i>	Apocynaceae	Green milkweed	N	none	N	HP
<i>Asimina triloba</i>	Annonaceae	Pawpaw	N	none	FACU+	TD
<i>Asparagus officinalis</i>	Asparagaceae	Garden asparagus	I	none	FACU	HP
<i>Asplenium platyneuron</i>	Polypodiaceae	Ebony spleenwort	N	none	FACU	HP
<i>Asplenium rhizophyllum</i>	Polypodiaceae	Walking fern	N	none	N	HP
<i>Asplenium ruta-muraria</i>	Polypodiaceae	Wall rue spleenwort	N	none	N	HP
<i>Asplenium trichomanes</i> ssp. <i>quadrialeans</i>	Polypodiaceae	Maidenhair spleenwort	N	none	N	HP
<i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	Polypodiaceae	Maidenhair spleenwort	N	none	N	HP
<i>Asplenium x ebenoides</i>	Polypodiaceae	Scott's spleenwort	N	none	N	HP
<i>Athyrium filix-femina</i> var. <i>angustum</i>	Polypodiaceae	Lady fern	N	none	FAC	HP
<i>Athyrium filix-femina</i> var. <i>asplenioides</i>	Polypodiaceae	Southern lady fern	N	none	FAC	HP
<i>Atriplex littoralis</i>	Amaranthaceae	Seashore orach	N	none	N	HA
<i>Atriplex patula</i>	Amaranthaceae	Spreading orach	N	none	FACW	HA
<i>Atriplex prostrata</i>	Amaranthaceae	Halberd-leaved orach	N	none	N	HA

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<i>Aureolaria flava</i> var. <i>flava</i>	Orobanchaceae	Yellow false-foxglove	N	none	N	HP
<i>Aureolaria pedicularia</i>	Orobanchaceae	Cut-leaf false-foxglove	N	none	N	HA
<i>Aureolaria virginica</i>	Orobanchaceae	Downy false-foxglove	N	none	N	HP
<i>Avena fatua</i>	Poaceae	Wild oats	I	none	N	HA
<i>Avena sativa</i>	Poaceae	Oats	I	none	N	HA
<i>Azolla caroliniana</i>	Azollaceae	Carolina mosquitofern	I	none	OBL	HP
<i>Baccharis halimifolia</i>	Asteraceae	Groundsel-tree	N	PR/PR	FACW	SD
<i>Baptisia tinctoria</i>	Fabaceae	Wild indigo	N	none	N	HP
<i>Barbarea verna</i>	Brassicaceae	Early wintercress	I	none	N	HB
<i>Barbarea vulgaris</i>	Brassicaceae	Common wintercress	I	none	FACU	HB
<i>Bartonia paniculata</i>	Gentianaceae	Screwstem	N	N/PR	OBL	HA
<i>Bartonia virginica</i>	Gentianaceae	Bartonia	N	none	FACW	HA
<i>Belamcanda chinensis</i>	Iridaceae	Blackberry-lily	I	none	N	HP
<i>Bellis perennis</i>	Asteraceae	English daisy	I	none	N	HP
<i>Berberis thunbergii</i>	Berberidaceae	Japanese barberry	I	none	N	SD
<i>Berberis vulgaris</i>	Berberidaceae	European barberry	I	none	N	SD
<i>Betula alleghaniensis</i>	Betulaceae	Yellow birch	N	none	FAC	TD
<i>Betula lenta</i>	Betulaceae	Black birch	N	none	FACU	TD
<i>Betula nigra</i>	Betulaceae	River birch	N	none	FACW	TD
<i>Betula populifolia</i>	Betulaceae	Gray birch	N	none	FAC	TD
<i>Bidens bidentoides</i>	Asteraceae	Swamp beggar-ticks	N	PT/PE	FACW+	HA
<i>Bidens bipinnata</i>	Asteraceae	Spanish needles	N	none	N	HA
<i>Bidens cernua</i>	Asteraceae	Bur-marigold	N	none	OBL	HA
<i>Bidens connata</i>	Asteraceae	Beggar-ticks	N	none	FACW+	HA
<i>Bidens discoidea</i>	Asteraceae	Small beggar-ticks	N	N/PR	FACW	HA
<i>Bidens frondosa</i>	Asteraceae	Beggar-ticks	N	none	FACW	HA
<i>Bidens laevis</i>	Asteraceae	Showy bur-marigold	N	N/PE	OBL	HA
<i>Bidens polylepis</i>	Asteraceae	Tickseed-sunflower	I	none	FACW	HA
<i>Bidens trichosperma</i>	Asteraceae	Tickseed-sunflower	N	none	OBL	HA
<i>Bidens tripartita</i>	Asteraceae	Beggar-ticks	N	none	FACW	HA
<i>Bidens vulgata</i>	Asteraceae	Beggar-ticks	N	none	N	HA
<i>Boehmeria cylindrica</i> var. <i>cylindrica</i>	Urticaceae	False nettle	N	none	FACW+	HP
<i>Boehmeria cylindrica</i> var. <i>drummondiana</i>	Urticaceae	False nettle	N	none	FACW+	HP
<i>Botrychium dissectum</i>	Ophioglossaceae	Cut-leaved grape-fern	N	none	FAC	HP

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<i>Botrychium matricariifolium</i>	Ophioglossaceae	Daisy-leaved moonwort	N	none	N	HP
<i>Botrychium multifidum</i>	Ophioglossaceae	Leathery grape fern	N	none	FACU	HP
<i>Botrychium oneidense</i>	Ophioglossaceae	Blunt-lobed grape fern	N	none	N	HP
<i>Botrychium simplex</i>	Ophioglossaceae	Least moonwort	N	none	FACU	HP
<i>Botrychium virginianum</i>	Ophioglossaceae	Rattlesnake fern	N	none	FACU	HP
<i>Brachyelytrum erectum</i>	Poaceae	Brachyelytrum	N	none	N	HP
<i>Brasenia schreberi</i>	Cabombaceae	Purple wen-dock	N	none	OBL	HP
<i>Brassica juncea</i>	Brassicaceae	Brown mustard	I	none	N	HA
<i>Brassica nigra</i>	Brassicaceae	Black mustard	I	none	N	HA
<i>Brassica rapa</i>	Brassicaceae	Field mustard	I	none	N	HA
<i>Briza media</i>	Poaceae	Quaking-grass	I	none	FAC	HP
<i>Bromus altissimus</i>	Poaceae	Bromegrass	N	none	FACW	HP
<i>Bromus commutatus</i>	Poaceae	Hairy chess	I	none	N	HA
<i>Bromus hordeaceus</i>	Poaceae	Soft chess	I	none	UPL	HA
<i>Bromus inermis</i>	Poaceae	Smooth brome	I	none	N	HP
<i>Bromus japonicus</i>	Poaceae	Japanese chess	I	none	FACU-	HA
<i>Bromus kalmii</i>	Poaceae	Bromegrass	N	N/PT	FACU	HP
<i>Bromus pubescens</i>	Poaceae	Canada brome	N	none	N	HP
<i>Bromus racemosus</i>	Poaceae	Soft chess	I	none	N	HA
<i>Bromus secalinus</i>	Poaceae	Cheat	I	none	N	HA
<i>Bromus sterilis</i>	Poaceae	Barren brome	I	none	N	HA
<i>Bromus tectorum</i>	Poaceae	Downy chess	I	none	N	HA
<i>Broussonetia papyrifera</i>	Moraceae	Paper-mulberry	I	none	N	TD
<i>Buchnera americana</i>	Orobanchaceae	Bluehearts	N	PX/PX	FACU	HB
<i>Buddleja davidii</i>	Scrophulariaceae	Butterfly-bush	I	none	N	SD
<i>Buglossoides arvensis</i>	Boraginaceae	Bastard alkanet	I	none	N	HA
	Cyperaceae	Sandrush	N	none	FACU	HA
	Apiaceae	Hare's ear	I	none	N	HA
	Cabombaceae	Fanwort	I	none	OBL	HP
	Poaceae	Canada bluejoint	N	none	FACW+	HP
	Poaceae	Reedgrass	N	none	OBL	HP
	Lamiaceae	Basil-thyme	I	none	N	HP
	Plantaginaceae	Water-starwort	N	none	OBL	HP
	Plantaginaceae	Water-starwort	N	none	OBL	HP
	Plantaginaceae	Water-starwort	I	none	OBL	HP
	Plantaginaceae	Water-starwort	N	none	FACW+	HA
	Orchidaceae	Grass-pink	N	none	FACW+	HP
	Ranunculaceae	Marsh-marigold	N	none	OBL	HP
	Convolvulaceae	Japanese bindweed	I	none	N	VP

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	Convolvulaceae	Japanese bindweed	I	none	N	VP
	Convolvulaceae	Hedge bindweed	N	none	FAC-	VP
	Convolvulaceae	Bindweed	N	none	N	VP
	Convolvulaceae	Low bindweed	N	none	N	VP
	Brassicaceae	Small-fruited false-flax	I	none	N	HA
	Campanulaceae	Tall bellflower	N	none	FAC	HA
	Campanulaceae	Marsh bellflower	N	none	OBL	HP
	Campanulaceae	Creeping bellflower	I	none	N	HP
	Campanulaceae	Harebell	N	none	FACU	HP
	Bignoniaceae	Trumpet-vine	N	none	FAC	VW
	Cannabaceae	Hemp	I	none	N	HA
	Brassicaceae	Shepherd's-purse	I	none	FACU	HA
	Brassicaceae	Toothwort	N	none	FACU	HP
	Brassicaceae	Bittercress	N	none	OBL	HP
	Brassicaceae	Toothwort	N	none	FACU	HP
	Brassicaceae	Two-leaved toothwort	N	none	FACU	HP
	Brassicaceae	Hairy bittercress	I	none	FACU	HA
	Brassicaceae	Bittercress	I	none	N	HP
	Brassicaceae	Small-flowered bittercress	N	none	FACU	HP
	Brassicaceae	Pennsylvania bittercress	N	none	OBL	HP
<i>Cardamine pratensis</i>	Brassicaceae	Cuckoo-flower	N	PE/PE	OBL	HP
<i>Cardamine rotundifolia</i>	Brassicaceae	Mountain watercress	N	none	OBL	HP
<i>Cardaria draba</i>	Brassicaceae	Hoarycress	I	none	N	HP
<i>Carduus nutans</i>	Asteraceae	Nodding thistle	I	none	N	HB
<i>Bulbostylis capillaris</i>	Cyperaceae	Sedge	N	N/SP	FAC	HP
<i>Bupleurum rotundifolium</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Cabomba caroliniana</i>	Cyperaceae	Broad-winged sedge	N	PT/PT	N	HP
<i>Calamagrostis canadensis</i> var. <i>canadensis</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Calamagrostis cinnoides</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Calamintha nepeta</i> ssp. <i>glandulosa</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Callitriche heterophylla</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Callitriche palustris</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Callitriche stagnalis</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Callitriche terrestris</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Calopogon tuberosus</i>	Cyperaceae	Bog sedge	N	none	FACW+	HP

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<i>Caltha palustris</i>	Cyperaceae	Bog sedge	N	none	OBL	HP
<i>Calystegia hederacea</i>	Cyperaceae	Bicknell's sedge	N	PE/PE	N	HP
<i>Calystegia pubescens</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Calystegia sepium</i>	Cyperaceae	Sedge	N	N/PT	UPL	HP
<i>Calystegia silvatica</i> ssp. <i>fraterniflora</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Calystegia spithamea</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Camelina microcarpa</i>	Cyperaceae	Bull Sedge	N	PE/PE	OBL	HP
<i>Campanula americana</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Campanula aparinoides</i>	Cyperaceae	Brown sedge	N	TU/PR	OBL	HP
<i>Campanula rapunculoides</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Campanula rotundifolia</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Campsis radicans</i>	Cyperaceae	Sedge	N	none	FAC+	HP
<i>Cannabis sativa</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Capsella bursa-pastoris</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Cardamine angustata</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Cardamine bulbosa</i>	Cyperaceae	Sedge	N	N/SP	FACW	HP
<i>Cardamine concatenata</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Cardamine diphylla</i>	Cyperaceae	Sedge	N	PE/PE	OBL	HP
<i>Cardamine hirsuta</i>	Cyperaceae	Short hair sedge	N	none	OBL	HP
<i>Cardamine impatiens</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Cardamine parviflora</i> var. <i>arenicola</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Cardamine pensylvanica</i>	Cyperaceae	Sedge	N	N/SP	FAC-	HP
<i>Carex debilis</i> var. <i>debilis</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Carex debilis</i> var. <i>rudgei</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Carex digitalis</i>	Cyperaceae	Sedge	N	none	UPL	HP
<i>Carex echinata</i> var. <i>echinata</i>	Cyperaceae	Prickly sedge	N	none	OBL	HP
<i>Carex emmonsii</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex emoryi</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex festucacea</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Carex folliculata</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex frankii</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex geyeri</i>	Cyperaceae	Geyer's sedge	N	PE/PE	N	HP
<i>Carex glaucoidea</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex gracilescens</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex gracillima</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Carex granularis</i> var. <i>granularis</i>	Cyperaceae	Sedge	N	none	FACW+	HP
<i>Carex granularis</i> var. <i>haleana</i>	Cyperaceae	Sedge	N	none	FACW+	HP
<i>Carex grayi</i>	Cyperaceae	Sedge	N	none	FACW+	HP

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<i>Carex grisea</i>	Cyperaceae	Sedge	N	none	FAC	HP
<i>Carex gynandra</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex haydenii</i>	Cyperaceae	Cloud sedge	N	TU/PT	OBL	HP
<i>Carex hirsutella</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex hirta</i>	Cyperaceae	Sedge	I	none	N	HP
<i>Carex hirtifolia</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex hitchcockiana</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex hystericina</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex interior</i>	Cyperaceae	Sedge	N	N/SP	OBL	HP
<i>Carex intumescens</i>	Cyperaceae	Sedge	N	none	FACW+	HP
<i>Carex jamesii</i>	Cyperaceae	Sedge	N	N/SP	N	HP
<i>Carex lacustris</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex laevivaginata</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex lasiocarpa</i>	Cyperaceae	Many-fruited sedge	N	PR/PR	OBL	HP
<i>Carex laxiculmis</i> var. <i>laxiculmis</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex laxiflora</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Carex leavenworthii</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex leptalea</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex leptonevia</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Carex limosa</i>	Cyperaceae	Mud sedge	N	TU/PT	OBL	HP
<i>Carex longii</i>	Cyperaceae	Long's sedge	N	TU/PT	OBL	HP
<i>Carex lucorum</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex lupuliformis</i>	Cyperaceae	False hop sedge	N	TU/PE	FACW+	HP
<i>Carex lupulina</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex lurida</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex meadii</i>	Cyperaceae	Mead's sedge	N	TU/PE	FAC	HP
<i>Carex mesochorea</i>	Cyperaceae	Midland sedge	N	none	FACU	HP
<i>Carex molesta</i>	Cyperaceae	Sedge	N	N/SP	N	HP
<i>Carex muhlenbergii</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex nigromarginata</i>	Cyperaceae	Sedge	N	none	UPL	HP
<i>Carex normalis</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Carex oligocarpa</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex pallescens</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex pedunculata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex pellita</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex pensylvanica</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex planispicata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex plantaginea</i>	Cyperaceae	Plantain sedge	N	none	N	HP
<i>Carex platyphylla</i>	Cyperaceae	Broad-leaf sedge	N	none	N	HP
<i>Carex prasina</i>	Cyperaceae	Sedge	N	none	OBL	HP

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<i>Carex projecta</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Carex radiata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex retroflexa</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex rosea</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex scabrata</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex scoparia</i>	Cyperaceae	Broom sedge	N	none	FACW	HP
<i>Carex seorsa</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Carex siccata</i>	Cyperaceae	Sedge	N	N/PE	FAC+	HP
<i>Carex sparganioides</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Carex spicata</i>	Cyperaceae	Sedge	I	none	N	HP
<i>Carex sprengeii</i>	Cyperaceae	Sedge	N	N/PR	FACU	HP
<i>Carex squarrosa</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Carex sterilis</i>	Cyperaceae	Atlantic sedge	N	PT/PE	OBL	HP
<i>Carex stipata</i> var. <i>maxima</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex stipata</i> var. <i>stipata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex straminea</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex striatula</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex stricta</i>	Cyperaceae	Tussock sedge	N	none	OBL	HP
<i>Carex styloflexa</i>	Cyperaceae	Sedge	N	N/SP	FACW-	HP
<i>Carex swanii</i>	Cyperaceae	Sedge	N	none	FACU	HP
<i>Carex tetanica</i>	Cyperaceae	Wood's sedge	N	PT/PT	FACW	HP
<i>Carex tomsa</i> var. <i>tomsa</i>	Cyperaceae	Sedge	N	N/SP	N	HP
<i>Carex torta</i>	Cyperaceae	Sedge	N	none	FACW	HP
<i>Carex tribuloides</i> var. <i>tribuloides</i>	Cyperaceae	Sedge	N	none	FACW+	HP
<i>Carex trichocarpa</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex typhina</i>	Cyperaceae	Cat-tail sedge	N	PE/PT	FACW+	HP
<i>Carex umbellata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex utriculata</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex vesicaria</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex vestita</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex virescens</i>	Cyperaceae	Sedge	N	none	N	HP
<i>Carex vulpinoidea</i>	Cyperaceae	Sedge	N	none	OBL	HP
<i>Carex willdenovii</i>	Cyperaceae	Sedge	N	none	UPL	HP
<i>Carpinus caroliniana</i>	Betulaceae	Hornbeam	N	none	FAC	TD
<i>Carum carvi</i>	Apiaceae	Caraway	I	none	N	HB
<i>Carya cordiformis</i>	Juglandaceae	Bitternut hickory	N	none	FACU+	TD
<i>Carya glabra</i>	Juglandaceae	Pignut hickory	N	none	FACU-	TD
<i>Carya laciniosa</i>	Juglandaceae	Shellbark hickory	N	N/SP	FAC	TD
<i>Carya ovata</i>	Juglandaceae	Shagbark hickory	N	none	FACU	TD

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<i>Carya tomentosa</i>	Juglandaceae	Mockernut hickory	N	none	FACU	TD
<i>Castanea dentata</i>	Fagaceae	American chestnut	N	none	N	TD
<i>Castanea pumila</i>	Fagaceae	Chinquapin	N	none	N	TD
<i>Castilleja coccinea</i>	Orobanchaceae	Indian paintbrush	N	TU/PT	FAC	HA
<i>Catalpa bignonioides</i>	Bignoniaceae	Catalpa	I	none	UPL	TD
<i>Catalpa speciosa</i>	Bignoniaceae	Catalpa	I	none	FAC	TD
<i>Caulophyllum thalictroides</i>	Berberidaceae	Blue cohosh	N	none	N	HP
<i>Ceanothus americanus</i>	Rhamnaceae	New Jersey tea	N	none	N	SD
<i>Celastrus orbiculatus</i>	Celastraceae	Oriental bittersweet	I	none	UPL	VW
<i>Celastrus scandens</i>	Celastraceae	American bittersweet	N	none	FACU-	VW
<i>Celosia argentea</i>	Amaranthaceae	Celosia	I	none	N	HA
<i>Celtis occidentalis</i>	Cannabaceae	Dogberry	N	none	FACU	TD
<i>Celtis occidentalis</i>	Cannabaceae	Hackberry	N	none	FACU	TD
<i>Celtis tenuifolia</i>	Cannabaceae	Dwarf hackberry	N	none	N	TD
<i>Cenchrus longispinus</i>	Poaceae	Sandbur	N	none	N	HA
<i>Cenchrus tribuloides</i>	Poaceae	Dune sandbur	I	none	UPL	HA
<i>Centaurea calcitrapa</i>	Asteraceae	Purple star-thistle	I	none	N	HB
<i>Centaurea cyanus</i>	Asteraceae	Bachelor's button	I	none	N	HA
<i>Centaurea jacea</i>	Asteraceae	Brown knapweed	I	none	N	HP
<i>Centaurea nigra</i>	Asteraceae	Black knapweed	I	none	N	HP
<i>Centaurea nigrescens</i>	Asteraceae	Knapweed	I	none	N	HP
<i>Centaurea stoebe ssp. micranthos</i>	Asteraceae	Bushy knapweed	I	none	N	HB
<i>Cephalanthus occidentalis</i>	Rubiaceae	Buttonbush	N	none	OBL	SD
<i>Cerastium arvense ssp. arvense</i>	Caryophyllaceae	Field chickweed	N	none	N	HP
<i>Cerastium fontanum ssp. triviale</i>	Caryophyllaceae	Common mouse-ear chickweed	I	none	FACU-	HP
<i>Cerastium glomeratum</i>	Caryophyllaceae	Mouse-ear chickweed	I	none	UPL	HA
<i>Cerastium nutans</i>	Caryophyllaceae	Nodding chickweed	N	none	FAC	HA
<i>Ceratophyllum demersum</i>	Ceratophyllaceae	Coontail	N	none	OBL	HP
<i>Ceratophyllum echinatum</i>	Ceratophyllaceae	Hornwort	N	none	OBL	HP
<i>Cercis canadensis</i>	Fabaceae	Redbud	N	none	N	TD
<i>Chaenorrhinum minus</i>	Plantaginaceae	Dwarf snapdragon	I	none	N	HA
<i>Chaerophyllum procumbens</i>	Apiaceae	Slender chervil	N	none	FACW	HA

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<i>Chamaecrista fasciculata</i>	Fabaceae	Partridge-pea	N	none	FACU	HA
<i>Chamaecrista nictitans</i>	Fabaceae	Wild sensitive-plant	N	none	FACU-	HA
<i>Chamaelirium luteum</i>	Melanthiaceae	Devil's-bit	N	none	FAC	HP
<i>Chasmanthium laxum</i>	Poaceae	Slender sea-oats	N	PE/PE	FAC	HP
<i>Cheilanthes lanosa</i>	Polypodiaceae	Hairy lip fern	N	none	N	HP
<i>Chelidonium majus</i>	Papaveraceae	Greater celandine	I	none	UPL	HB
<i>Chelone glabra</i>	Plantaginaceae	Turtlehead	N	none	OBL	HP
<i>Chenopodium album</i> var. <i>album</i>	Amaranthaceae	Lamb's quarters	I	none	FACU+	HA
<i>Chenopodium album</i> var. <i>missouriense</i>	Amaranthaceae	Lamb's quarters	N	none	N	HA
<i>Chenopodium berlandieri</i>	Amaranthaceae	Goosefoot	I	none	N	HA
<i>Chenopodium bushianum</i>	Amaranthaceae	Pigweed	N	none	N	HA
<i>Chenopodium capitatum</i>	Amaranthaceae	Indian-paint	N	TU/PE	N	HA
<i>Chenopodium glaucum</i>	Amaranthaceae	Oak-leaved goosefoot	I	none	FACW-	HA
<i>Chenopodium murale</i>	Amaranthaceae	Nettle-leaved goosefoot	I	none	N	HA
<i>Chenopodium simplex</i>	Amaranthaceae	Maple-leaved goosefoot	N	none	N	HA
<i>Chenopodium standleyanum</i>	Amaranthaceae	Woodland goosefoot	N	none	N	HA
<i>Chenopodium strictum</i> var. <i>glaucophyllum</i>	Amaranthaceae	Goosefoot	I	none	N	HA
<i>Chenopodium urticum</i>	Amaranthaceae	Upright goosefoot	I	none	N	HA
<i>Chimaphila maculata</i>	Ericaceae	Pipsissewa	N	none	N	HP
<i>Chimaphila umbellata</i>	Ericaceae	Pipsissewa	N	none	N	HP
<i>Chionanthus virginicus</i>	Oleaceae	Fringe-tree	N	N/PT	FAC+	TD
<i>Chloris verticillata</i>	Poaceae	Windmill-grass	I	none	N	HP
<i>Chrysopsis mariana</i>	Asteraceae	Golden aster	N	PT/PE	UPL	HP
<i>Chrysosplenium americanum</i>	Saxifragaceae	Golden saxifrage	N	none	OBL	HP
<i>Cichorium intybus</i>	Asteraceae	Blue chicory	I	none	N	HP
<i>Cicuta bulbifera</i>	Apiaceae	Water-hemlock	N	none	OBL	HP
<i>Cicuta maculata</i> var. <i>maculata</i>	Apiaceae	Beaver-poison	N	none	OBL	HP
<i>Cinna arundinacea</i>	Poaceae	Wood reedgrass	N	none	FACW	HP
<i>Circaea canadensis</i> ssp. <i>canadensis</i>	Onagraceae	Enchanter's-nightshade	N	none	FACU	HP
<i>Cirsium altissimum</i>	Asteraceae	Tall thistle	N	none	N	HB
<i>Cirsium arvense</i>	Asteraceae	Canada thistle	I	none	FACU	HP
<i>Cirsium discolor</i>	Asteraceae	Field thistle	N	none	UPL	HB
<i>Cirsium muticum</i>	Asteraceae	Swamp thistle	N	none	OBL	HB
<i>Cirsium pumilum</i>	Asteraceae	Pasture thistle	N	none	N	HB

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<i>Cirsium vulgare</i>	Asteraceae	Bull-thistle	I	none	FACU-	HB
<i>Claytonia virginica</i>	Portulacaceae	Spring-beauty	N	none	FAC	HP
<i>Clematis occidentalis</i>	Ranunculaceae	Purple clematis	N	none	N	VP
<i>Clematis terniflora</i>	Ranunculaceae	Sweet autumn clematis	I	none	FACU-	VP
<i>Clematis virginiana</i>	Ranunculaceae	Virgin's-bower	N	none	FAC	VP
<i>Cleome hassleriana</i>	Cleomaceae	Spider-flower	I	none	N	HA
<i>Clethra alnifolia</i>	Clethraceae	Sweet pepperbush	N	none	FAC+	SD
<i>Clinopodium vulgare</i>	Lamiaceae	Wild basil	I	none	N	HP
<i>Coincya monensis</i>	Brassicaceae	Coincya	I	none	N	HA
<i>Collinsonia canadensis</i>	Lamiaceae	Horse balm	N	none	FAC+	HP
<i>Comandra umbellata</i>	Santalaceae	Bastard toadflax	N	none	FACU-	HP
<i>Commelina communis</i> <i>var. communis</i>	Commelinaceae	Asiatic dayflower	I	none	FAC-	HA
<i>Commelina communis</i> <i>var. ludens</i>	Commelinaceae	Asiatic dayflower	I	none	FAC-	HA
<i>Commelina diffusa</i>	Commelinaceae	Creeping dayflower	I	none	N	HP
<i>Comptonia peregrina</i>	Myricaceae	Sweet-fern	N	none	N	SD
<i>Conium maculatum</i>	Apiaceae	Poison-hemlock	I	none	FACW	HB
<i>Conoclinium coelestinum</i>	Asteraceae	Mistflower	N	N/SP	FAC	HP
<i>Conopholis americana</i>	Orobanchaceae	Squaw-root	N	none	N	HP
<i>Conringia orientalis</i>	Brassicaceae	Hare's-ear mustard	I	none	N	HA
<i>Consolida ajacis</i>	Ranunculaceae	Garden larkspur	I	none	N	HA
<i>Convallaria majalis</i>	Ruscaceae	Lily-of-the-valley	I	none	N	HP
<i>Convolvulus arvensis</i>	Convolvulaceae	Field bindweed	I	none	N	VP
<i>Conyza canadensis var. canadensis</i>	Asteraceae	Horseweed	N	none	UPL	HA
<i>Conyza canadensis var. pusilla</i>	Asteraceae	Fleabane	I	none	N	HA
<i>Corallorhiza maculata</i>	Orchidaceae	Spotted coralroot	N	none	FACU	HP
<i>Corallorhiza odontorhiza</i>	Orchidaceae	Autumn coralroot	N	none	N	HP
<i>Corallorhiza wisteriana</i>	Orchidaceae	Wister's coralroot	N	TU/PE	FAC	HP
<i>Coreopsis lanceolata</i>	Asteraceae	Longstalk tickseed	I	none	FACU	HP
<i>Coreopsis rosea</i>	Asteraceae	Pink tickseed	N	PX/PX	FACW	HP
<i>Coreopsis tinctoria</i>	Asteraceae	Plains tickseed	I	none	FAC-	HA
<i>Coreopsis tripteris</i>	Asteraceae	Tall tickseed	N	none	FAC	HP
<i>Cornus alternifolia</i>	Cornaceae	Alternate-leaved dogwood	N	none	N	TD
<i>Cornus amomum ssp. amomum</i>	Cornaceae	Silky dogwood, kinnikinnik	N	none	FACW	SD
<i>Cornus florida</i>	Cornaceae	Flowering dogwood	N	none	FACU-	TD

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<i>Cornus racemosa</i>	Cornaceae	Gray dogwood	N	none	FAC-	SD
<i>Cornus rugosa</i>	Cornaceae	Round-leaved dogwood	N	none	N	SD
<i>Coronilla varia</i>	Fabaceae	Crown-vetch	I	none	N	HP
<i>Corydalis flavula</i>	Papaveraceae	Yellow fumewort	N	none	FACU	HB
<i>Corydalis sempervirens</i>	Papaveraceae	Rock harlequin	N	none	N	HB
<i>Corylus americana</i>	Betulaceae	American filbert	N	none	FACU-	SD
<i>Corylus cornuta</i>	Betulaceae	Beaked hazelnut	N	none	FACU-	SD
<i>Cosmos bipinnatus</i>	Asteraceae	Cosmos	I	none	N	HA
<i>Cosmos sulphureus</i>	Asteraceae	Orange cosmos	I	none	N	HA
<i>Cotinus coggygria</i>	Anacardiaceae	Smoke-tree	I	none	N	TD
<i>Crassula aquatica</i>	Crassulaceae	Water- pigmyweed	N	PX/PX	OBL	HA
<i>Crataegus calpodendron</i>	Rosaceae	Pear hawthorn	N	none	N	SD
<i>Crataegus chrysocarpa</i>	Rosaceae	Fireberry hawthorn	N	none	N	SD
<i>Crataegus coccinea</i>	Rosaceae	Red-fruited hawthorn	N	none	N	SD
<i>Crataegus crus-galli</i>	Rosaceae	Cockspur hawthorn	N	none	FACU	SD
<i>Crataegus intricata</i>	Rosaceae	Biltmore hawthorn	N	none	N	SD
<i>Crataegus macrocarpa</i>	Rosaceae	Fanleaf hawthorn	N	none	N	SD
<i>Crataegus mollis</i>	Rosaceae	Downy hawthorn	N	TU/TU	FACU	TD
<i>Crataegus monogyna</i>	Rosaceae	English hawthorn	I	none	N	SD
<i>Crataegus pruinosa</i>	Rosaceae	Frosted hawthorn	N	none	N	SD
<i>Crataegus punctata</i>	Rosaceae	Dotted hawthorn	N	none	N	TD
<i>Crataegus uniflora</i>	Rosaceae	One-fruited hawthorn	N	none	N	SD
<i>Crepis capillaris</i>	Asteraceae	Hawk's-beard	I	none	N	HA
<i>Crepis tectorum</i>	Asteraceae	Hawk's-beard	I	none	N	HA
<i>Crotalaria sagittalis</i>	Fabaceae	Rattlebox	N	none	N	HA
<i>Croton glandulosus</i>	Euphorbiaceae	Croton	I	none	N	HA
<i>Crotonopsis elliptica</i>	Euphorbiaceae	Elliptical rushfoil	N	PX/PX	N	HA
<i>Crypsis schoenoides</i>	Poaceae	Grass	I	none	N	HA
<i>Cryptotaenia canadensis</i>	Apiaceae	Honewort	N	none	FAC	HP
<i>Cucurbita pepo</i>	Cucurbitaceae	Pumpkin	I	none	N	VA
<i>Cunila origanoides</i>	Lamiaceae	Common dittany	N	none	N	HP
<i>Cuphea viscosissima</i>	Lythraceae	Blue waxweed	N	none	FAC-	HA
<i>Cuscuta campestris</i>	Convolvulaceae	Dodder	N	N/PT	N	VA
<i>Cuscuta cephalanthi</i>	Convolvulaceae	Buttonbush dodder	N	TU/PT	N	VA
<i>Cuscuta compacta</i>	Convolvulaceae	Dodder	N	N/PT	N	VA
<i>Cuscuta gronovii var.</i>	Convolvulaceae	Common dodder	N	none	N	VA

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<i>gronovii</i>						
<i>Cuscuta gronovii</i> var. <i>latiflora</i>	Convolvulaceae	Dodder	N	none	N	VA
<i>Cuscuta pentagona</i>	Convolvulaceae	Field dodder	N	N/PT	N	VA
<i>Cuscuta polygonorum</i>	Convolvulaceae	Smartweed dodder	N	TU/PT	N	VA
<i>Cycloloma atriplicifolium</i>	Amaranthaceae	Winged pigweed	I	none	FACU-	HA
<i>Cymbalaria muralis</i>	Plantaginaceae	Kenilworth-ivy	I	none	N	HA
<i>Cynodon dactylon</i>	Poaceae	Bermudagrass	I	none	FACU	HP
<i>Cynoglossum officinale</i>	Boraginaceae	Hound's-tongue	I	none	N	HB
<i>Cynoglossum virginianum</i>	Boraginaceae	Wild comfrey	N	none	N	HP
<i>Cynosurus cristatus</i>	Poaceae	Crested dog's- tail	I	none	UPL	HP
<i>Cyperus bipartitus</i>	Cyperaceae	Umbrella sedge	N	none	FACW+	HA
<i>Cyperus brevifolioides</i>	Cyperaceae	Umbrella sedge	I	none	N	HP
<i>Cyperus dentatus</i>	Cyperaceae	Umbrella sedge	N	none	FACW+	HP
<i>Cyperus diandrus</i>	Cyperaceae	Umbrella sedge	N	PE/PE	FACW	HA
<i>Cyperus echinatus</i>	Cyperaceae	Umbrella sedge	N	N/SP	FACU	HP
<i>Cyperus erythrorhizos</i>	Cyperaceae	Redroot flatsedge	N	none	FACW+	HA
<i>Cyperus esculentus</i>	Cyperaceae	Yellow nutsedge	N	none	FACW	HP
<i>Cyperus flavescens</i>	Cyperaceae	Umbrella sedge	N	none	OBL	HA
<i>Cyperus lancastricensis</i>	Cyperaceae	Umbrella sedge	N	N/PT	FACU	HP
<i>Cyperus lupulinus</i>	Cyperaceae	Umbrella sedge	N	none	UPL	HP
<i>Cyperus microiria</i>	Cyperaceae	Umbrella sedge	I	none	N	HA
<i>Cyperus odoratus</i>	Cyperaceae	Umbrella sedge	N	none	FACW	HA
<i>Cyperus refractus</i>	Cyperaceae	Reflexed flatsedge	N	PE/PE	FACU+	HP
<i>Cyperus serotinus</i>	Cyperaceae	Umbrella sedge	I	none	OBL	HP
<i>Cyperus squarrosus</i>	Cyperaceae	Umbrella sedge	N	none	FACW+	HA
<i>Cyperus strigosus</i>	Cyperaceae	False nutsedge	N	none	FACW	HP
<i>Cyperus tenuifolius</i>	Cyperaceae	Thin-leaved flatsedge	N	none	FACW	HA
<i>Cypripedium acaule</i>	Orchidaceae	Pink lady's- slipper	N	none	FACU-	HP
<i>Cypripedium parviflorum</i> var. <i>pubescens</i>	Orchidaceae	Large yellow lady's-slipper	N	none	FAC+	HP
<i>Cystopteris bulbifera</i>	Polypodiaceae	Bulblet bladder fern	N	none	FAC	HP
<i>Cystopteris fragilis</i>	Polypodiaceae	Fragile fern	N	none	FACU	HP
<i>Cystopteris protrusa</i>	Polypodiaceae	Protruding bladder fern	N	none	N	HP
<i>Cystopteris tenuis</i>	Polypodiaceae	Fragile fern	N	none	FACU	HP
<i>Dactylis glomerata</i>	Poaceae	Orchardgrass	I	none	FACU	HP
<i>Danthonia compressa</i>	Poaceae	Northern oatgrass	N	none	FACU-	HP
<i>Danthonia spicata</i>	Poaceae	Poverty-grass	N	none	N	HP

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<i>Datura meteloides</i>	Solanaceae	Downy thorn-apple	I	none	N	HA
<i>Datura stramonium</i>	Solanaceae	Jimsonweed	I	none	N	HA
<i>Daucus carota</i>	Apiaceae	Queen Anne's-lace	I	none	N	HB
<i>Decodon verticillatus</i>	Lythraceae	Water-willow	N	none	OBL	HP
<i>Dennstaedtia punctilobula</i>	Polypodiaceae	Hay-scented fern	N	none	N	HP
<i>Deparia acrostichoides</i>	Polypodiaceae	Silvery glade fern	N	none	FAC	HP
<i>Deschampsia cespitosa</i>	Poaceae	Tufted hairgrass	N	N/PT	FACW	HP
<i>Deschampsia flexuosa</i>	Poaceae	Common hairgrass	N	none	N	HP
<i>Desmodium canadense</i>	Fabaceae	Showy tick-trefoil	N	none	FAC	HP
<i>Desmodium canescens</i>	Fabaceae	Hoary tick-trefoil	N	none	N	HP
<i>Desmodium ciliare</i>	Fabaceae	Tick-clover	N	none	N	HP
<i>Desmodium cuspidatum</i>	Fabaceae	Tick-clover	N	none	N	HP
<i>Desmodium glutinosum</i>	Fabaceae	Sticky tick-clover	N	none	N	HP
<i>Desmodium humifusum</i>	Fabaceae	Tick-trefoil	N	none	N	VP
<i>Desmodium laevigatum</i>	Fabaceae	Smooth tick-clover	N	N/TU	N	HP
<i>Desmodium marilandicum</i>	Fabaceae	Maryland tick-clover	N	none	N	HP
<i>Desmodium nudiflorum</i>	Fabaceae	Naked-flowered tick-trefoil	N	none	N	HP
<i>Desmodium nuttallii</i>	Fabaceae	Nuttall's tick-trefoil	N	TU/TU	N	HP
<i>Desmodium obtusum</i>	Fabaceae	Tick-trefoil	N	N/TU	N	HP
<i>Desmodium paniculatum</i>	Fabaceae	Tick-trefoil	N	none	UPL	HP
<i>Desmodium perplexum</i>	Fabaceae	Tick-trefoil	N	none	N	HP
<i>Desmodium rotundifolium</i>	Fabaceae	Round-leaved tick-trefoil	N	none	N	HP
<i>Deutzia scabra</i>	Hydrangeaceae	Deutzia	I	none	N	SD
<i>Dianthus armeria</i>	Caryophyllaceae	Deptford pink	I	none	N	HB
<i>Dianthus barbatus</i>	Caryophyllaceae	Sweet-william	I	none	N	HP
<i>Dicentra canadensis</i>	Papaveraceae	Squirrel-corn	N	none	N	HP
<i>Dicentra cucullaria</i>	Papaveraceae	Dutchman's-breeches	N	none	N	HP
<i>Dichanthelium acuminatum</i>	Poaceae	Panic grass	N	none	FAC	HP
<i>Dichanthelium annulum</i>	Poaceae	Annulus panic grass	N	TU/PT	N	HP
<i>Dichanthelium boscii</i>	Poaceae	Panic grass	N	none	N	HP
<i>Dichanthelium clandestinum</i>	Poaceae	Deer-tongue grass	N	none	FAC+	HP
<i>Dichanthelium columbianum</i>	Poaceae	Panic grass	N	none	N	HP
<i>Dichanthelium commutatum</i> ssp. <i>commutatum</i>	Poaceae	Panic grass	N	none	FACU+	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Dichanthelium depauperatum</i>	Poaceae	Poverty panic grass	N	none	N	HP
<i>Dichanthelium dichotomum</i>	Poaceae	Panic grass	N	none	FAC	HP
<i>Dichanthelium latifolium</i>	Poaceae	Panic grass	N	none	FACU-	HP
<i>Dichanthelium linearifolium</i>	Poaceae	Panic grass	N	none	N	HP
<i>Dichanthelium lucidum</i>	Poaceae	Shining panic grass	N	TU/PE	FAC	HP
<i>Dichanthelium meridionale</i>	Poaceae	Panic grass	N	none	N	HP
<i>Dichanthelium microcarpon</i>	Poaceae	Panic grass	N	none	FACU	HP
<i>Dichanthelium oligosanthes</i>	Poaceae	Panic grass	N	N/PT	FACU	HP
<i>Dichanthelium polyanthes</i>	Poaceae	Panic grass	N	N/WA	FACU	HP
<i>Dichanthelium scoparium</i>	Poaceae	Velvety panic grass	N	PE/PE	FACW	HP
<i>Dichanthelium sphaerocarpon</i>	Poaceae	Panic grass	N	none	FACU	HP
<i>Dichanthelium spretum</i>	Poaceae	Panic grass	N	PX/PE	N	HP
<i>Dichanthelium yadkinense</i>	Poaceae	Yadkin River panic grass	N	TU/PE	N	HP
<i>Diervilla lonicera</i>	Caprifoliaceae	Bush-honeysuckle	N	none	N	SD
<i>Digitaria ciliaris</i>	Poaceae	Southern crabgrass	I	none	N	HA
<i>Digitaria cognata</i>	Poaceae	Fall witchgrass	N	none	N	HP
<i>Digitaria filiformis</i>	Poaceae	Slender crabgrass	N	none	N	HA
<i>Digitaria ischaemum</i>	Poaceae	Smooth crabgrass	I	none	UPL	HA
<i>Digitaria sanguinalis</i>	Poaceae	Northern crabgrass	I	none	FACU-	HA
<i>Diodia teres</i>	Rubiaceae	Rough buttonweed	N	none	N	HA
<i>Dioscorea batatas</i>	Dioscoreaceae	Chinese yam	I	none	N	VP
<i>Dioscorea villosa</i>	Dioscoreaceae	Wild yam	N	none	FAC+	VP
<i>Diospyros virginiana</i>	Ebenaceae	Persimmon	N	none	FAC-	TD
<i>Diphasiastrum digitatum</i>	Lycopodiaceae	Deep-rooted running-pine	N	none	FACU-	HP
<i>Diphasiastrum tristachyum</i>	Lycopodiaceae	Deep-rooted running-pine	N	none	N	HP
<i>Diplazium pycnocarpon</i>	Polypodiaceae	Narrow-leaved glade fern	N	none	FAC	HP
<i>Dipsacus sativus</i>	Dipsacaceae	Fuller's teasel	I	none	N	HB
<i>Dipsacus sylvestris</i>	Dipsacaceae	Teasel	I	none	N	HB
<i>Dirca palustris</i>	Thymelaeaceae	Leatherwood	N	none	FAC	SD
<i>Doellingeria infirma</i>	Asteraceae	Flat-topped white aster	N	none	N	HP
<i>Doellingeria umbellata</i>	Asteraceae	Flat-topped white aster	N	none	FACW	HP
<i>Draba reptans</i>	Brassicaceae	Whitlow-grass	N	PX/PX	N	HA

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<i>Draba verna</i>	Brassicaceae	Whitlow-grass	I	none	N	HA
<i>Dryopteris campyloptera</i>	Polypodiaceae	Mountain wood fern	N	PE/PE	N	HP
<i>Dryopteris carthusiana</i>	Polypodiaceae	Spinulose wood fern	N	none	FAC+	HP
<i>Dryopteris celsa</i>	Polypodiaceae	Log fern	N	N/PE	OBL	HP
<i>Dryopteris clintoniana</i>	Polypodiaceae	Clinton's wood fern	N	N/PT	FACW+	HP
<i>Dryopteris cristata</i>	Polypodiaceae	Crested shield fern	N	none	FACW+	HP
<i>Dryopteris goldiana</i>	Polypodiaceae	Goldie's wood fern	N	none	FAC+	HP
<i>Dryopteris intermedia</i>	Polypodiaceae	Evergreen wood-fern	N	none	FACU	HP
<i>Dryopteris marginalis</i>	Polypodiaceae	Marginal wood fern	N	none	FACU-	HP
<i>Dryopteris x boottii</i>	Polypodiaceae	Boott's hybrid wood fern	N	none	N	HP
<i>Dryopteris x slossonae</i>	Polypodiaceae	Boott's hybrid wood fern	N	none	N	HP
<i>Dryopteris x triploidea</i>	Polypodiaceae	Triploid hybrid wood fern	N	none	N	HP
<i>Dryopteris x uliginosa</i>	Polypodiaceae	Braun's wood fern	N	none	N	HP
<i>Duchesnea indica</i>	Rosaceae	Indian strawberry	I	none	FACU-	HP
<i>Dulichium arundinaceum</i> var. <i>arundinaceum</i>	Cyperaceae	Three-way sedge	N	none	OBL	HP
<i>Dysphania ambrosioides</i>	Amaranthaceae	Mexican-tea	I	none	FACU	HA
<i>Dysphania botrys</i>	Amaranthaceae	Feather-geranium	I	none	UPL	HA
<i>Dysphania pumilio</i>	Amaranthaceae	Goosefoot	I	none	N	HA
<i>Echinochloa crusgalli</i> var. <i>crusgalli</i>	Poaceae	Barnyard-grass	I	none	FACU	HA
<i>Echinochloa muricata</i>	Poaceae	Barnyard-grass	N	none	FACW+	HA
<i>Echinochloa walteri</i>	Poaceae	Walter's barnyard-grass	N	PE/PE	FACW+	HA
<i>Echinocystis lobata</i>	Cucurbitaceae	Prickly cucumber	N	none	FAC	VA
<i>Echinops sphaerocephalus</i>	Asteraceae	Globe-thistle	I	none	N	HP
<i>Echium vulgare</i>	Boraginaceae	Viper's bugloss	I	none	N	HB
<i>Eclipta prostrata</i>	Asteraceae	Yerba-de-tajo	N	none	FAC	HA
<i>Egeria densa</i>	Hydrocharitaceae	Brazilian waterweed	I	none	OBL	HP
<i>Elaeagnus umbellata</i>	Elaeagnaceae	Autumn-olive	I	none	N	SD
<i>Elatine americana</i>	Elatinaceae	American waterwort	N	PX/PE	OBL	HA
<i>Elatine minima</i>	Elatinaceae	Small waterwort	N	TU/SP	OBL	HA
<i>Eleocharis acicularis</i>	Cyperaceae	Needle spike-rush	N	none	OBL	HP
<i>Eleocharis engelmannii</i>	Cyperaceae	Spike-rush	N	none	FACW+	HA

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<i>Eleocharis erythropoda</i>	Cyperaceae	Spike-rush	N	none	OBL	HP
<i>Eleocharis intermedia</i>	Cyperaceae	Matted spike-rush	N	PT/PT	FACW+	HA
<i>Eleocharis obtusa</i> var. <i>obtusa</i>	Cyperaceae	Wright's spike-rush	N	none	OBL	HA
<i>Eleocharis obtusa</i> var. <i>peasei</i>	Cyperaceae	Spike-rush	N	PE/PE	OBL	HA
<i>Eleocharis olivacea</i>	Cyperaceae	Capitate spike-rush	N	PR/SP	OBL	HP
<i>Eleocharis palustris</i>	Cyperaceae	Creeping spike-rush	N	none	OBL	HP
<i>Eleocharis parvula</i>	Cyperaceae	Dwarf spike-rush	N	PE/PE	OBL	HP
<i>Eleocharis quadrangulata</i>	Cyperaceae	Four-angled spike-rush	N	PE/PE	OBL	HP
<i>Eleocharis tenuis</i> var. <i>pseudoptera</i>	Cyperaceae	Slender spike-rush	N	none	FACW+	HP
<i>Eleocharis tenuis</i> var. <i>tenuis</i>	Cyperaceae	Spike-rush	N	none	FACW+	HP
<i>Eleocharis tenuis</i> var. <i>verrucosa</i>	Cyperaceae	Slender spike-rush	N	PE/PE	FACW+	HP
<i>Eleusine indica</i>	Poaceae	Goosegrass	I	none	FACU-	HA
<i>Ellisia nyctelea</i>	Boraginaceae	Waterpod	N	PT/PT	FACU	HA
<i>Elodea canadensis</i>	Hydrocharitaceae	Ditch-moss	N	none	OBL	HP
<i>Elodea nuttallii</i>	Hydrocharitaceae	Waterweed	N	none	OBL	HP
<i>Elsholtzia ciliata</i>	Lamiaceae	Elsholtzia	I	none	N	HA
<i>Elymus canadensis</i> var. <i>canadensis</i>	Poaceae	Canada wild-rye	N	none	FACU+	HP
<i>Elymus hystrix</i>	Poaceae	Bottlebrush-grass	N	none	N	HP
<i>Elymus repens</i>	Poaceae	Quackgrass	I	none	FACU-	HP
<i>Elymus riparius</i>	Poaceae	Riverbank wild-rye	N	none	FACW	HP
<i>Elymus villosus</i>	Poaceae	Wild-rye	N	none	FACU-	HP
<i>Elymus virginicus</i>	Poaceae	Virginia wild-rye	N	none	FACW-	HP
<i>Epifagus virginiana</i>	Orobanchaceae	Beechdrops	N	none	N	HA
<i>Epigaea repens</i>	Ericaceae	Trailing-arbutus	N	none	N	SE
<i>Epilobium angustifolium</i>	Onagraceae	Fireweed	N	none	FAC	HP
<i>Epilobium ciliatum</i>	Onagraceae	Willow-herb	N	none	FAC-	HP
<i>Epilobium coloratum</i>	Onagraceae	Purple-leaved willow-herb	N	none	FACW+	HP
<i>Epilobium leptophyllum</i>	Onagraceae	Willow-herb	N	none	OBL	HP
<i>Epilobium strictum</i>	Onagraceae	Downy willow-herb	N	PE/PR	OBL	HP
<i>Epipactis helleborine</i>	Orchidaceae	Bastard hellebore	I	none	UPL	HP
<i>Equisetum arvense</i>	Equisetaceae	Field horsetail	N	none	FAC	HP
<i>Equisetum fluviatile</i>	Equisetaceae	Water horsetail	N	none	OBL	HP
<i>Equisetum hyemale</i>	Equisetaceae	Scouring-rush	N	none	FACW	HP
<i>Equisetum sylvaticum</i>	Equisetaceae	Woodland horsetail	N	none	FACW	HP

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<i>Equisetum x ferrissii</i>	Equisetaceae	Intermediate scouring-rush	N	N/PE	N	HP
<i>Equisetum x litorale</i>	Equisetaceae	Shore horsetail	N	none	N	HP
<i>Eragrostis capillaris</i>	Poaceae	Lacegrass	N	none	N	HA
<i>Eragrostis cilianensis</i>	Poaceae	Stink grass	I	none	FACU	HA
<i>Eragrostis frankii</i>	Poaceae	Lovegrass	N	none	FACW	HA
<i>Eragrostis hypnoides</i>	Poaceae	Creeping lovegrass	N	none	OBL	HA
<i>Eragrostis minor</i>	Poaceae	Lovegrass	I	none	N	HA
<i>Eragrostis pectinacea</i>	Poaceae	Carolina lovegrass	N	none	FAC	HA
<i>Eragrostis pilosa</i>	Poaceae	India lovegrass	I	none	FACU	HA
<i>Eragrostis spectabilis</i>	Poaceae	Purple lovegrass	N	none	UPL	HP
<i>Erechtites hieraciifolius</i>	Asteraceae	Fireweed	N	none	FACU	HA
<i>Erigeron annuus</i>	Asteraceae	Daisy fleabane	N	none	FACU	HA
<i>Erigeron philadelphicus</i>	Asteraceae	Daisy fleabane	N	none	FACU	HP
<i>Erigeron pulchellus</i>	Asteraceae	Robin's-plantain	N	none	FACU	HB
<i>Erigeron strigosus var. strigosus</i>	Asteraceae	Daisy fleabane	N	none	FACU+	HA
<i>Eriocaulon parkeri</i>	Eriocaulaceae	Parkers's pipewort	N	PX/PX	OBL	HP
<i>Eriophorum gracile</i>	Cyperaceae	Slender cotton- grass	N	PE/PE	OBL	HP
<i>Eriophorum virginicum</i>	Cyperaceae	Tawny cotton- grass	N	none	OBL	HP
<i>Erodium cicutarium</i>	Geraniaceae	Red-stem filaree	I	none	N	HA
<i>Erucastrum gallicum</i>	Brassicaceae	Dog-mustard	I	none	N	HA
<i>Eryngium aquaticum</i>	Apiaceae	Marsh eryngo	N	PX/PX	OBL	HP
<i>Erysimum cheiranthoides</i>	Brassicaceae	Treacle-mustard	I	none	FAC	HA
<i>Erysimum repandum</i>	Brassicaceae	Treacle-mustard	I	none	N	HA
<i>Erythronium americanum</i>	Liliaceae	Yellow trout-lily	N	none	N	HP
<i>Eschscholzia californica</i>	Papaveraceae	California poppy	I	none	N	HA
<i>Euonymus alatus</i>	Celastraceae	Winged euonymous	I	none	N	SD
<i>Euonymus americanus</i>	Celastraceae	Hearts-a- bursting	N	N/SP	FAC	SD
<i>Euonymus atropurpureus</i>	Celastraceae	Burning-bush	N	none	FACU	SD
<i>Euonymus europaeus</i>	Celastraceae	European spindletree	I	none	N	SD
<i>Euonymus fortunei</i>	Celastraceae	Wintercreeper	I	none	N	VW
<i>Euonymus hamiltonianus</i>	Celastraceae	Spindle-tree	I	none	N	SD
<i>Eupatorium album</i>	Asteraceae	White-bracted eupatorium	N	PX/PE	N	HP
<i>Eupatorium hyssopifolium</i>	Asteraceae	Hyssop-leaved eupatorium	N	none	N	HP
<i>Eupatorium leucolepis</i>	Asteraceae	White-bracted thoroughwort	N	PX/PX	FACW+	HP

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<i>Eupatorium perfoliatum</i>	Asteraceae	Boneset	N	none	FACW+	HP
<i>Eupatorium pilosum</i>	Asteraceae	Ragged eupatorium	N	N/SP	FACW	HP
<i>Eupatorium rotundifolium var. ovatum</i>	Asteraceae	Round-leaved eupatorium	N	TU/TU	FAC-	HP
<i>Eupatorium rotundifolium var. rotundifolium</i>	Asteraceae	Round-leaved eupatorium	N	TU/TU	FAC-	HP
<i>Eupatorium serotinum</i>	Asteraceae	Late eupatorium	I	none	FAC-	HP
<i>Eupatorium sessilifolium</i>	Asteraceae	Upland eupatorium	N	none	N	HP
<i>Euphorbia corollata</i>	Euphorbiaceae	Flowering spurge	N	none	N	HP
<i>Euphorbia cyparissias</i>	Euphorbiaceae	Cypress spurge	I	none	N	HP
<i>Euphorbia helioscopia</i>	Euphorbiaceae	Wartweed	I	none	N	HA
<i>Euphorbia ippecacuanhae</i>	Euphorbiaceae	Wild ipecac	N	PE/PE	N	HP
<i>Euphorbia lathyris</i>	Euphorbiaceae	Caper spurge	I	none	N	HA
<i>Euphorbia maculata</i>	Euphorbiaceae	Spotted spurge	N	none	FACU-	HA
<i>Euphorbia marginata</i>	Euphorbiaceae	Snow-on-the- mountain	I	none	UPL	HA
<i>Euphorbia nutans</i>	Euphorbiaceae	Eyebane	N	none	FACU-	HA
<i>Euphorbia vermiculata</i>	Euphorbiaceae	Hairy spurge	N	none	N	HA
<i>Eurybia divaricata</i>	Asteraceae	White wood aster	N	none	N	HP
<i>Eurybia macrophylla</i>	Asteraceae	Bigleaf aster	N	none	N	HP
<i>Eurybia radula</i>	Asteraceae	Rough aster	N	N/PT	OBL	HP
<i>Eurybia schreberi</i>	Asteraceae	Schreber's aster	N	none	N	HP
<i>Eurybia spectabilis</i>	Asteraceae	Showy aster	N	PE/PE	N	HP
<i>Euthamia caroliniana</i>	Asteraceae	Grass-leaved goldenrod	N	PT/PT	FAC	HP
<i>Euthamia graminifolia</i>	Asteraceae	Grass-leaved goldenrod	N	none	FAC	HP
<i>Eutrochium dubium</i>	Asteraceae	Joe-pye-weed	N	none	FACW	HP
<i>Eutrochium fistulosum</i>	Asteraceae	Joe-pye-weed	N	none	FACW	HP
<i>Eutrochium maculatum</i>	Asteraceae	Spotted joe-pye- weed	N	none	N	HP
<i>Eutrochium purpureum</i>	Asteraceae	Joe-pye-weed	N	none	N	HP
<i>Fagopyrum esculentum</i>	Polygonaceae	Buckwheat	I	none	N	HA
<i>Fagus grandifolia</i>	Fagaceae	American beech	N	none	FACU	TD
<i>Fallopia cilinodis</i>	Polygonaceae	Fringed bindweed	N	none	N	VP
<i>Fallopia convolvulus</i>	Polygonaceae	Black bindweed	I	none	FACU	VA
<i>Fallopia dumetorum</i>	Polygonaceae	Climbing false- buckwheat	I	none	FAC	VP
<i>Fallopia japonica</i>	Polygonaceae	Japanese knotweed	I	none	FACU-	HP
<i>Fallopia sachalinensis</i>	Polygonaceae	Giant knotweed	I	none	UPL	HP
<i>Fallopia scandens</i>	Polygonaceae	Climbing false-	N	none	FAC	VP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
		buckwheat				
<i>Festuca obtusa</i>	Poaceae	Nodding fescue	N	none	FACU	HP
<i>Festuca ovina</i>	Poaceae	Sheep fescue	I	none	N	HP
<i>Festuca rubra</i>	Poaceae	Red fescue	I	none	FACU	HP
<i>Festuca tenuifolia</i>	Poaceae	Hair fescue	I	none	N	HP
<i>Filago vulgaris</i>	Asteraceae	Cotton-rose	I	none	N	HA
<i>Filipendula rubra</i>	Rosaceae	Queen-of-the-prairie	N	TU/TU	FACW	HP
<i>Fimbristylis autumnalis</i>	Cyperaceae	Slender fimbry	N	none	FACW+	HA
<i>Floerkea proserpinacoides</i>	Limnanthaceae	False-mermaid	N	none	FAC	HA
<i>Fragaria vesca</i> ssp. <i>americana</i>	Rosaceae	Sow-teat strawberry	N	none	N	HP
<i>Fragaria vesca</i> ssp. <i>vesca</i>	Rosaceae	Sow-teat strawberry	I	none	N	HP
<i>Fragaria virginiana</i>	Rosaceae	Wild strawberry	N	none	FACU	HP
<i>Fraxinus americana</i> var. <i>americana</i>	Oleaceae	White ash	N	none	FACU	TD
<i>Fraxinus americana</i> var. <i>biltmoreana</i>	Oleaceae	Biltmore ash	N	none	FACU	TD
<i>Fraxinus nigra</i>	Oleaceae	Black ash	N	none	FACW	TD
<i>Fraxinus pennsylvanica</i>	Oleaceae	Red ash	N	none	FACW	TD
<i>Froelichia gracilis</i>	Amaranthaceae	Cottonweed	I	none	N	HA
<i>Fumaria officinalis</i>	Papaveraceae	Common fumitory	I	none	N	HA
<i>Galanthus nivalis</i>	Alliaceae	Snowdrop	I	none	N	HP
<i>Galearis spectabilis</i>	Orchidaceae	Showy orchis	N	none	N	HP
<i>Galeopsis bifida</i>	Lamiaceae	Hemp-nettle	I	none	N	HA
<i>Galinsoga parviflora</i> var. <i>parviflora</i>	Asteraceae	Small-flowered quickweed	I	none	N	HA
<i>Galinsoga quadriradiata</i>	Asteraceae	Quickweed	I	none	N	HA
<i>Galium aparine</i>	Rubiaceae	Bedstraw	N	none	FACU	HA
<i>Galium asprellum</i>	Rubiaceae	Rough bedstraw	N	none	OBL	HP
<i>Galium boreale</i>	Rubiaceae	Northern bedstraw	N	none	FACU	HP
<i>Galium circaezans</i> var. <i>circaezans</i>	Rubiaceae	Wild licorice	N	none	UPL	HP
<i>Galium circaezans</i> var. <i>hypomalacum</i>	Rubiaceae	Wild licorice	N	none	UPL	HP
<i>Galium concinnum</i>	Rubiaceae	Shining bedstraw	N	none	UPL	HP
<i>Galium lanceolatum</i>	Rubiaceae	Wild licorice	N	none	N	HP
<i>Galium mollugo</i>	Rubiaceae	White bedstraw	I	none	N	HP
<i>Galium obtusum</i>	Rubiaceae	Cleavers	N	none	FACW+	HP
<i>Galium pedemontanum</i>	Rubiaceae	Bedstraw	I	none	N	HA
<i>Galium pilosum</i>	Rubiaceae	Bedstraw	N	none	N	HP
<i>Galium tinctorium</i>	Rubiaceae	Bedstraw	N	none	OBL	HP
<i>Galium triflorum</i>	Rubiaceae	Sweet-scented bedstraw	N	none	FACU	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Galium verum</i> var. <i>verum</i>	Rubiaceae	Our-lady's bedstraw	I	none	N	HP
<i>Gamochaeta purpurea</i> var. <i>purpurea</i>	Asteraceae	Purple cudweed	N	none	N	HA
<i>Gaultheria procumbens</i>	Ericaceae	Teaberry	N	none	FACU	SE
<i>Gaura biennis</i>	Onagraceae	Gaura	N	none	FACU	HA
<i>Gaylussacia baccata</i>	Ericaceae	Black huckleberry	N	none	FACU	SD
<i>Gaylussacia frondosa</i>	Ericaceae	Dangleberry	N	none	FAC	SD
<i>Gentiana alba</i>	Gentianaceae	Yellowish gentian	N	TU/PX	FACU	HP
<i>Gentiana andrewsii</i>	Gentianaceae	Bottle gentian	N	none	FACW	HP
<i>Gentiana clausa</i>	Gentianaceae	Meadow closed gentian	N	none	FACW	HP
<i>Gentiana saponaria</i>	Gentianaceae	Soapwort gentian	N	TU/PE	FACW	HP
<i>Gentianella quinquefolia</i>	Gentianaceae	Stiff gentian	N	none	FAC	HA
<i>Gentianopsis crinita</i>	Gentianaceae	Eastern fringed gentian	N	none	OBL	HA
<i>Geranium carolinianum</i>	Geraniaceae	Wild geranium	N	none	N	HA
<i>Geranium columbinum</i>	Geraniaceae	Long-stalked cranesbill	I	none	N	HA
<i>Geranium dissectum</i>	Geraniaceae	Cut-leaved cranesbill	I	none	N	HA
<i>Geranium maculatum</i>	Geraniaceae	Wood geranium	N	none	FACU	HP
<i>Geranium molle</i>	Geraniaceae	Dove's-foot cranesbill	I	none	N	HA
<i>Geranium pusillum</i>	Geraniaceae	Slender cranesbill	I	none	N	HA
<i>Geranium robertianum</i>	Geraniaceae	Herb-robert	N	none	N	HA
<i>Geum aleppicum</i>	Rosaceae	Yellow avens	I	none	FAC	HP
<i>Geum canadense</i>	Rosaceae	White avens	N	none	FACU	HP
<i>Geum laciniatum</i>	Rosaceae	Herb-bennet	N	none	FAC+	HP
<i>Geum vernum</i>	Rosaceae	Spring avens	N	none	FACU	HP
<i>Geum virginianum</i>	Rosaceae	Cream-colored avens	N	none	FAC-	HP
<i>Gillenia trifoliata</i>	Rosaceae	Bowman's-root	N	none	N	HP
<i>Ginkgo biloba</i>	Ginkgoaceae	Maidenhair tree	I	none	N	TD
<i>Glechoma hederacea</i>	Lamiaceae	Gill-over-the-ground	I	none	FACU	HP
<i>Gleditsia triacanthos</i>	Fabaceae	Honey-locust	N	none	FAC-	TD
<i>Glossostigma cleistanthum</i>	Phrymaceae	Mudmat	I	none	N	HA
<i>Glyceria acutiflora</i>	Poaceae	Mannagrass	N	none	OBL	HP
<i>Glyceria canadensis</i>	Poaceae	Rattlesnake mannagrass	N	none	OBL	HP
<i>Glyceria grandis</i>	Poaceae	American mannagrass	N	none	OBL	HP
<i>Glyceria melicaria</i>	Poaceae	Slender mannagrass	N	none	OBL	HP
<i>Glyceria septentrionalis</i>	Poaceae	Floating	N	none	OBL	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
		mannagrass				
<i>Glyceria striata</i>	Poaceae	Fowl mannagrass	N	none	OBL	HP
<i>Gnaphalium uliginosum</i>	Asteraceae	Low cudweed	N	none	FAC	HA
<i>Goodyera pubescens</i>	Orchidaceae	Downy rattlesnake- plantain	N	none	FACU-	HP
<i>Gratiola aurea</i>	Plantaginaceae	Goldenpert	N	TU/PE	OBL	HP
<i>Gratiola neglecta</i>	Plantaginaceae	Hedge hyssop	N	none	OBL	HA
<i>Gymnocladus dioicus</i>	Fabaceae	Kentucky coffee- tree	N	none	N	TD
<i>Hackelia virginiana</i>	Boraginaceae	Beggar's-lice	N	none	FACU	HB
<i>Halesia carolina</i>	Styracaceae	Carolina silverbell	I	none	N	TD
<i>Hamamelis virginiana</i>	Hamamelidaceae	Witch-hazel	N	none	FACU+	SD
<i>Hedeoma pulegioides</i>	Lamiaceae	American pennyroyal	N	none	N	HA
<i>Hedera helix</i>	Araliaceae	English ivy	I	none	N	VW
<i>Helenium amarum</i>	Asteraceae	Sneezeweed	I	none	FACU-	HA
<i>Helenium autumnale</i>	Asteraceae	Common sneezeweed	N	none	FACW+	HP
<i>Helenium flexuosum</i>	Asteraceae	Southern sneezeweed	I	none	FAC-	HP
<i>Helianthemum bicknellii</i>	Cistaceae	Bicknell's hoary rockrose	N	PE/PE	N	HP
<i>Helianthemum canadense</i>	Cistaceae	Frostweed	N	none	N	HP
<i>Helianthemum propinquum</i>	Cistaceae	Frostweed	N	N/TU	N	HP
<i>Helianthus angustifolius</i>	Asteraceae	Swamp sunflower	N	PX/PX	FACW	HP
<i>Helianthus annuus</i>	Asteraceae	Common sunflower	I	none	FAC-	HA
<i>Helianthus decapetalus</i>	Asteraceae	Thin-leaved sunflower	N	none	FACU	HP
<i>Helianthus divaricatus</i>	Asteraceae	Rough sunflower	N	none	N	HP
<i>Helianthus giganteus</i>	Asteraceae	Swamp sunflower	N	none	FACW	HP
<i>Helianthus grosseserratus</i>	Asteraceae	Sawtooth sunflower	I	none	FACW	HP
<i>Helianthus laetiflorus</i>	Asteraceae	Showy sunflower	I	none	N	HP
<i>Helianthus maximiliani</i>	Asteraceae	Maximilian's sunflower	I	none	UPL	HP
<i>Helianthus mollis</i>	Asteraceae	Ashy sunflower	I	none	N	HP
<i>Helianthus petiolaris</i> <i>ssp. petiolaris</i>	Asteraceae	Sunflower	I	none	N	HA
<i>Helianthus strumosus</i>	Asteraceae	Rough-leaved sunflower	N	none	N	HP
<i>Helianthus tuberosus</i>	Asteraceae	Jerusalem artichoke	I	none	FAC	HP
<i>Heliopsis helianthoides</i>	Asteraceae	Ox-eye	N	none	N	HP

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<i>Heliotropium europaeum</i>	Boraginaceae	European heliotrope	I	none	N	HA
<i>Hemerocallis fulva</i>	Hemerocallidaceae	Orange day-lily	I	none	UPL	HP
<i>Heracleum lanatum</i>	Apiaceae	Cow-parsnip	N	none	FACU-	HP
<i>Hesperis matronalis</i>	Brassicaceae	Dame's-rocket	I	none	N	HP
<i>Heteranthera dubia</i>	Pontederiaceae	Water star-grass	N	none	OBL	HP
<i>Heteranthera multiflora</i>	Pontederiaceae	Mud-plantain	N	PE/PE	OBL	HP
<i>Heteranthera reniformis</i>	Pontederiaceae	Mud-plantain	N	none	OBL	HP
<i>Heterotheca subaxillaris</i>	Asteraceae	Camphorweed	I	none	UPL	HA
<i>Heuchera americana</i>	Saxifragaceae	Alum-root	N	none	N	HP
<i>Hibiscus moscheutos</i>	Malvaceae	Rose-mallow	N	none	OBL	HP
<i>Hibiscus syriacus</i>	Malvaceae	Rose-of-sharon	I	none	N	SD
<i>Hibiscus trionum</i>	Malvaceae	Flower-of-the-hour	I	none	N	HA
<i>Hieracium aurantiacum</i>	Asteraceae	Orange hawkweed	I	none	N	HP
<i>Hieracium caespitosum</i>	Asteraceae	King-devil	I	none	N	HP
<i>Hieracium flagellare</i>	Asteraceae	Hawkweed	I	none	N	HP
<i>Hieracium gronovii</i>	Asteraceae	Hawkweed	N	none	UPL	HP
<i>Hieracium lachenalii</i>	Asteraceae	European hawkweed	I	none	N	HP
<i>Hieracium paniculatum</i>	Asteraceae	Hawkweed	N	none	N	HP
<i>Hieracium piloselloides</i>	Asteraceae	King-devil	I	none	N	HP
<i>Hieracium sabaudum</i>	Asteraceae	Hawkweed	I	none	N	HP
<i>Hieracium scabrum</i>	Asteraceae	Hawkweed	N	none	N	HP
<i>Hieracium umbellatum</i>	Asteraceae	Canada hawkweed	N	N/PE	N	HP
<i>Hieracium venosum</i>	Asteraceae	Rattlesnake-weed	N	none	N	HP
<i>Holcus lanatus</i>	Poaceae	Velvetgrass	I	none	FACU	HP
<i>Hordeum jubatum</i>	Poaceae	Foxtail-barley	N	none	FAC	HP
<i>Hordeum pusillum</i>	Poaceae	Little-barley	N	PX/PX	FAC	HA
<i>Hordeum vulgare</i>	Poaceae	Barley	I	none	N	HA
<i>Hosta lancifolia</i>	Agavaceae	Narrow-leaved plantain-lily	I	none	N	HP
<i>Hosta ventricosa</i>	Agavaceae	Blue plantain-lily	I	none	N	HP
<i>Hottonia inflata</i>	Primulaceae	American featherfoil	N	PX/PX	OBL	HP
<i>Houstonia caerulea</i>	Rubiaceae	Bluets	N	none	FACU	HP
<i>Humulus japonicus</i>	Cannabaceae	Japanese hops	I	none	FACU	HP
<i>Humulus lupulus var. lupuloides</i>	Cannabaceae	Brewer's hops	N	none	N	HP
<i>Humulus lupulus var. lupulus</i>	Cannabaceae	Brewer's hops	N	none	N	HP
<i>Humulus lupulus var. pubescens</i>	Cannabaceae	Brewer's hops	I	none	N	HP
<i>Huperzia lucidula</i>	Lycopodiaceae	Shining firmoss	N	none	FACW-	HP

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<i>Hybanthus concolor</i>	Violaceae	Green-violet	N	none	FACU-	HP
<i>Hydrangea arborescens</i>	Hydrangeaceae	Sevenbark	N	none	FACU	SD
<i>Hydrangea paniculata</i>	Hydrangeaceae	Peegee hydrangea	I	none	FAC	SD
<i>Hydrastis canadensis</i>	Ranunculaceae	Goldenseal	N	PV/PV	N	HP
<i>Hydrilla verticillata</i>	Hydrocharitaceae	Hydrilla	I	none	OBL	HP
<i>Hydrocotyle americana</i>	Araliaceae	Marsh pennywort	N	none	OBL	HP
<i>Hydrocotyle ranunculoides</i>	Araliaceae	Floating pennywort	N	none	OBL	HP
<i>Hydrocotyle sibthorpioides</i>	Araliaceae	Lawn pennywort	I	none	N	HP
<i>Hydrocotyle umbellata</i>	Araliaceae	Water pennywort	N	PX/PX	OBL	HP
<i>Hydrophyllum canadense</i>	Boraginaceae	Canadian waterleaf	N	none	N	HP
<i>Hydrophyllum virginianum</i>	Boraginaceae	Virginia waterleaf	N	none	FAC	HP
<i>Hypericum adpressum</i>	Hypericaceae	Creeping St.John's-wort	N	PX/PX	OBL	HP
<i>Hypericum boreale</i>	Hypericaceae	Dwarf St.John's- wort	N	none	OBL	HP
<i>Hypericum canadense</i>	Hypericaceae	Canadian St.John's-wort	N	none	FACW	HA
<i>Hypericum crux- andreae</i>	Hypericaceae	St.Peter's-wort	N	PX/PX	FACU	SD
<i>Hypericum denticulatum</i>	Hypericaceae	Coppery St.Johns-wort	N	PX/PX	FACW-	HP
<i>Hypericum dissimulatum</i>	Hypericaceae	St.John's-wort	N	N/SP	FACW	HP
<i>Hypericum ellipticum</i>	Hypericaceae	Pale St. John's- wort	N	none	OBL	HP
<i>Hypericum gentianoides</i>	Hypericaceae	Orange-grass	N	none	UPL	HA
<i>Hypericum mutilum</i>	Hypericaceae	Dwarf St. John's-wort	N	none	FACW	HP
<i>Hypericum perforatum</i>	Hypericaceae	St. John's-wort	I	none	N	HP
<i>Hypericum prolificum</i>	Hypericaceae	Shrubby St. John's-wort	N	none	FACU	SD
<i>Hypericum punctatum</i>	Hypericaceae	Spotted St. John's-wort	N	none	FAC-	HP
<i>Hypericum pyramidatum</i>	Hypericaceae	Great St. John's- wort	N	none	FAC	HP
<i>Hypericum stragulum</i>	Hypericaceae	St. Andrew's- cross	N	N/PT	N	SD
<i>Hypochoeris radicata</i>	Asteraceae	Cat's-ear	I	none	N	HP
<i>Hypoxis hirsuta</i>	Hypoxidaceae	Yellow star- grass	N	none	FAC	HP
<i>Ilex crenata</i>	Aquifoliaceae	Japanese Holly	I	none	N	SE
<i>Ilex glabra</i>	Aquifoliaceae	Inkberry	N	PX/PX	FACW-	SE
<i>Ilex laevigata</i>	Aquifoliaceae	Smooth winterberry	N	none	OBL	SD
<i>Ilex opaca</i>	Aquifoliaceae	American holly	N	PT/PT	FACU	TE
<i>Ilex verticillata</i>	Aquifoliaceae	Winterberry	N	none	FACW+	SD
<i>Impatiens balsamina</i>	Balsaminaceae	Garden balsam	I	none	N	HA

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Impatiens capensis</i>	Balsaminaceae	Jewelweed	N	none	FACW	HA
<i>Impatiens pallida</i>	Balsaminaceae	Pale jewelweed	N	none	FACW	HA
<i>Inula helenium</i>	Asteraceae	Elecampane	I	none	N	HP
<i>Ionactis linariifolius</i>	Asteraceae	Stiff-leaved aster	N	none	N	HP
<i>Ipomoea coccinea</i>	Convolvulaceae	Red morning- glory	I	none	FACU	VA
<i>Ipomoea hederacea</i>	Convolvulaceae	Ivy-leaved morning-glory	I	none	FACU	VA
<i>Ipomoea lacunosa</i>	Convolvulaceae	White morning- glory	N	none	FACW	VA
<i>Ipomoea pandurata</i>	Convolvulaceae	Man-of-the-earth	N	none	FACU	VP
<i>Ipomoea purpurea</i>	Convolvulaceae	Common morning-glory	I	none	UPL	VA
<i>Ipomoea quamoclit</i>	Convolvulaceae	Cypress-vine	I	none	UPL	VA
<i>Iris germanica</i>	Iridaceae	Bearded iris	I	none	N	HP
<i>Iris prismatica</i>	Iridaceae	Slender blue flag	N	PE/PE	OBL	HP
<i>Iris pseudacorus</i>	Iridaceae	Water flag	I	none	OBL	HP
<i>Iris versicolor</i>	Iridaceae	Northern blue flag	N	none	OBL	HP
<i>Isoetes engelmannii</i>	Isoetaceae	Engelmann's quillwort	N	none	OBL	HP
<i>Isoetes riparia</i>	Isoetaceae	Shore quillwort	N	none	OBL	HP
<i>Isoetes valida</i>	Isoetaceae	Strong quillwort	N	N/PR	OBL	HP
<i>Isoetes x dodgei</i>	Isoetaceae	Dodge's quillwort	N	none	OBL	HP
<i>Isotria verticillata</i>	Orchidaceae	Whorled- pogonia	N	none	FACU	HP
<i>Itea virginica</i>	Iteaceae	Tassel-white	N	PX/PE	OBL	SD
<i>Ixeris stolonifera</i>	Asteraceae	Creeping lettuce	I	none	N	HP
<i>Jeffersonia diphylla</i>	Berberidaceae	Twinleaf	N	none	N	HP
<i>Juglans cinerea</i>	Juglandaceae	Butternut	N	N/SP	FACU+	TD
<i>Juglans nigra</i>	Juglandaceae	Black walnut	N	none	FACU	TD
<i>Juncus acuminatus</i>	Juncaceae	Sharp-fruited rush	N	none	OBL	HP
<i>Juncus biflorus</i>	Juncaceae	Grass rush	N	TU/PT	FACW	HP
<i>Juncus bufonius</i>	Juncaceae	Toad rush	N	none	FACW	HA
<i>Juncus canadensis</i>	Juncaceae	Canada rush	N	none	OBL	HP
<i>Juncus debilis</i>	Juncaceae	Weak rush	N	N/PT	OBL	HP
<i>Juncus dichotomus</i>	Juncaceae	Forked rush	N	PE/PE	FACW-	HP
<i>Juncus dudleyi</i>	Juncaceae	Rush	N	none	N	HP
<i>Juncus effusus</i> var. <i>pylaei</i>	Juncaceae	Soft rush	N	none	FACW+	HP
<i>Juncus effusus</i> var. <i>solutus</i>	Juncaceae	Soft rush	N	none	OBL	HP
<i>Juncus inflexus</i>	Juncaceae	Meadow rush	I	none	FACW	HP
<i>Juncus marginatus</i>	Juncaceae	Grass-leaved rush	N	none	FACW	HP

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<i>Juncus nodosus</i>	Juncaceae	Knotted rush	N	none	OBL	HP
<i>Juncus scirpoides</i>	Juncaceae	Sedge rush	N	PE/PE	FACW	HP
<i>Juncus secundus</i>	Juncaceae	Rush	N	none	FACU	HP
<i>Juncus subcaudatus</i>	Juncaceae	Rush	N	none	OBL	HP
<i>Juncus tenuis</i> var. <i>tenuis</i>	Juncaceae	Path rush	N	none	FAC-	HP
<i>Juncus torreyi</i>	Juncaceae	Torrey's rush	N	PT/PR	FACW	HP
<i>Juniperus communis</i>	Cupressaceae	Common juniper	N	N/TU	N	SE
<i>Juniperus virginiana</i>	Cupressaceae	Eastern red- cedar	N	none	FACU	TE
<i>Justicia americana</i>	Acanthaceae	Water-willow	N	none	OBL	HP
<i>Kalmia angustifolia</i>	Ericaceae	Sheep laurel	N	none	FAC	SE
<i>Kalmia latifolia</i>	Ericaceae	Mountain laurel	N	none	FACU	SE
<i>Kickxia elatine</i>	Plantaginaceae	Cancerwort	I	none	FAC	HA
<i>Kochia scoparia</i>	Amaranthaceae	Belvedere	I	none	UPL	HA
<i>Koelreuteria paniculata</i>	Sapindaceae	Golden rain-tree	I	none	N	TD
<i>Krigia biflora</i>	Asteraceae	Dwarf dandelion	N	none	FACW	HP
<i>Krigia virginica</i>	Asteraceae	Dwarf dandelion	N	none	UPL	HA
<i>Kummerowia stipulacea</i>	Fabaceae	Korean- lespedeza	I	none	FACU	HA
<i>Kummerowia striata</i>	Fabaceae	Japanese clover	I	none	FACU	HA
<i>Lactuca biennis</i>	Asteraceae	Blue lettuce	N	none	FACU	HA
<i>Lactuca canadensis</i>	Asteraceae	Wild lettuce	N	none	FACU-	HA
<i>Lactuca floridana</i> var. <i>floridana</i>	Asteraceae	Woodland lettuce	N	none	FACU-	HA
<i>Lactuca floridana</i> var. <i>villosa</i>	Asteraceae	Woodland lettuce	N	none	FACU-	HA
<i>Lactuca serriola</i>	Asteraceae	Prickly lettuce	I	none	FAC-	HA
<i>Lamium album</i>	Lamiaceae	Snowflake	I	none	N	HP
<i>Lamium amplexicaule</i>	Lamiaceae	Henbit	I	none	N	HA
<i>Lamium maculatum</i>	Lamiaceae	Spotted dead- nettle	I	none	N	HP
<i>Lamium purpureum</i>	Lamiaceae	Purple dead- nettle	I	none	N	HA
<i>Laportea canadensis</i>	Urticaceae	Wood-nettle	N	none	FAC	HP
<i>Lappula squarrosa</i>	Boraginaceae	Beggar's-lice	I	none	N	HA
<i>Lapsana communis</i>	Asteraceae	Nipplewort	I	none	N	HA
<i>Larix decidua</i>	Pinaceae	European larch	I	none	N	TD
<i>Lathyrus latifolius</i>	Fabaceae	Perennial sweetpea	I	none	N	VP
<i>Lathyrus palustris</i>	Fabaceae	Marsh pea	N	TU/PE	FACW+	VP
<i>Lechea minor</i>	Cistaceae	Thyme-leaved pinweed	N	N/PE	N	HP
<i>Lechea pulchella</i>	Cistaceae	Pinweed	N	none	N	HP
<i>Lechea racemulosa</i>	Cistaceae	Pinweed	N	none	N	HP
<i>Lechea villosa</i>	Cistaceae	Pinweed	N	N/SP	N	HP

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<i>Leersia oryzoides</i>	Poaceae	Rice cutgrass	N	none	OBL	HP
<i>Leersia virginica</i>	Poaceae	Cutgrass	N	none	FACW	HP
<i>Lemna minor</i>	Araceae	Duckweed	N	none	OBL	HP
<i>Lemna perpusilla</i>	Araceae	Duckweed	N	N/TU	OBL	HP
<i>Lemna trisulca</i>	Araceae	Star duckweed	N	none	OBL	HP
<i>Lemna turionifera</i>	Araceae	Winter duckweed	N	TU/TU	OBL	HP
<i>Lemna valdiviana</i>	Araceae	Pale duckweed	N	PX/PX	OBL	HP
<i>Leontodon autumnalis</i>	Asteraceae	Fall-dandelion	I	none	N	HP
<i>Leontodon saxatilis</i> ssp. <i>saxatilis</i>	Asteraceae	Hawkbit	I	none	FACU	HP
<i>Leonurus cardiaca</i>	Lamiaceae	Common motherwort	I	none	N	HP
<i>Leonurus marrubiastrum</i>	Lamiaceae	Motherwort	I	none	N	HB
<i>Lepidium campestre</i>	Brassicaceae	Fieldcress	I	none	N	HA
<i>Lepidium densiflorum</i>	Brassicaceae	Wild pepper- grass	I	none	FAC	HA
<i>Lepidium virginicum</i>	Brassicaceae	Poor-man's- pepper	N	none	FACU-	HA
<i>Leptochloa panicea</i>	Poaceae	Red sprangletop	I	none	FACW	HA
<i>Lespedeza capitata</i>	Fabaceae	Round-headed bush-clover	N	none	FACU-	HP
<i>Lespedeza capitata</i> x <i>virginica</i>	Fabaceae	Lespedeza	N	none	N	HP
<i>Lespedeza cuneata</i>	Fabaceae	Bush-clover	I	none	N	HP
<i>Lespedeza hirta</i>	Fabaceae	Bush-clover	N	none	N	HP
<i>Lespedeza hirta</i> x <i>intermedia</i>	Fabaceae	Nuttall's bush- clover	N	none	N	HP
<i>Lespedeza intermedia</i>	Fabaceae	Bush-clover	N	none	N	HP
<i>Lespedeza procumbens</i>	Fabaceae	Trailing bush- clover	N	none	N	HP
<i>Lespedeza repens</i>	Fabaceae	Creeping bush- clover	N	none	N	HP
<i>Lespedeza stuevei</i>	Fabaceae	Tall bush-clover	N	PX/PX	N	HP
<i>Lespedeza violacea</i>	Fabaceae	Slender bush- clover	N	none	N	HP
<i>Lespedeza virginica</i>	Fabaceae	Slender bush- clover	N	none	N	HP
<i>Leucanthemum vulgare</i>	Asteraceae	Ox-eye daisy	I	none	N	HP
<i>Leucothoe racemosa</i>	Ericaceae	Fetter-bush	N	TU/PT	FACW	SD
<i>Liatris spicata</i> var. <i>spicata</i>	Asteraceae	Blazing-star	N	none	FAC+	HP
<i>Ligustrum amurense</i>	Oleaceae	Amur privet	I	none	N	SD
<i>Ligustrum obtusifolium</i>	Oleaceae	Obtuse-leaved privet	I	none	N	SD
<i>Ligustrum ovalifolium</i>	Oleaceae	California privet	I	none	N	SD
<i>Ligustrum vulgare</i>	Oleaceae	Common privet	I	none	FACU	SD
<i>Lilium canadense</i> ssp. <i>canadense</i>	Liliaceae	Canada lily	N	none	FAC+	HP
<i>Lilium lancifolium</i>	Liliaceae	Tiger lily	I	none	N	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Lilium philadelphicum</i>	Liliaceae	Wood lily	N	none	FACU+	HP
<i>Lilium superbum</i>	Liliaceae	Turk's-cap lily	N	none	FACW+	HP
<i>Limosella australis</i>	Plantaginaceae	Awl-shaped mudwort	N	PX/PX	OBL	HA
<i>Linaria canadensis</i>	Plantaginaceae	Old-field toadflax	N	none	N	HA
<i>Linaria genistifolia</i> ssp. <i>dalmatica</i>	Plantaginaceae	Toadflax	I	none	N	HP
<i>Linaria vulgaris</i>	Plantaginaceae	Butter-and-eggs	I	none	N	HP
<i>Lindera benzoin</i>	Lauraceae	Spicebush	N	none	FACW-	SD
<i>Lindernia dubia</i> var. <i>anagallidea</i>	Plantaginaceae	False pimpernel	N	none	OBL	HA
<i>Lindernia dubia</i> var. <i>dubia</i>	Plantaginaceae	False pimpernel	N	none	OBL	HA
<i>Lindernia dubia</i> var. <i>inundata</i>	Plantaginaceae	False pimpernel	N	none	OBL	HA
<i>Linum intercursum</i>	Linaceae	Sandplain wild flax	N	PE/PE	N	HP
<i>Linum medium</i> var. <i>texanum</i>	Linaceae	Yellow flax	N	none	FACU	HP
<i>Linum striatum</i>	Linaceae	Ridged yellow flax	N	none	FACW	HP
<i>Linum usitatissimum</i>	Linaceae	Common flax	I	none	N	HA
<i>Linum virginianum</i>	Linaceae	Slender yellow flax	N	none	FACU	HP
<i>Liparis liliifolia</i>	Orchidaceae	Lily-leaved twayblade	N	none	FACU-	HP
<i>Liparis loeselii</i>	Orchidaceae	Yellow twayblade	N	none	FACW	HP
<i>Liquidambar styraciflua</i>	Altingiaceae	Sweetgum	N	none	FAC	TD
<i>Liriodendron tulipifera</i>	Magnoliaceae	Tuliptree	N	none	FACU	TD
<i>Listera australis</i>	Orchidaceae	Southern twayblade	N	PE/PE	FACW	HP
<i>Listera cordata</i>	Orchidaceae	Heartleaf twayblade	N	PE/PE	FACW+	HP
<i>Lobelia cardinalis</i>	Campanulaceae	Cardinal-flower	N	none	FACW+	HP
<i>Lobelia chinensis</i>	Campanulaceae	Chinese lobelia	I	none	N	HP
<i>Lobelia inflata</i>	Campanulaceae	Indian-tobacco	N	none	FACU	HA
<i>Lobelia nuttallii</i>	Campanulaceae	Nuttall's lobelia	N	PX/PX	FACW	HP
<i>Lobelia siphilitica</i>	Campanulaceae	Great blue lobelia	N	none	FACW+	HP
<i>Lobelia spicata</i> var. <i>spicata</i>	Campanulaceae	Spiked lobelia	N	none	FAC	HP
<i>Lobularia maritima</i>	Brassicaceae	Sweet alyssum	I	none	N	HA
<i>Lolium multiflorum</i>	Poaceae	Ryegrass	I	none	N	HP
<i>Lolium perenne</i>	Poaceae	Perennial ryegrass	I	none	FACU-	HP
<i>Lolium temulentum</i>	Poaceae	Darnel	I	none	N	HA
<i>Lonicera dioica</i> var. <i>dioica</i>	Caprifoliaceae	Mountain honeysuckle	N	none	FACU	SD
<i>Lonicera fragrantissima</i>	Caprifoliaceae	Fragrant honeysuckle	I	none	N	SD

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<i>Lonicera japonica</i>	Caprifoliaceae	Japanese honeysuckle	I	none	FAC-	VW
<i>Lonicera maackii</i>	Caprifoliaceae	Amur honeysuckle	I	none	N	SD
<i>Lonicera morrowii</i>	Caprifoliaceae	Morrow's honeysuckle	I	none	N	SD
<i>Lonicera oblongifolia</i>	Caprifoliaceae	Swamp fly honeysuckle	N	PE/PE	OBL	SD
<i>Lonicera sempervirens</i>	Caprifoliaceae	Trumpet honeysuckle	N	none	FACU	VW
<i>Lonicera standishii</i>	Caprifoliaceae	Honeysuckle	I	none	N	SD
<i>Lonicera tatarica</i>	Caprifoliaceae	Tartarian honeysuckle	I	none	FACU	SD
<i>Lonicera x bella</i>	Caprifoliaceae	Pretty honeysuckle	I	none	FACU-	SD
<i>Lotus corniculatus</i>	Fabaceae	Bird's-foot trefoil	I	none	FACU-	HP
<i>Ludwigia alternifolia</i>	Onagraceae	False loosestrife	N	none	FACW+	HP
<i>Ludwigia hexapetala</i>	Onagraceae	Water-primrose	I	none	OBL	HP
<i>Ludwigia palustris</i>	Onagraceae	Marsh-purslane	N	none	OBL	HP
<i>Ludwigia peploides ssp. glabrescens</i>	Onagraceae	Primrose-willow	N	none	OBL	HP
<i>Ludwigia sphaerocarpa</i>	Onagraceae	Spherical-fruited seedbox	N	PX/PX	OBL	HP
<i>Lunaria annua</i>	Brassicaceae	Honesty	I	none	N	HB
<i>Lupinus perennis</i>	Fabaceae	Blue lupine	N	PR/PR	N	HP
<i>Luzula acuminata</i>	Juncaceae	Hairy woodrush	N	none	FAC	HP
<i>Luzula bulbosa</i>	Juncaceae	Woodrush	N	TU/PE	FACU	HP
<i>Luzula echinata</i>	Juncaceae	Common woodrush	N	none	FACU	HP
<i>Luzula multiflora</i>	Juncaceae	Field woodrush	N	none	FACU	HP
<i>Lycium barbarum</i>	Solanaceae	Matrimony-vine	I	none	N	SD
<i>Lycopodiella alopecuroides</i>	Lycopodiaceae	Foxtail bog clubmoss	N	PE/PE	FACW+	HP
<i>Lycopodiella appressa</i>	Lycopodiaceae	Appressed bog clubmoss	N	PT/PT	FACW+	HP
<i>Lycopodiella inundata</i>	Lycopodiaceae	Northern bog clubmoss	N	none	OBL	HP
<i>Lycopodium clavatum</i>	Lycopodiaceae	Common clubmoss	N	none	FAC	HP
<i>Lycopodium dendroideum</i>	Lycopodiaceae	Round-branch ground-pine	N	none	FACU	HP
<i>Lycopodium obscurum</i>	Lycopodiaceae	Flat-branched ground-pine	N	none	FACU	HP
<i>Lycopus americanus</i>	Lamiaceae	Water-horehound	N	none	OBL	HP
<i>Lycopus europaeus</i>	Lamiaceae	European water-horehound	I	none	OBL	HP
<i>Lycopus rubellus</i>	Lamiaceae	Gypsy-wort	N	PE/PE	OBL	HP
<i>Lycopus uniflorus</i>	Lamiaceae	Bugleweed	N	none	OBL	HP
<i>Lycopus virginicus</i>	Lamiaceae	Bugleweed	N	none	OBL	HP
<i>Lygodium palmatum</i>	Lygodiaceae	Climbing fern	N	PR/SP	FACW	VP

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<i>Lyonia ligustrina</i>	Ericaceae	Maleberry	N	none	FACW	SD
<i>Lyonia mariana</i>	Ericaceae	Staggerbush	N	PE/PE	FAC-	SD
<i>Lysimachia ciliata</i>	Myrsinaceae	Fringed loosestrife	N	none	FACW	HP
<i>Lysimachia clethroides</i>	Myrsinaceae	Loosestrife	I	none	N	HP
<i>Lysimachia hybrida</i>	Myrsinaceae	Lance-leaved loosestrife	N	N/PT	OBL	HP
<i>Lysimachia lanceolata</i>	Myrsinaceae	Loosestrife	N	none	FAC	HP
<i>Lysimachia nummularia</i>	Myrsinaceae	Creeping-charlie	I	none	FACW-	HP
<i>Lysimachia punctata</i>	Myrsinaceae	Spotted loosestrife	I	none	OBL	HP
<i>Lysimachia quadrifolia</i>	Myrsinaceae	Whorled loosestrife	N	none	FACU-	HP
<i>Lysimachia terrestris</i>	Myrsinaceae	Swamp-candles	N	none	OBL	HP
<i>Lysimachia x producta</i>	Myrsinaceae	Loosestrife	N	none	N	HP
<i>Lythrum alatum</i>	Lythraceae	Winged loosestrife	N	TU/PE	FACW+	HP
<i>Lythrum hyssopifolia</i>	Lythraceae	Hyssop loosestrife	I	none	OBL	HA
<i>Lythrum salicaria</i>	Lythraceae	Purple loosestrife	I	none	FACW+	HP
<i>Macleaya cordata</i>	Papaveraceae	Plume-poppy	I	none	N	HP
<i>Maclura pomifera</i>	Moraceae	Osage-orange	I	none	UPL	TD
<i>Magnolia kobus</i>	Magnoliaceae	Kobus magnolia	I	none	N	TD
<i>Magnolia tripetala</i>	Magnoliaceae	Umbrella-tree	N	PT/PR	FACU	TD
<i>Magnolia virginiana</i>	Magnoliaceae	Sweet-bay magnolia	N	PT/PT	FACW+	TD
<i>Maianthemum canadense</i>	Ruscaceae	Canada mayflower	N	none	FAC-	HP
<i>Maianthemum racemosum</i>	Ruscaceae	False solomon's-seal	N	none	N	HP
<i>Maianthemum stellatum</i>	Ruscaceae	Starflower	N	N/SP	N	HP
<i>Malaxis unifolia</i>	Orchidaceae	Green adder's- mouth	N	none	FAC	HP
<i>Malus coronaria</i>	Rosaceae	Sweet crabapple	N	none	N	TD
<i>Malus pumila</i>	Rosaceae	Apple	I	none	N	TD
<i>Malva moschata</i>	Malvaceae	Musk mallow	I	none	UPL	HP
<i>Malva neglecta</i>	Malvaceae	Cheeses	I	none	N	HA
<i>Malva sylvestris</i>	Malvaceae	Cheeses	I	none	N	HB
<i>Malva verticillata</i>	Malvaceae	Whorled mallow	I	none	N	HA
<i>Marrubium vulgare</i>	Lamiaceae	Common horehound	I	none	N	HP
<i>Marsilea quadrifolia</i>	Marsileaceae	European water- clover	I	none	OBL	HP
<i>Matricaria chamomilla</i>	Asteraceae	Wild camomile	I	none	N	HA
<i>Matricaria discoidea</i>	Asteraceae	Pineapple-weed	I	none	FACU	HA
<i>Matteuccia struthiopteris</i>	Polypodiaceae	Ostrich fern	N	none	FACW	HP
<i>Mazus miquelii</i>	Phrymaceae	Mazus	I	none	N	HP
<i>Medeola virginiana</i>	Liliaceae	Indian	N	none	N	HP

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		cucumber-root				
<i>Medicago lupulina</i>	Fabaceae	Black medic	I	none	UPL	HA
<i>Medicago sativa</i>	Fabaceae	Alfalfa	I	none	N	HP
<i>Melampyrum lineare</i> <i>var. americanum</i>	Orobanchaceae	Cow-wheat	I	none	FACU	HA
<i>Melampyrum lineare</i> <i>var. pectinatum</i>	Orobanchaceae	Cow-wheat	N	none	FACU	HA
<i>Melilotus alba</i>	Fabaceae	White sweet-clover	I	none	FACU	HB
<i>Melilotus officinalis</i>	Fabaceae	Yellow sweet-clover	I	none	FACU-	HB
<i>Melissa officinalis</i>	Lamiaceae	Lemon-balm	I	none	N	HP
<i>Menispermum canadense</i>	Menispermaceae	Moonseed	N	none	FACU	VW
<i>Mentha aquatica</i>	Lamiaceae	Water mint	I	none	FACW+	HP
<i>Mentha arvensis</i>	Lamiaceae	Field mint	N	none	FACW	HP
<i>Mentha longifolia</i>	Lamiaceae	Horse mint	I	none	FACU	HP
<i>Mentha spicata</i>	Lamiaceae	Spearmint	I	none	FACW	HP
<i>Mentha x gentilis</i>	Lamiaceae	Red mint	I	none	FACW	HP
<i>Mentha x piperita</i>	Lamiaceae	Peppermint	I	none	FACW+	HP
<i>Mentha x rotundifolia</i>	Lamiaceae	Apple mint	I	none	FACW	HP
<i>Mentha x verticillata</i>	Lamiaceae	Mint	I	none	N	HP
<i>Mentha x villosa</i>	Lamiaceae	Apple mint	I	none	FACW	HP
<i>Menyanthes trifoliata</i>	Menyanthaceae	Bogbean	N	none	OBL	HP
<i>Mertensia virginica</i>	Boraginaceae	Virginia bluebell	N	none	FACW	HP
<i>Micranthemum micranthemoides</i>	Plantaginaceae	Nuttall's mud-flower	N	PX/PX	OBL	HA
<i>Microstegium vimineum</i>	Poaceae	Stiltgrass	I	none	FAC	HA
<i>Mikania scandens</i>	Asteraceae	Climbing hempweed	N	none	FACW+	VP
<i>Mimulus alatus</i>	Phrymaceae	Winged monkey-flower	N	none	OBL	HP
<i>Mimulus ringens</i>	Phrymaceae	Allegheny monkey-flower	N	none	OBL	HP
<i>Minuartia michauxii</i>	Caryophyllaceae	Rock sandwort	N	none	N	HA
<i>Mirabilis nyctaginea</i>	Nyctaginaceae	Heart-leaved umbrellawort	I	none	FACU-	HP
<i>Miscanthus sinensis var. sinensis</i>	Poaceae	Eulalia	I	none	FACU	HP
<i>Miscanthus sinensis var. zebrinus</i>	Poaceae	Zebra grass	I	none	FACU	HP
<i>Mitchella repens</i>	Rubiaceae	Partridge-berry	N	none	FACU	HP
<i>Mitella diphylla</i>	Saxifragaceae	Bishop's-cap	N	none	FACU	HP
<i>Moehringia lateriflora</i>	Caryophyllaceae	Blunt-leaved sandwort	N	none	FAC	HP
<i>Mollugo verticillata</i>	Molluginaceae	Carpetweed	I	none	FAC	HA
<i>Monarda clinopodia</i>	Lamiaceae	Bee-balm	N	none	N	HP
<i>Monarda didyma</i>	Lamiaceae	Bee-balm	N	none	FAC+	HP
<i>Monarda fistulosa</i>	Lamiaceae	Horsemint	N	none	UPL	HP

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<i>Monarda media</i>	Lamiaceae	Bee-balm	N	none	N	HP
<i>Monotropa hypopithys</i>	Ericaceae	Pinesap	N	none	N	HP
<i>Monotropa uniflora</i>	Ericaceae	Indian-pipe	N	none	FACU-	HP
<i>Morus alba</i>	Moraceae	White mulberry	I	none	UPL	TD
<i>Morus rubra</i>	Moraceae	Red mulberry	N	none	FACU	TD
<i>Muhlenbergia frondosa</i>	Poaceae	Wirestem muhly	N	none	FAC	HP
<i>Muhlenbergia glomerata</i>	Poaceae	Spike muhly	N	none	FACW	HP
<i>Muhlenbergia mexicana</i>	Poaceae	Muhly	N	none	FACW	HP
<i>Muhlenbergia schreberi</i>	Poaceae	Dropseed	N	none	FAC	HP
<i>Muhlenbergia sobolifera</i>	Poaceae	Creeping muhly	N	none	N	HP
<i>Muhlenbergia sylvatica</i>	Poaceae	Muhly	N	none	FAC+	HP
<i>Muhlenbergia tenuiflora</i>	Poaceae	Muhly	N	none	N	HP
<i>Muscari botryoides</i>	Hyacinthaceae	Grape-hyacinth	I	none	N	HP
<i>Myosotis laxa</i>	Boraginaceae	Wild forget-me-not	N	none	OBL	HP
<i>Myosotis scorpioides</i>	Boraginaceae	Forget-me-not	I	none	OBL	HP
<i>Myosotis stricta</i>	Boraginaceae	Forget-me-not	I	none	N	HA
<i>Myosotis verna</i>	Boraginaceae	Spring forget-me-not	N	none	FAC-	HA
<i>Myosoton aquaticum</i>	Caryophyllaceae	Giant chickweed	I	none	FACW	HP
<i>Myrica pensylvanica</i>	Myricaceae	Bayberry	N	none	FAC	SD
<i>Myriophyllum aquaticum</i>	Haloragaceae	Parrot's-feather	I	none	OBL	HP
<i>Myriophyllum heterophyllum</i>	Haloragaceae	Broad-leaved water-milfoil	N	PE/SP	OBL	HP
<i>Myriophyllum humile</i>	Haloragaceae	Water-milfoil	N	none	OBL	HP
<i>Myriophyllum spicatum</i>	Haloragaceae	Eurasian water-milfoil	I	none	OBL	HP
<i>Najas flexilis</i>	Hydrocharitaceae	Northern waternymph	N	none	OBL	HA
<i>Najas gracillima</i>	Hydrocharitaceae	Slender waternymph	N	PT/SP	OBL	HA
<i>Najas guadalupensis</i>	Hydrocharitaceae	Southern waternymph	N	none	OBL	HA
<i>Najas minor</i>	Hydrocharitaceae	Waternymph	I	none	OBL	HA
<i>Narcissus poeticus</i>	Alliaceae	Poet's narcissus	I	none	N	HP
<i>Narcissus pseudonarcissus</i>	Alliaceae	Daffodil	I	none	N	HP
<i>Nasturtium officinale</i>	Brassicaceae	Watercress	I	none	OBL	HP
<i>Nepeta cataria</i>	Lamiaceae	Catnip	I	none	FACU	HP
<i>Nuphar advena</i>	Nymphaeaceae	Spatterdock	N	none	OBL	HP
<i>Nuphar microphylla</i>	Nymphaeaceae	Spatterdock	N	TU/PE	OBL	HP
<i>Nuphar variegata</i>	Nymphaeaceae	Spatterdock	N	none	OBL	HP
<i>Nymphaea odorata</i>	Nymphaeaceae	Fragrant water-lily	N	none	OBL	HP
<i>Nymphoides cordata</i>	Menyanthaceae	Floating-heart	N	PT/PT	OBL	HP
<i>Nymphoides peltata</i>	Menyanthaceae	Waterfringe	I	none	OBL	HP

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<i>Nyssa sylvatica</i>	Nyssaceae	Sourgum	N	none	FAC	TD
<i>Obolaria virginica</i>	Gentianaceae	Pennywort	N	none	N	HP
<i>Oclemena acuminata</i>	Asteraceae	Wood aster	N	none	N	HP
<i>Oenothera biennis</i>	Onagraceae	Evening- primrose	N	none	FACU-	HB
<i>Oenothera fruticosa</i> <i>ssp. fruticosa</i>	Onagraceae	Sundrops	N	none	FAC	HP
<i>Oenothera fruticosa</i> <i>ssp. glauca</i>	Onagraceae	Sundrops	N	none	FAC	HP
<i>Oenothera laciniata</i>	Onagraceae	Cut-leaved evening- primrose	N	none	FACU-	HA
<i>Oenothera nutans</i>	Onagraceae	Evening- primrose	N	none	N	HB
<i>Oenothera parviflora</i>	Onagraceae	Evening- primrose	N	none	FACU-	HB
<i>Oenothera perennis</i>	Onagraceae	Sundrops	N	none	FAC-	HP
<i>Oenothera pilosella</i>	Onagraceae	Sundrops	N	none	FAC	HP
<i>Oenothera speciosa</i>	Onagraceae	White evening- primrose	I	none	N	HP
<i>Oldenlandia uniflora</i>	Rubiaceae	Clustered mille graines	N	N/PE	FACW	HA
<i>Onoclea sensibilis</i>	Polypodiaceae	Sensitive fern	N	none	FACW	HP
<i>Ophioglossum pusillum</i>	Ophioglossaceae	Northern adder's-tongue	N	none	N	HP
<i>Ophioglossum vulgatum</i>	Ophioglossaceae	Southern adder's-tongue	N	PX/SP	FACW	HP
<i>Opuntia humifusa</i>	Cactaceae	Eastern prickly- pear cactus	N	PR/PR	N	HP
<i>Ornithogalum umbellatum</i>	Hyacinthaceae	Star-of- Bethlehem	I	none	FACU	HP
<i>Orobanche uniflora</i>	Orobanchaceae	Broom-rape	N	none	FACU	HP
<i>Orontium aquaticum</i>	Araceae	Goldenclub	N	PR/SP	OBL	HP
<i>Osmorhiza claytonii</i>	Apiaceae	Sweet-cicely	N	none	FACU-	HP
<i>Osmorhiza longistylis</i>	Apiaceae	Anise root	N	none	FACU	HP
<i>Osmunda cinnamomea</i>	Osmundaceae	Cinnamon fern	N	none	FACW	HP
<i>Osmunda claytoniana</i>	Osmundaceae	Interrupted fern	N	none	FAC	HP
<i>Osmunda regalis</i>	Osmundaceae	Royal fern	N	none	OBL	HP
<i>Ostrya virginiana</i>	Betulaceae	Hop-hornbeam	N	none	FACU-	TD
<i>Oxalis dillenii ssp. filipes</i>	Oxalidaceae	Southern yellow wood-sorrel	N	none	N	HP
<i>Oxalis stricta</i>	Oxalidaceae	Common yellow wood-sorrel	N	none	UPL	HP
<i>Oxalis violacea</i>	Oxalidaceae	Violet wood- sorrel	N	none	N	HP
<i>Oxypolis rigidior</i>	Apiaceae	Cowbane	N	TU/PT	OBL	HP
<i>Pachysandra terminalis</i>	Buxaceae	Japanese pachysandra	I	none	N	HP
<i>Packera anonyma</i>	Asteraceae	Appalachian groundsel	N	PR/PR	UPL	HP
<i>Packera aurea</i>	Asteraceae	Golden ragwort	N	none	FACW	HP

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<i>Packera obovata</i>	Asteraceae	Ragwort	N	none	FACU-	HP
<i>Packera paupercula</i>	Asteraceae	Balsam ragwort	N	none	FAC	HP
<i>Panax quinquefolius</i>	Araliaceae	Ginseng	N	PV/PV	N	HP
<i>Panax trifolius</i>	Araliaceae	Dwarf ginseng	N	none	N	HP
<i>Panicum amarum var. amarulum</i>	Poaceae	Beachgrass	N	PE/PE	FACU-	HP
<i>Panicum anceps</i>	Poaceae	Panic grass	N	none	FAC	HP
<i>Panicum capillare</i>	Poaceae	Witchgrass	N	none	FAC-	HA
<i>Panicum dichotomiflorum</i>	Poaceae	Smooth panic grass	N	none	FACW-	HA
<i>Panicum flexile</i>	Poaceae	Old witchgrass	N	TU/PT	FACU	HA
<i>Panicum gattingeri</i>	Poaceae	Witchgrass	N	none	FAC	HA
<i>Panicum longifolium</i>	Poaceae	Long-leaved panic grass	N	TU/PE	OBL	HP
<i>Panicum miliaceum</i>	Poaceae	Broomcorn millet	I	none	N	HA
<i>Panicum philadelphicum</i>	Poaceae	Panic grass	N	none	FAC-	HA
<i>Panicum rigidulum</i>	Poaceae	Panic grass	N	none	FACW+	HP
<i>Panicum stipitatum</i>	Poaceae	Panic grass	N	none	FACW+	HP
<i>Panicum verrucosum</i>	Poaceae	Panic grass	N	none	FACW	HA
<i>Panicum virgatum</i>	Poaceae	Switchgrass	N	none	FAC	HP
<i>Papaver orientale</i>	Papaveraceae	Oriental poppy	I	none	N	HP
<i>Papaver rhoeas</i>	Papaveraceae	Corn poppy	I	none	N	HP
<i>Papaver somniferum</i>	Papaveraceae	Opium poppy	I	none	N	HP
<i>Parietaria pensylvanica</i>	Urticaceae	Pellitory	N	none	N	HA
<i>Parnassia glauca</i>	Parnassiaceae	Grass-of-parnassus	N	PE/PE	OBL	HP
<i>Paronychia canadensis</i>	Caryophyllaceae	Forked chickweed	N	none	N	HA
<i>Paronychia fastigiata var. fastigiata</i>	Caryophyllaceae	Whitlow-wort	N	none	N	HA
<i>Parthenocissus inserta</i>	Vitaceae	Grape woodbine	N	none	N	VW
<i>Parthenocissus quinquefolia</i>	Vitaceae	Virginia-creeper	N	none	FACU	VW
<i>Parthenocissus tricuspidata</i>	Vitaceae	Boston ivy	I	none	N	VW
<i>Paspalum laeve</i>	Poaceae	Field beadgrass	N	none	FAC+	HP
<i>Paspalum setaceum var. muhlenbergii</i>	Poaceae	Slender beadgrass	N	none	FACU+	HP
<i>Paspalum setaceum var. psammophilum</i>	Poaceae	Slender beadgrass	N	none	FACU+	HP
<i>Paspalum setaceum var. setaceum</i>	Poaceae	Slender beadgrass	N	none	FACU+	HP
<i>Pastinaca sativa</i>	Apiaceae	Wild parsnip	I	none	N	HB
<i>Paulownia tomentosa</i>	Paulowniaceae	Empress-tree	I	none	N	TD
<i>Pedicularis canadensis</i>	Orobanchaceae	Forest lousewort	N	none	FACU	HP
<i>Pedicularis lanceolata</i>	Orobanchaceae	Swamp lousewort	N	N/PE	FACW	HP
<i>Pellaea atropurpurea</i>	Polypodiaceae	Purple cliffbrake	N	none	N	HP

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<i>Pellaea glabella</i>	Polypodiaceae	Smooth cliffbrake	N	none	N	HP
<i>Peltandra virginica</i>	Araceae	Arrow-arum	N	none	OBL	HP
<i>Penstemon calycosus</i>	Plantaginaceae	Beard-tongue	I	none	UPL	HP
<i>Penstemon digitalis</i>	Plantaginaceae	Tall white beard-tongue	N	none	FAC	HP
<i>Penstemon hirsutus</i>	Plantaginaceae	Northeastern beard-tongue	N	none	N	HP
<i>Penstemon pallidus</i>	Plantaginaceae	Eastern white beard-tongue	I	none	FACU	HP
<i>Penthorum sedoides</i>	Penthoraceae	Ditch stonecrop	N	none	OBL	HP
<i>Perilla frutescens</i>	Lamiaceae	Perilla	I	none	FACU+	HA
<i>Persicaria amphibia</i>	Polygonaceae	Water smartweed	N	TU/SP	OBL	HP
<i>Persicaria arifolia</i>	Polygonaceae	Halberd-leaf tearthumb	N	none	OBL	HA
<i>Persicaria hydropiper</i>	Polygonaceae	Smartweed	I	none	OBL	HA
<i>Persicaria hydropiperoides</i>	Polygonaceae	Mild water-pepper	N	none	OBL	HP
<i>Persicaria lapathifolia</i>	Polygonaceae	Dock-leaf smartweed	I	none	FACW+	HA
<i>Persicaria longiseta</i>	Polygonaceae	Low smartweed	I	none	FACU-	HA
<i>Persicaria maculosa</i>	Polygonaceae	Lady's-thumb	I	none	FACW	HA
<i>Persicaria orientalis</i>	Polygonaceae	Kiss-me-over-the-garden-gate	I	none	FACU-	HA
<i>Persicaria pennsylvanica</i>	Polygonaceae	Smartweed	N	none	FACW	HA
<i>Persicaria perfoliata</i>	Polygonaceae	Mile-a-minute weed	I	none	FAC	HA
<i>Persicaria punctata</i>	Polygonaceae	Dotted smartweed	N	none	OBL	HA
<i>Persicaria robustior</i>	Polygonaceae	Large water-smartweed	N	none	OBL	HP
<i>Persicaria sagittata</i>	Polygonaceae	Tearthumb	N	none	OBL	HA
<i>Persicaria setacea</i>	Polygonaceae	Swamp smartweed	N	N/PT	OBL	HP
<i>Persicaria virginiana</i>	Polygonaceae	Jumpseed	N	none	FAC	HP
<i>Petasites hybridus</i>	Asteraceae	Butterfly-dock	I	none	N	HP
<i>Petrorhagia saxifraga</i>	Caryophyllaceae	Saxifrage pink	I	none	N	HP
<i>Petunia x hybrida</i>	Solanaceae	Petunia	I	none	N	HA
<i>Phalaris arundinacea</i>	Poaceae	Reed canary-grass	N	none	FACW	HP
<i>Phalaris canariensis</i>	Poaceae	Canary-grass	I	none	FACU	HA
<i>Phaseolus polystachios</i>	Fabaceae	Wild bean	N	N/PE	N	VP
<i>Phegopteris connectilis</i>	Polypodiaceae	Long beech fern	N	none	FACU+	HP
<i>Phegopteris hexagonoptera</i>	Polypodiaceae	Broad beech fern	N	none	FAC	HP
<i>Phellodendron amurense</i>	Rutaceae	Corktree	I	none	N	TD
<i>Philadelphus coronarius</i>	Hydrangeaceae	Mock-orange	I	none	N	SD
<i>Philadelphus pubescens</i>	Hydrangeaceae	Mock-orange	I	none	N	SD

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<i>Phleum pratense</i>	Poaceae	Timothy	I	none	FACU	HP
<i>Phlox divaricata</i> ssp. <i>divaricata</i>	Polemoniaceae	Wild blue phlox	N	none	FACU	HP
<i>Phlox divaricata</i> ssp. <i>laphamii</i>	Polemoniaceae	Blue phlox	I	none	N	HP
<i>Phlox maculata</i>	Polemoniaceae	Meadow phlox	N	none	FACW	HP
<i>Phlox paniculata</i>	Polemoniaceae	Summer phlox	N	none	FACU	HP
<i>Phlox pilosa</i>	Polemoniaceae	Downy phlox	N	TU/PE	FACU	HP
<i>Phlox subulata</i> ssp. <i>subulata</i>	Polemoniaceae	Moss-pink	N	none	N	HP
<i>Phoradendron leucarpum</i>	Santalaceae	Christmas mistletoe	N	PX/PX	N	SE
<i>Photinia melanocarpa</i>	Rosaceae	Black chokeberry	N	none	FAC	SD
<i>Photinia pyrifolia</i>	Rosaceae	Red chokeberry	N	none	FACW	SD
<i>Photinia villosa</i>	Rosaceae	Photinia	I	none	N	TD
<i>Phragmites australis</i> ssp. <i>australis</i>	Poaceae	Common reed	I	none	FACW	HP
<i>Phryma leptostachya</i>	Phrymaceae	Lopseed	N	none	FACU-	HP
<i>Physalis alkekengi</i>	Solanaceae	Chinese-lantern	I	none	N	HP
<i>Physalis heterophylla</i>	Solanaceae	Clammy ground- cherry	N	none	N	HP
<i>Physalis philadelphica</i>	Solanaceae	Tomatillo	I	none	UPL	HA
<i>Physalis pubescens</i> var. <i>integrifolia</i>	Solanaceae	Hairy ground- cherry	N	none	FACU-	HA
<i>Physalis subglabrata</i>	Solanaceae	Ground-cherry	N	none	N	HP
<i>Physocarpus opulifolius</i>	Rosaceae	Ninebark	N	none	FACW-	SD
<i>Physostegia virginiana</i>	Lamiaceae	False dragonhead	N	none	FAC+	HP
<i>Phytolacca americana</i>	Phytolaccaceae	Pokeweed	N	none	FACU+	HP
<i>Picea abies</i>	Pinaceae	Norway spruce	I	none	N	TE
<i>Picea glauca</i>	Pinaceae	White spruce	I	none	FACU	TE
<i>Picea pungens</i>	Pinaceae	Colorado blue spruce	I	none	N	TE
<i>Picris hieracioides</i>	Asteraceae	Ox-tongue	I	none	N	HB
<i>Pilea pumila</i>	Urticaceae	Clearweed	N	none	FACW	HA
<i>Pimpinella saxifraga</i>	Apiaceae	Burnet-saxifrage	I	none	N	HP
<i>Pinus echinata</i>	Pinaceae	Short-leaf pine	N	N/PT	N	TE
<i>Pinus nigra</i>	Pinaceae	Austrian pine	I	none	N	TE
<i>Pinus pungens</i>	Pinaceae	Table-mountain pine	N	none	N	TE
<i>Pinus rigida</i>	Pinaceae	Pitch pine	N	none	FACU	TE
<i>Pinus strobus</i>	Pinaceae	Eastern white pine	N	none	FACU	TE
<i>Pinus sylvestris</i>	Pinaceae	Scots pine	I	none	N	TE
<i>Pinus virginiana</i>	Pinaceae	Virginia pine	N	none	N	TE
<i>Piptatherum racemosum</i>	Poaceae	Ricegrass	N	none	N	HP
<i>Piptochaetium avenaceum</i>	Poaceae	Black oatgrass	N	N/PE	UPL	HP

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<i>Plantago aristata</i>	Plantaginaceae	Bristly plantain	I	none	N	HA
<i>Plantago lanceolata</i>	Plantaginaceae	English plantain	I	none	UPL	HP
<i>Plantago major</i>	Plantaginaceae	Broad-leaved plantain	I	none	FACU	HP
<i>Plantago pusilla</i>	Plantaginaceae	Dwarf plantain	N	none	UPL	HA
<i>Plantago rugelii</i>	Plantaginaceae	Rugel's plantain	N	none	FACU	HP
<i>Plantago virginica</i>	Plantaginaceae	Dwarf plantain	N	none	UPL	HA
<i>Platanthera ciliaris</i>	Orchidaceae	Yellow fringed- orchid	N	TU/PT	FACW	HP
<i>Platanthera clavellata</i>	Orchidaceae	Clubspur orchid	N	none	FACW+	HP
<i>Platanthera flava</i> var. <i>herbiola</i>	Orchidaceae	Tubercled rein- orchid	N	none	FACW	HP
<i>Platanthera lacera</i>	Orchidaceae	Ragged fringed- orchid	N	none	FACW	HP
<i>Platanthera psycodes</i>	Orchidaceae	Purple fringed- orchid	N	none	FACW	HP
<i>Platanus occidentalis</i>	Platanaceae	Sycamore	N	none	FACW-	TD
<i>Pluchea odorata</i> var. <i>succulenta</i>	Asteraceae	Marsh fleabane	N	TU/PE	N	HA
<i>Poa annua</i>	Poaceae	Annual bluegrass	I	none	FACU	HA
<i>Poa autumnalis</i>	Poaceae	Autumn bluegrass	N	PE/PE	FAC	HP
<i>Poa bulbosa</i>	Poaceae	Bulbous bluegrass	I	none	N	HP
<i>Poa compressa</i>	Poaceae	Canada bluegrass	I	none	FACU	HP
<i>Poa cuspidata</i>	Poaceae	Bluegrass	N	none	N	HP
<i>Poa nemoralis</i>	Poaceae	Wood bluegrass	I	none	FAC	HP
<i>Poa palustris</i>	Poaceae	Fowl bluegrass	N	none	FACW	HP
<i>Poa pratensis</i>	Poaceae	Kentucky bluegrass	I	none	FACU	HP
<i>Poa sylvestris</i>	Poaceae	Woodland bluegrass	N	none	FACW	HP
<i>Poa trivialis</i>	Poaceae	Rough bluegrass	I	none	FACW	HP
<i>Podophyllum peltatum</i>	Berberidaceae	Mayapple	N	none	N	HP
<i>Podostemum ceratophyllum</i>	Podostemaceae	Riverweed	N	TU/SP	OBL	HP
<i>Pogonia ophioglossoides</i>	Orchidaceae	Rose pogonia	N	none	OBL	HP
<i>Polanisia dodecandra</i> <i>ssp. dodecandra</i>	Cleomaceae	Clammyweed	N	none	N	HA
<i>Polemonium reptans</i>	Polemoniaceae	Spreading Jacob's-ladder	N	none	FACU	HP
<i>Polygala cruciata</i>	Polygalaceae	Cross-leaved milkwort	N	PE/PE	FACW+	HA
<i>Polygala lutea</i>	Polygalaceae	Yellow milkwort	N	PX/PX	FACW+	HB
<i>Polygala nuttallii</i>	Polygalaceae	Nuttall's milkwort	N	N/PE	FAC	HA
<i>Polygala paucifolia</i>	Polygalaceae	Bird-on-the-wing	N	none	FACU	HP
<i>Polygala sanguinea</i>	Polygalaceae	Field milkwort	N	none	FACU	HA

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<i>Polygala senega</i> var. <i>senega</i>	Polygalaceae	Seneca snakeroot	N	none	FACU	HP
<i>Polygala verticillata</i> var. <i>ambigua</i>	Polygalaceae	Whorled milkwort	N	none	UPL	HA
<i>Polygala verticillata</i> var. <i>isocycla</i>	Polygalaceae	Whorled milkwort	N	none	UPL	HA
<i>Polygala verticillata</i> var. <i>verticillata</i>	Polygalaceae	Whorled milkwort	N	none	UPL	HA
<i>Polygonatum biflorum</i> var. <i>biflorum</i>	Ruscaceae	Solomon's-seal	N	none	FACU	HP
<i>Polygonatum biflorum</i> var. <i>commutatum</i>	Ruscaceae	Solomon's-seal	N	none	FACU	HP
<i>Polygonatum pubescens</i>	Ruscaceae	Solomon's-seal	N	none	N	HP
<i>Polygonella articulata</i>	Polygonaceae	Jointweed	N	TU/PE	N	HA
<i>Polygonum aviculare</i>	Polygonaceae	Knotweed	I	none	FACU	HA
<i>Polygonum aviculare</i>	Polygonaceae	Doorweed	I	none	N	HA
<i>Polygonum aviculare</i>	Polygonaceae	Knotweed	N	none	N	HA
<i>Polygonum bellardii</i>	Polygonaceae	Needle-leaf knotweed	I	none	N	HA
<i>Polygonum erectum</i>	Polygonaceae	Erect knotweed	N	none	FACU	HA
<i>Polygonum ramosissimum</i> ssp. <i>prolificum</i>	Polygonaceae	Bushy knotweed	N	none	N	HA
<i>Polygonum tenue</i>	Polygonaceae	Slender knotweed	N	none	N	HA
<i>Polymnia canadensis</i>	Asteraceae	Leaf-cup	N	N/SP	N	HP
<i>Polypodium appalachianum</i>	Polypodiaceae	Appalachian polypody	N	none	N	HP
<i>Polypodium virginianum</i>	Polypodiaceae	Common polypody	N	none	N	HP
<i>Polypogon monspeliensis</i>	Poaceae	Beardgrass	I	none	FACW+	HA
<i>Polystichum acrostichoides</i>	Polypodiaceae	Christmas fern	N	none	N	HP
<i>Poncirus trifoliata</i>	Rutaceae	Hardy orange	I	none	N	SD
<i>Pontederia cordata</i>	Pontederiaceae	Pickereel-weed	N	none	OBL	HP
<i>Populus alba</i>	Salicaceae	White poplar	I	none	N	TD
<i>Populus deltoides</i>	Salicaceae	Eastern cottonwood	N	none	FACU-	TD
<i>Populus grandidentata</i>	Salicaceae	Bigtooth aspen	N	none	FACU-	TD
<i>Populus nigra</i>	Salicaceae	Black poplar	I	none	N	TD
<i>Populus tremuloides</i>	Salicaceae	Quaking aspen	N	none	N	TD
<i>Populus x canescens</i>	Salicaceae	Gray poplar	I	none	N	TD
<i>Populus x jackii</i>	Salicaceae	Balm-of-Gilead	I	none	N	TD
<i>Portulaca grandiflora</i>	Portulacaceae	Moss-rose	I	none	N	HA
<i>Portulaca oleracea</i>	Portulacaceae	Purslane	N	none	FAC	HA
<i>Potamogeton amplifolius</i>	Potamogetonaceae	Bigleaf pondweed	N	none	OBL	HP
<i>Potamogeton bicupulatus</i>	Potamogetonaceae	Pondweed	N	N/SP	OBL	HP

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<i>Potamogeton crispus</i>	Potamogetonaceae	Curly pondweed	I	none	OBL	HP
<i>Potamogeton diversifolius</i>	Potamogetonaceae	Snailseed pondweed	N	none	OBL	HP
<i>Potamogeton epihydrus</i>	Potamogetonaceae	Ribbonleaf pondweed	N	none	OBL	HP
<i>Potamogeton foliosus</i>	Potamogetonaceae	Leafy pondweed	N	none	OBL	HP
<i>Potamogeton natans</i>	Potamogetonaceae	Floating pondweed	N	none	OBL	HP
<i>Potamogeton nodosus</i>	Potamogetonaceae	Longleaf pondweed	N	none	OBL	HP
<i>Potamogeton oakesianus</i>	Potamogetonaceae	Oakes' pondweed	N	TU/PE	OBL	HP
<i>Potamogeton pectinatus</i>	Potamogetonaceae	Sago pondweed	N	none	OBL	HP
<i>Potamogeton perfoliatus</i>	Potamogetonaceae	Perfoliate pondweed	N	none	OBL	HP
<i>Potamogeton pulcher</i>	Potamogetonaceae	Heartleaf pondweed	N	PE/PE	OBL	HP
<i>Potamogeton pusillus</i>	Potamogetonaceae	Pondweed	N	none	OBL	HP
<i>Potamogeton robbinsii</i>	Potamogetonaceae	Flat-leaved pondweed	N	PR/SP	OBL	HP
<i>Potamogeton spirillus</i>	Potamogetonaceae	Snailseed pondweed	N	none	OBL	HP
<i>Potamogeton zosteriformis</i>	Potamogetonaceae	Flat-stemmed pondweed	N	PR/PR	OBL	HP
<i>Potentilla argentea</i>	Rosaceae	Hoary cinquefoil	I	none	UPL	HP
<i>Potentilla arguta</i>	Rosaceae	Tall cinquefoil	N	none	UPL	HP
<i>Potentilla canadensis</i>	Rosaceae	Cinquefoil	N	none	N	HP
<i>Potentilla intermedia</i>	Rosaceae	Downy cinquefoil	I	none	N	HP
<i>Potentilla norvegica</i> ssp. <i>monspeliensis</i>	Rosaceae	Strawberry-weed	N	none	FACU	HA
<i>Potentilla recta</i>	Rosaceae	Sulfur cinquefoil	I	none	N	HP
<i>Potentilla reptans</i>	Rosaceae	Creeping cinquefoil	I	none	N	HP
<i>Potentilla simplex</i>	Rosaceae	Old-field cinquefoil	N	none	FACU-	HP
<i>Prenanthes alba</i>	Asteraceae	Rattlesnake-root	N	none	FACU	HP
<i>Prenanthes altissima</i>	Asteraceae	Rattlesnake-root	N	none	FACU-	HP
<i>Prenanthes serpentaria</i>	Asteraceae	Lion's-foot	N	N/PT	N	HP
<i>Prenanthes trifoliolata</i>	Asteraceae	Gall-of-the-earth	N	none	N	HP
<i>Proserpinaca louisianica</i>	Martyniaceae	Unicorn-plant	I	none	FACU	HA
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Haloragaceae	Common mermaid-weed	N	none	OBL	HP
<i>Proserpinaca palustris</i> var. <i>palustris</i>	Haloragaceae	Common mermaid-weed	N	none	OBL	HP
<i>Proserpinaca pectinata</i>	Haloragaceae	Comb-leaved mermaid-weed	N	PX/PX	OBL	HP
<i>Prunella vulgaris</i> ssp. <i>lanceolata</i>	Lamiaceae	Heal-all	N	none	FACU+	HP
<i>Prunella vulgaris</i> ssp. <i>vulgaris</i>	Lamiaceae	Heal-all	I	none	FACU+	HP
<i>Prunus alleghaniensis</i>	Rosaceae	Allegheny plum	N	N/PT	UPL	TD

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<i>Prunus americana</i>	Rosaceae	Wild plum	N	none	FACU-	SD
<i>Prunus angustifolia</i>	Rosaceae	Chickasaw plum	N	none	N	TD
<i>Prunus avium</i>	Rosaceae	Sweet cherry	I	none	N	TD
<i>Prunus cerasus</i>	Rosaceae	Pie cherry	I	none	N	TD
<i>Prunus maritima</i>	Rosaceae	Beach plum	N	PE/PE	N	SD
<i>Prunus padus</i>	Rosaceae	European bird cherry	I	none	N	TD
<i>Prunus pennsylvanica</i>	Rosaceae	Pin cherry	N	none	FACU-	TD
<i>Prunus persica</i>	Rosaceae	Peach	I	none	N	TD
<i>Prunus pumila</i> var. <i>depressa</i>	Rosaceae	Sand cherry	N	N/PE	N	SD
<i>Prunus serotina</i>	Rosaceae	Wild black cherry	N	none	FACU	TD
<i>Prunus subhirtella</i>	Rosaceae	Higan cherry	I	none	N	TD
<i>Prunus virginiana</i>	Rosaceae	Choke cherry	N	none	FACU	SD
<i>Pseudognaphalium obtusifolium</i>	Asteraceae	Fragrant cudweed	N	none	N	HA
<i>Ptelea trifoliata</i>	Rutaceae	Hoptree	N	PT/PT	FAC	SD
<i>Pteridium aquilinum</i>	Polypodiaceae	Northern bracken fern	N	none	FACU	HP
<i>Ptilimnium capillaceum</i>	Apiaceae	Mock bishop's weed	N	PE/PX	OBL	HP
<i>Pueraria lobata</i>	Fabaceae	Kudzu	I	none	N	VW
<i>Pycnanthemum clinopodioides</i>	Lamiaceae	Mountain-mint	N	N/PX	N	HP
<i>Pycnanthemum incanum</i>	Lamiaceae	Mountain-mint	N	none	N	HP
<i>Pycnanthemum muticum</i>	Lamiaceae	Mountain-mint	N	none	FACW	HP
<i>Pycnanthemum tenuifolium</i>	Lamiaceae	Mountain-mint	N	none	FACW	HP
<i>Pycnanthemum torrei</i>	Lamiaceae	Torrey's mountain-mint	N	PE/PE	N	HP
<i>Pycnanthemum verticillatum</i> var. <i>verticillatum</i>	Lamiaceae	Mountain-mint	N	none	FAC	HP
<i>Pycnanthemum virginianum</i>	Lamiaceae	Mountain-mint	N	none	FAC	HP
<i>Pyrola americana</i>	Ericaceae	Wild lily-of-the- valley	N	none	FAC	HP
<i>Pyrola chlorantha</i>	Ericaceae	Wintergreen	N	N/PE	UPL	HP
<i>Pyrola elliptica</i>	Ericaceae	Shinleaf	N	none	UPL	HP
<i>Pyrus calleryana</i>	Rosaceae	Callery pear	I	none	N	TD
<i>Pyrus communis</i>	Rosaceae	Pear	I	none	N	TD
<i>Quercus alba</i>	Fagaceae	White oak	N	none	FACU	TD
<i>Quercus alba</i> x <i>montana</i>	Fagaceae	Saul oak	N	none	N	TD
<i>Quercus bicolor</i>	Fagaceae	Swamp white oak	N	none	FACW+	TD
<i>Quercus coccinea</i>	Fagaceae	Scarlet oak	N	none	N	TD
<i>Quercus falcata</i>	Fagaceae	Southern red	N	PE/PE	FACU-	TD

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
		oak				
<i>Quercus ilicifolia</i>	Fagaceae	Scrub oak	N	none	N	SD
<i>Quercus imbricaria</i>	Fagaceae	Shingle oak	N	none	FAC	TD
<i>Quercus imbricaria x palustris</i>	Fagaceae	Oak	N	none	N	TD
<i>Quercus marilandica</i>	Fagaceae	Blackjack oak	N	none	N	TD
<i>Quercus marilandica x phellos</i>	Fagaceae	Rudkin oak	N	none	N	TD
<i>Quercus michauxii</i>	Fagaceae	Swamp chestnut oak	N	N/PE	FACW	TD
<i>Quercus montana</i>	Fagaceae	Chestnut oak	N	none	FACW	TD
<i>Quercus muhlenbergii</i>	Fagaceae	Yellow oak	N	none	UPL	TD
<i>Quercus palustris</i>	Fagaceae	Pin oak	N	none	FACW	TD
<i>Quercus phellos</i>	Fagaceae	Willow oak	N	PE/PE	FAC+	TD
<i>Quercus phellos x rubra</i>	Fagaceae	Bartram oak	N	none	N	TD
<i>Quercus prinoides</i>	Fagaceae	Dwarf chestnut oak	N	none	N	SD
<i>Quercus rubra</i>	Fagaceae	Northern red oak	N	none	FACU-	TD
<i>Quercus stellata</i>	Fagaceae	Post oak	N	none	UPL	TD
<i>Quercus velutina</i>	Fagaceae	Black oak	N	none	N	TD
<i>Ranunculus abortivus</i>	Ranunculaceae	Small-flowered crowfoot	N	none	FACW-	HA
<i>Ranunculus acris</i>	Ranunculaceae	Common meadow buttercup	I	none	FAC+	HP
<i>Ranunculus ambigens</i>	Ranunculaceae	Water-plantain spearwort	N	N/TU	OBL	HP
<i>Ranunculus aquatilis var. diffusus</i>	Ranunculaceae	White water-crowfoot	N	N/PR	OBL	HP
<i>Ranunculus bulbosus</i>	Ranunculaceae	Bulbous buttercup	I	none	UPL	HP
<i>Ranunculus ficaria</i>	Ranunculaceae	Lesser celandine	I	none	N	HP
<i>Ranunculus flabellaris</i>	Ranunculaceae	Yellow water-crowfoot	N	N/PT	OBL	HP
<i>Ranunculus hispidus var. caricetorum</i>	Ranunculaceae	Marsh buttercup	N	none	FAC	HP
<i>Ranunculus hispidus var. hispidus</i>	Ranunculaceae	Hairy buttercup	N	none	FAC	HP
<i>Ranunculus hispidus var. nitidus</i>	Ranunculaceae	Hairy buttercup	N	none	FACW+	HP
<i>Ranunculus micranthus</i>	Ranunculaceae	Small-flowered crowfoot	N	none	FACU	HP
<i>Ranunculus pensylvanicus</i>	Ranunculaceae	Bristly crowfoot	N	none	OBL	HA
<i>Ranunculus pusillus</i>	Ranunculaceae	Low spearwort	N	N/PE	OBL	HA
<i>Ranunculus recurvatus</i>	Ranunculaceae	Hooked crowfoot	N	none	FAC+	HP
<i>Ranunculus repens</i>	Ranunculaceae	Creeping buttercup	I	none	FAC	HP
<i>Ranunculus sceleratus</i>	Ranunculaceae	Celery-leaved crowfoot	I	none	OBL	HA

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Raphanus raphanistrum</i>	Brassicaceae	Wild radish	I	none	N	HA
<i>Raphanus sativus</i>	Brassicaceae	Garden radish	I	none	N	HA
<i>Ratibida columnifera</i>	Asteraceae	Coneflower	I	none	N	HP
<i>Ratibida pinnata</i>	Asteraceae	Prairie coneflower	N	TU/PE	N	HP
<i>Reseda luteola</i>	Resedaceae	Dyer's rocket	I	none	N	HB
<i>Rhamnus cathartica</i>	Rhamnaceae	Buckthorn	I	none	N	SD
<i>Rhamnus frangula</i>	Rhamnaceae	Alder buckthorn	I	none	N	SD
<i>Rheum rhabarbarum</i>	Polygonaceae	Rhubarb	I	none	N	HP
<i>Rhexia mariana</i>	Melastomaceae	Maryland meadow-beauty	N	PE/PE	OBL	HP
<i>Rhexia virginica</i>	Melastomaceae	Meadow-beauty	N	none	OBL	HP
<i>Rhododendron arborescens</i>	Ericaceae	Smooth azalea	N	none	FAC	SD
<i>Rhododendron maximum</i>	Ericaceae	Rosebay	N	none	FAC	SE
<i>Rhododendron periclymenoides</i>	Ericaceae	Pinxter-flower	N	none	FAC	SD
<i>Rhododendron viscosum</i>	Ericaceae	Swamp azalea	N	none	FACW+	SD
<i>Rhodotypos scandens</i>	Rosaceae	Jetbead	I	none	N	SD
<i>Rhus copallina</i> var. <i>copallina</i>	Anacardiaceae	Shining sumac	N	none	N	SD
<i>Rhus copallina</i> var. <i>latifolia</i>	Anacardiaceae	Shining sumac	N	none	N	SD
<i>Rhus glabra</i>	Anacardiaceae	Smooth sumac	N	none	N	SD
<i>Rhus typhina</i>	Anacardiaceae	Staghorn sumac	N	none	N	SD
<i>Rhynchospora alba</i>	Cyperaceae	White beak-rush	N	none	OBL	HP
<i>Rhynchospora capitellata</i>	Cyperaceae	Beak-rush	N	none	OBL	HP
<i>Rhynchospora recognita</i>	Cyperaceae	Beak-rush	N	TU/PE	FACW	HP
<i>Ribes americanum</i>	Grossulariaceae	Wild black currant	N	none	FACW	SD
<i>Ribes hirtellum</i>	Grossulariaceae	Northern wild gooseberry	N	N/SP	FAC	SD
<i>Ribes odoratum</i>	Grossulariaceae	Buffalo currant	I	none	N	SD
<i>Ribes rotundifolium</i>	Grossulariaceae	Wild gooseberry	N	none	N	SD
<i>Ribes rubrum</i>	Grossulariaceae	Garden red currant	I	none	N	SD
<i>Ribes uva-crispa</i> var. <i>sativum</i>	Grossulariaceae	European garden gooseberry	I	none	N	SD
<i>Ricinus communis</i>	Euphorbiaceae	Castor-bean	I	none	N	HA
<i>Robinia hispida</i>	Fabaceae	Bristly locust	I	none	N	TD
<i>Robinia pseudoacacia</i>	Fabaceae	Black locust	N	none	FACU-	TD
<i>Robinia viscosa</i>	Fabaceae	Clammy locust	I	none	N	TD
<i>Rorippa palustris</i>	Brassicaceae	Marsh watercress	N	none	OBL	HA
<i>Rorippa sylvestris</i>	Brassicaceae	Creeping yellowcress	I	none	FACW	HP

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<i>Rosa blanda</i>	Rosaceae	Meadow rose	N	N/TU	N	SD
<i>Rosa canina</i>	Rosaceae	Dog rose	I	none	N	SD
<i>Rosa carolina</i>	Rosaceae	Pasture rose	N	none	UPL	SD
<i>Rosa cinnamomea</i>	Rosaceae	Cinnamon rose	I	none	N	SD
<i>Rosa eglanteria</i>	Rosaceae	Sweetbrier	I	none	N	SD
<i>Rosa gallica</i>	Rosaceae	French rose	I	none	N	SD
<i>Rosa micrantha</i>	Rosaceae	Sweetbriar	I	none	FACU	SD
<i>Rosa multiflora</i>	Rosaceae	Multiflora rose	I	none	FACU	SD
<i>Rosa palustris</i>	Rosaceae	Swamp rose	N	none	OBL	SD
<i>Rosa setigera</i>	Rosaceae	Prairie rose	I	N/TU	FACU	SD
<i>Rosa virginiana</i>	Rosaceae	Wild rose	N	TU/TU	FAC	SD
<i>Rosa wichuraiana</i>	Rosaceae	Memorial rose	I	none	N	SD
<i>Rotala ramosior</i>	Lythraceae	Tooth cup	N	PR/PR	OBL	HA
<i>Rubus allegheniensis</i>	Rosaceae	Common blackberry	N	none	FACU-	SD
<i>Rubus caesius</i>	Rosaceae	European dewberry	I	none	N	SD
<i>Rubus canadensis</i>	Rosaceae	Smooth blackberry	N	none	N	SD
<i>Rubus cuneifolius</i>	Rosaceae	Sand blackberry	N	TU/PE	UPL	SD
<i>Rubus enslenii</i>	Rosaceae	Southern dewberry	N	none	FACU	VW
<i>Rubus flagellaris</i>	Rosaceae	Prickly dewberry	N	none	FACU	VW
<i>Rubus hispidus</i>	Rosaceae	Swamp dewberry	N	none	FACW	VW
<i>Rubus idaeus var. strigosus</i>	Rosaceae	Red raspberry	N	none	FAC-	SD
<i>Rubus laciniatus</i>	Rosaceae	Cut-leaved blackberry	I	none	UPL	SD
<i>Rubus occidentalis</i>	Rosaceae	Black-cap	N	none	N	SD
<i>Rubus odoratus</i>	Rosaceae	Purple-flowering raspberry	N	none	N	SD
<i>Rubus pensilvanicus</i>	Rosaceae	Blackberry	N	none	N	SD
<i>Rubus phoenicolasius</i>	Rosaceae	Wineberry	I	none	N	SD
<i>Rubus pubescens</i>	Rosaceae	Dwarf blackberry	N	none	FACW	SD
<i>Rubus recurvicaulis</i>	Rosaceae	Dewberry	N	none	FACU	VW
<i>Rubus setosus</i>	Rosaceae	Bristly blackberry	N	TU/PE	FACW	SD
<i>Rudbeckia fulgida var. fulgida</i>	Asteraceae	Eastern coneflower	N	N/PT	FAC	HP
<i>Rudbeckia hirta var. hirta</i>	Asteraceae	Black-eyed- susan	N	none	FACU-	HB
<i>Rudbeckia hirta var. pulcherrima</i>	Asteraceae	Black-eyed- susan	N	none	FACU-	HB
<i>Rudbeckia laciniata var. laciniata</i>	Asteraceae	Cutleaf coneflower	N	none	FACW	HP
<i>Rudbeckia triloba var. triloba</i>	Asteraceae	Three-lobed coneflower	N	none	FACU	HP
<i>Rumex acetosella</i>	Polygonaceae	Sheep sorrel	I	none	UPL	HP

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<i>Rumex altissimus</i>	Polygonaceae	Tall dock	N	none	FACW-	HP
<i>Rumex britanica</i>	Polygonaceae	Great water-dock	N	none	OBL	HP
<i>Rumex crispus</i>	Polygonaceae	Curly dock	I	none	FACU	HP
<i>Rumex obtusifolius</i>	Polygonaceae	Bitter dock	I	none	FACU-	HP
<i>Rumex patientia</i>	Polygonaceae	Monk's rhubarb	I	none	N	HP
<i>Rumex pulcher</i>	Polygonaceae	Fiddle-dock	I	none	FACW-	HP
<i>Rumex triangulivalvis</i>	Polygonaceae	Willow-leaf dock	I	none	FAC	HP
<i>Sabatia angularis</i>	Gentianaceae	Common marsh-pink	N	none	FAC+	HA
<i>Sabatia campanulata</i>	Gentianaceae	Slender marsh-pink	N	PX/PX	FACW	HP
<i>Saccharum giganteum</i>	Poaceae	Giant beardgrass	N	PX/PX	FACW+	HP
<i>Sagina decumbens</i>	Caryophyllaceae	Pearlwort	N	none	N	HA
<i>Sagina japonica</i>	Caryophyllaceae	Japanese pearlwort	I	none	N	HA
<i>Sagina procumbens</i>	Caryophyllaceae	Bird's-eye	N	none	FACW-	HP
<i>Sagittaria australis</i>	Alismataceae	Appalachian arrowhead	N	none	OBL	HP
<i>Sagittaria calycina</i>	Alismataceae	Long-lobed arrowhead	N	PE/PE	OBL	HA
<i>Sagittaria filiformis</i>	Alismataceae	Arrowhead	N	PX/PX	OBL	HP
<i>Sagittaria graminea</i> var. <i>graminea</i>	Alismataceae	Grass-leaved sagittaria	N	none	OBL	HP
<i>Sagittaria latifolia</i> var. <i>latifolia</i>	Alismataceae	Wapato	N	none	OBL	HP
<i>Sagittaria latifolia</i> var. <i>pubescens</i>	Alismataceae	Wapato	N	none	OBL	HP
<i>Sagittaria rigida</i>	Alismataceae	Arrowhead	N	none	OBL	HP
<i>Sagittaria subulata</i>	Alismataceae	Subulate arrowhead	N	PR/PR	OBL	HP
<i>Salix alba</i>	Salicaceae	White willow	I	none	FACW	TD
<i>Salix babylonica</i> complex	Salicaceae	Weeping willow	I	none	FACW-	TD
<i>Salix bebbiana</i>	Salicaceae	Long-beaked willow	N	none	FACW	SD
<i>Salix caprea</i>	Salicaceae	Goat willow	I	none	N	SD
<i>Salix discolor</i>	Salicaceae	Pussy willow	N	none	FACW	SD
<i>Salix eriocephala</i>	Salicaceae	Diamond willow	N	none	FACW+	SD
<i>Salix exigua</i>	Salicaceae	Sandbar willow	N	none	OBL	SD
<i>Salix fragilis</i>	Salicaceae	Crack willow	I	none	FAC+	TD
<i>Salix humilis</i> var. <i>humilis</i>	Salicaceae	Upland willow	N	none	FACU	SD
<i>Salix humilis</i> var. <i>tristis</i>	Salicaceae	Dwarf upland willow	N	none	FACU	SD
<i>Salix lucida</i> ssp. <i>lucida</i>	Salicaceae	Shining willow	N	none	FACW	SD
<i>Salix myricoides</i>	Salicaceae	Broad-leaved willow	N	N/PE	FAC	SD
<i>Salix nigra</i>	Salicaceae	Black willow	N	none	FACW+	TD
<i>Salix petiolaris</i>	Salicaceae	Slender willow	N	TU/SP	FACW+	SD

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<i>Salix purpurea</i>	Salicaceae	Basket willow	I	none	N	SD
<i>Salix sericea</i>	Salicaceae	Silky willow	N	none	OBL	SD
<i>Salsola tragus</i>	Amaranthaceae	Russian-thistle	I	none	FACU	HA
<i>Salvia lyrata</i>	Lamiaceae	Lyre-leaved sage	N	none	UPL	HP
<i>Salvia verticillata</i>	Lamiaceae	Sage	I	none	N	HP
<i>Sambucus canadensis</i>	Adoxaceae	American elder	N	none	FACW	SD
<i>Sambucus racemosa</i> <i>var. pubens</i>	Adoxaceae	Red-berried elder	N	none	FACU	SD
<i>Samolus parviflorus</i>	Theophrastaceae	Water pimpernel	N	TU/PR	OBL	HP
<i>Sanguinaria canadensis</i>	Papaveraceae	Bloodroot	N	none	UPL	HP
<i>Sanguisorba canadensis</i>	Rosaceae	American burnet	N	none	FACW+	HP
<i>Sanguisorba minor</i>	Rosaceae	Salad burnet	I	none	FAC	HP
<i>Sanicula canadensis</i> <i>var. canadensis</i>	Apiaceae	Canadian sanicle	N	none	UPL	HB
<i>Sanicula canadensis</i> <i>var. grandis</i>	Apiaceae	Canadian sanicle	N	none	UPL	HB
<i>Sanicula marilandica</i>	Apiaceae	Black snake root	N	none	UPL	HP
<i>Sanicula odorata</i>	Apiaceae	Yellow-flowered sanicle	N	none	FACU	HP
<i>Sanicula trifoliata</i>	Apiaceae	Large-fruited sanicle	N	none	N	HB
<i>Saponaria officinalis</i>	Caryophyllaceae	Bouncing-bet	I	none	FACU-	HP
<i>Sassafras albidum</i>	Lauraceae	Sassafras	N	none	FACU-	TD
<i>Saururus cernuus</i>	Saururaceae	Lizard's-tail	N	none	OBL	HP
<i>Saxifraga pensylvanica</i>	Saxifragaceae	Swamp saxifrage	N	none	OBL	HP
<i>Saxifraga virginensis</i>	Saxifragaceae	Early saxifrage	N	none	FAC-	HP
<i>Schedonorus arundinaceus</i>	Poaceae	Fescue	I	none	FACU-	HP
<i>Schedonorus pratensis</i>	Poaceae	Meadow fescue	I	none	FACU-	HP
<i>Schizachyrium scoparium var. scoparium</i>	Poaceae	Little bluestem	N	none	FACU	HP
<i>Schoenoplectus fluviatilis</i>	Cyperaceae	River bulrush	N	PR/PR	OBL	HP
<i>Schoenoplectus pungens</i>	Cyperaceae	Chairmaker's rush	N	none	FACW+	HP
<i>Schoenoplectus purshianus</i>	Cyperaceae	Bulrush	N	none	OBL	HA
<i>Schoenoplectus smithii</i>	Cyperaceae	Smith's bulrush	N	PE/PE	OBL	HP
<i>Schoenoplectus tabernaemontani</i>	Cyperaceae	Great bulrush	N	none	OBL	HP
<i>Scirpus atrovirens</i>	Cyperaceae	Black bulrush	N	none	OBL	HP
<i>Scirpus cyperinus</i>	Cyperaceae	Wool-grass	N	none	FACW+	HP
<i>Scirpus expansus</i>	Cyperaceae	Wood bulrush	N	none	OBL	HP
<i>Scirpus georgianus</i>	Cyperaceae	Bulrush	N	none	OBL	HP
<i>Scirpus hattorianus</i>	Cyperaceae	Bulrush	N	none	OBL	HP

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<i>Scirpus microcarpus</i>	Cyperaceae	Bulrush	N	none	OBL	HP
<i>Scirpus pendulus</i>	Cyperaceae	Bulrush	N	none	OBL	HP
<i>Scirpus polyphyllus</i>	Cyperaceae	Bulrush	N	none	OBL	HP
<i>Scleranthus annuus</i>	Caryophyllaceae	Knawel	I	none	FACU-	HA
<i>Scleria muhlenbergii</i>	Cyperaceae	Reticulated nut-rush	N	PE/PE	OBL	HA
<i>Scleria pauciflora</i>	Cyperaceae	Few-flowered nut-rush	N	PT/PT	FACU+	HP
<i>Scleria triglomerata</i>	Cyperaceae	Whip-grass	N	TU/PE	FAC	HP
<i>Scrophularia lanceolata</i>	Scrophulariaceae	Lanceleaf figwort	N	none	FACU+	HP
<i>Scrophularia marilandica</i>	Scrophulariaceae	Eastern figwort	N	none	FACU-	HP
<i>Scutellaria elliptica</i> var. <i>elliptica</i>	Lamiaceae	Hairy skullcap	N	none	N	HP
<i>Scutellaria galericulata</i>	Lamiaceae	Common skullcap	N	none	OBL	HP
<i>Scutellaria integrifolia</i>	Lamiaceae	Hyssop skullcup	N	none	FACW	HP
<i>Scutellaria lateriflora</i>	Lamiaceae	Mad-dog skullcap	N	none	FACW+	HP
<i>Scutellaria leonardii</i>	Lamiaceae	Small skullcap	N	none	N	HP
<i>Scutellaria nervosa</i>	Lamiaceae	Skullcap	N	none	FAC	HP
<i>Secale cereale</i>	Poaceae	Rye	I	none	N	HA
<i>Sedum acre</i>	Crassulaceae	Love-entangle	I	none	OBL	HP
<i>Sedum album</i>	Crassulaceae	White orpine	I	none	N	HP
<i>Sedum kamtschaticum</i> ssp. <i>ellacombianum</i>	Crassulaceae	Orange stonecrop	I	none	N	HP
<i>Sedum rosea</i>	Crassulaceae	Roseroot stonecrop	N	PE/PE	FACU-	HP
<i>Sedum sarmentosum</i>	Crassulaceae	Orpine	I	none	N	HP
<i>Sedum telephium</i>	Crassulaceae	Garden orpine	I	none	N	HP
<i>Sedum ternatum</i>	Crassulaceae	Wild stonecrop	N	none	N	HP
<i>Sedum x alboroseum</i>	Crassulaceae	Garden orpine	I	none	N	HP
<i>Selaginella apoda</i>	Selaginellaceae	Meadow spikemoss	N	none	FACW	HP
<i>Selaginella rupestris</i>	Selaginellaceae	Rock spikemoss	N	none	N	HP
<i>Senecio vulgaris</i>	Asteraceae	Common groundsel	I	none	FACU	HA
<i>Senna hebecarpa</i>	Fabaceae	Northern wild senna	N	none	FAC	HP
<i>Senna marilandica</i>	Fabaceae	Southern wild senna	N	TU/PR	FAC+	HP
<i>Sericocarpus asteroides</i>	Asteraceae	White-topped aster	N	none	N	HP
<i>Sericocarpus linifolius</i>	Asteraceae	Narrow-leaved white-topped aster	N	PE/PE	N	HP
<i>Setaria faberi</i>	Poaceae	Giant foxtail	I	none	UPL	HA
<i>Setaria italica</i>	Poaceae	Foxtail millet	I	none	FACU	HA
<i>Setaria parviflora</i>	Poaceae	Perennial foxtail	N	none	FAC	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Setaria pumila</i>	Poaceae	Yellow foxtail	I	none	FAC	HA
<i>Setaria verticillata</i>	Poaceae	Bristly foxtail	I	none	FAC	HA
<i>Setaria viridis var. major</i>	Poaceae	Green foxtail	I	none	N	HA
<i>Setaria viridis var. viridis</i>	Poaceae	Green foxtail	I	none	N	HA
<i>Sicyos angulatus</i>	Cucurbitaceae	Bur cucumber	N	none	FACU	VA
<i>Sida spinosa</i>	Malvaceae	Prickly sida	I	none	UPL	HA
<i>Silene antirrhina</i>	Caryophyllaceae	Sleepy catchfly	N	none	N	HA
<i>Silene armeria</i>	Caryophyllaceae	Garden catchfly	I	none	N	HA
<i>Silene coronaria</i>	Caryophyllaceae	Rose-campion	I	none	N	HP
<i>Silene flos-cuculi</i>	Caryophyllaceae	Ragged-robin	I	none	FACU	HP
<i>Silene latifolia</i>	Caryophyllaceae	White campion	I	none	N	HA
<i>Silene noctiflora</i>	Caryophyllaceae	Night-flowering catchfly	I	none	N	HA
<i>Silene stellata</i>	Caryophyllaceae	Starry campion	N	none	N	HP
<i>Silene vulgaris</i>	Caryophyllaceae	Bladder campion	I	none	N	HP
<i>Silphium asteriscus var. trifoliatum</i>	Asteraceae	Whorled rosinweed	N	none	N	HP
<i>Sinapis alba</i>	Brassicaceae	White-mustard	I	none	N	HA
<i>Sinapis arvensis</i>	Brassicaceae	Charlock	I	none	N	HA
<i>Sisymbrium altissimum</i>	Brassicaceae	Tumble-mustard	I	none	FACU-	HA
<i>Sisymbrium officinale</i>	Brassicaceae	Hedge-mustard	I	none	N	HA
<i>Sisyrinchium angustifolium</i>	Iridaceae	Blue-eyed-grass	N	none	FACW-	HP
<i>Sisyrinchium atlanticum</i>	Iridaceae	Eastern blue- eyed-grass	N	PE/PE	FACW	HP
<i>Sisyrinchium mucronatum</i>	Iridaceae	Blue-eyed-grass	N	none	FAC+	HP
<i>Sium suave</i>	Apiaceae	Water-parsnip	N	none	OBL	HP
<i>Smilax glauca</i>	Smilacaceae	Catbrier	N	none	FACU	VW
<i>Smilax herbacea</i>	Smilacaceae	Carrion-flower	N	none	FAC	VP
<i>Smilax hispida</i>	Smilacaceae	Bristly greenbrier	N	none	N	VW
<i>Smilax pulverulenta</i>	Smilacaceae	Carrion-flower	N	none	FACU	VP
<i>Smilax rotundifolia</i>	Smilacaceae	Catbrier	N	none	FAC	VW
<i>Solanum carolinense</i>	Solanaceae	Horse-nettle	N	none	UPL	HP
<i>Solanum dulcamara var. dulcamara</i>	Solanaceae	Trailing nightshade	I	none	FAC	VW
<i>Solanum dulcamara var. villosissimum</i>	Solanaceae	Trailing nightshade	I	none	FAC	VW
<i>Solanum nigrum</i>	Solanaceae	Black nightshade	I	none	N	HA
<i>Solanum rostratum</i>	Solanaceae	Buffalo-bur	I	none	N	HA
<i>Solidago altissima</i>	Asteraceae	Late goldenrod	N	none	FACU	HP
<i>Solidago arguta var. arguta</i>	Asteraceae	Forest goldenrod	N	none	N	HP
<i>Solidago bicolor</i>	Asteraceae	Silver-rod	N	none	N	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Solidago caesia</i>	Asteraceae	Bluestem goldenrod	N	none	FACU	HP
<i>Solidago canadensis</i> <i>var. canadensis</i>	Asteraceae	Canada goldenrod	N	none	FACU	HP
<i>Solidago canadensis</i> <i>var. hargerii</i>	Asteraceae	Canada goldenrod	N	none	FACU	HP
<i>Solidago flexicaulis</i>	Asteraceae	Zigzag goldenrod	N	none	FACU	HP
<i>Solidago gigantea var.</i> <i>gigantea</i>	Asteraceae	Smooth goldenrod	N	none	FACW	HP
<i>Solidago gigantea var.</i> <i>serotina</i>	Asteraceae	Smooth goldenrod	N	none	FACW	HP
<i>Solidago juncea</i>	Asteraceae	Early goldenrod	N	none	N	HP
<i>Solidago nemoralis</i>	Asteraceae	Gray goldenrod	N	none	N	HP
<i>Solidago patula ssp.</i> <i>patula</i>	Asteraceae	Spreading goldenrod	N	none	OBL	HP
<i>Solidago puberula</i>	Asteraceae	Downy goldenrod	N	none	FACU-	HP
<i>Solidago rigida</i>	Asteraceae	Stiff goldenrod	N	TU/PE	UPL	HP
<i>Solidago rugosa ssp.</i> <i>aspera var. aspera</i>	Asteraceae	Wrinkle-leaf goldenrod	N	none	FAC	HP
<i>Solidago rugosa ssp.</i> <i>rugosa var. rugosa</i>	Asteraceae	Wrinkle-leaf goldenrod	N	none	FAC	HP
<i>Solidago sempervirens</i>	Asteraceae	Seaside goldenrod	I	none	FACW	HP
<i>Solidago speciosa</i>	Asteraceae	Showy goldenrod	N	N/PT	N	HP
<i>Solidago squarrosa</i>	Asteraceae	Ragged goldenrod	N	none	N	HP
<i>Solidago uliginosa</i>	Asteraceae	Bog goldenrod	N	N/PT	OBL	HP
<i>Solidago ulmifolia var.</i> <i>ulmifolia</i>	Asteraceae	Elm-leaved goldenrod	N	none	N	HP
<i>Sonchus arvensis ssp.</i> <i>uliginosus</i>	Asteraceae	Field sow-thistle	I	none	UPL	HP
<i>Sonchus asper</i>	Asteraceae	Spiny-leaved sow-thistle	I	none	FAC	HA
<i>Sonchus oleraceus</i>	Asteraceae	Common sow- thistle	I	none	UPL	HA
<i>Sorghastrum nutans</i>	Poaceae	Indian-grass	N	none	UPL	HP
<i>Sorghum bicolor ssp. x</i> <i>drummondii</i>	Poaceae	Shattercane	I	none	UPL	HA
<i>Sorghum halepense</i>	Poaceae	Johnsongrass	I	none	FACU	HP
<i>Sparganium</i> <i>americanum</i>	Sparganiaceae	Bur-reed	N	none	OBL	HP
<i>Sparganium</i> <i>androcladum</i>	Sparganiaceae	Branching bur- reed	N	PE/PE	OBL	HP
<i>Sparganium</i> <i>eurycarpum</i>	Sparganiaceae	Bur-reed	N	none	OBL	HP
<i>Spartina pectinata</i>	Poaceae	Freshwater cordgrass	N	none	OBL	HP
<i>Spergularia morisonii</i>	Caryophyllaceae	Spurrey	I	none	N	HA
<i>Spergularia rubra</i>	Caryophyllaceae	Purple sand- spurrey	I	none	FACU	HA
<i>Sphenopholis nitida</i>	Poaceae	Wedgegrass	N	none	N	HP

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<i>Sphenopholis obtusata</i> <i>var. major</i>	Poaceae	Slender wedgrass	N	none	FAC-	HP
<i>Sphenopholis obtusata</i> <i>var. obtusata</i>	Poaceae	Prairie wedgrass	N	none	FAC-	HP
<i>Sphenopholis obtusata</i> <i>x pennsylvanica</i>	Poaceae	Wedgrass	N	none	FAC	HP
<i>Sphenopholis</i> <i>pennsylvanica</i>	Poaceae	Swamp-oats	N	none	OBL	HP
<i>Spiraea alba</i>	Rosaceae	Meadow-sweet	N	none	FACW+	SD
<i>Spiraea japonica</i>	Rosaceae	Japanese spiraea	I	none	FACU-	SD
<i>Spiraea latifolia</i>	Rosaceae	Meadow-sweet	N	none	FAC+	SD
<i>Spiraea prunifolia</i>	Rosaceae	Bridal-wreath spiraea	I	none	N	SD
<i>Spiraea tomentosa</i>	Rosaceae	Hardhack	N	none	FACW-	SD
<i>Spiraea x billiardii</i>	Rosaceae	Spiraea	I	none	N	SD
<i>Spiranthes cernua</i>	Orchidaceae	Nodding ladies'- tresses	N	none	FACW	HP
<i>Spiranthes lacera var.</i> <i>gracilis</i>	Orchidaceae	Southern slender ladies'- tresses	N	none	FACU-	HP
<i>Spiranthes lacera var.</i> <i>lacera</i>	Orchidaceae	Northern slender ladies'-tresses	N	none	FACU-	HP
<i>Spiranthes lucida</i>	Orchidaceae	Shining ladies'- tresses	N	N/PT	FACW	HP
<i>Spiranthes ochroleuca</i>	Orchidaceae	Yellow nodding ladies'-tresses	N	none	FACW	HP
<i>Spiranthes tuberosa</i>	Orchidaceae	Slender ladies'- tresses	N	TU/PE	FACU-	HP
<i>Spirodela polyrhiza</i>	Araceae	Greater duckweed	N	none	OBL	HP
<i>Sporobolus compositus</i>	Poaceae	Dropseed	N	none	UPL	HP
<i>Sporobolus neglectus</i>	Poaceae	Small rushgrass	N	none	FACU-	HA
<i>Sporobolus vaginiflorus</i>	Poaceae	Poverty grass	N	none	UPL	HA
<i>Stachys hyssopifolia</i> <i>var. ambigua</i>	Lamiaceae	Hedge-nettle	N	TU/PX	FACW+	HP
<i>Stachys hyssopifolia</i> <i>var. hyssopifolia</i>	Lamiaceae	Hedge-nettle	N	TU/PX	FACW+	HP
<i>Stachys palustris var.</i> <i>palustris</i>	Lamiaceae	Hedge-nettle	I	none	OBL	HP
<i>Stachys tenuifolia</i>	Lamiaceae	Creeping hedge- nettle	N	none	FACW+	HP
<i>Staphylea trifolia</i>	Staphyleaceae	Bladdernut	N	none	FAC	SD
<i>Stellaria alsine</i>	Caryophyllaceae	Bog chickweed	I	none	OBL	HA
<i>Stellaria graminea</i>	Caryophyllaceae	Lesser stitchwort	I	none	FACU-	HP
<i>Stellaria longifolia</i>	Caryophyllaceae	Long-leaved stitchwort	N	none	FACW	HP
<i>Stellaria media</i>	Caryophyllaceae	Common chickweed	I	none	N	HA
<i>Stellaria pubera</i>	Caryophyllaceae	Great chickweed	N	none	N	HP
<i>Strophostyles helvola</i>	Fabaceae	Wild bean	N	none	FACU	VA
<i>Strophostyles</i>	Fabaceae	Wild bean	I	none	N	VP

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<i>leiosperma</i>						
<i>Strophostyles umbellata</i>	Fabaceae	Wild bean	N	N/PE	FACU	VP
<i>Stylosanthes biflora</i>	Fabaceae	Pencil-flower	N	TU/PE	N	HP
<i>Styrax japonicus</i>	Styracaceae	Japanese styrax	I	none	N	TD
<i>Symphoricarpos albus</i> <i>var. laevigatus</i>	Caprifoliaceae	Snowberry	I	none	FACU-	SD
<i>Symphoricarpos orbiculatus</i>	Caprifoliaceae	Coralberry	N	none	UPL	SD
<i>Symphyotrichum cordifolium</i>	Asteraceae	Blue wood aster	N	none	N	HP
<i>Symphyotrichum dumosum</i>	Asteraceae	Bushy aster	N	TU/PE	FAC	HP
<i>Symphyotrichum ericoides</i> ssp. <i>ericoides</i>	Asteraceae	White heath aster	N	TU/PT	FACU	HP
<i>Symphyotrichum laeve</i> <i>var. concinnum</i>	Asteraceae	Smooth blue aster	N	none	N	HP
<i>Symphyotrichum laeve</i> <i>var. laeve</i>	Asteraceae	Smooth blue aster	N	none	N	HP
<i>Symphyotrichum lanceolatum</i> ssp. <i>lanceolatum</i> var. <i>lanceolatum</i>	Asteraceae	Panicled aster	N	none	N	HP
<i>Symphyotrichum lateriflorum</i>	Asteraceae	Calico aster	N	none	FACW-	HP
<i>Symphyotrichum lowrieianum</i>	Asteraceae	Smooth heart-leaved aster	N	none	N	HP
<i>Symphyotrichum novae-angliae</i>	Asteraceae	New England aster	N	none	FAC	HP
<i>Symphyotrichum novi-belgii</i> var. <i>novi-belgii</i>	Asteraceae	New York aster	N	PT/PT	FACW+	HP
<i>Symphyotrichum patens</i>	Asteraceae	Late purple aster	N	none	N	HP
<i>Symphyotrichum phlogifolium</i>	Asteraceae	Late purple aster	N	none	N	HP
<i>Symphyotrichum pilosum</i> var. <i>pilosum</i>	Asteraceae	Heath aster	N	none	UPL	HP
<i>Symphyotrichum prenanthoides</i>	Asteraceae	Zig-zag aster	N	none	FAC	HP
<i>Symphyotrichum puniceum</i>	Asteraceae	Purple-stemmed aster	N	none	OBL	HP
<i>Symphyotrichum racemosum</i>	Asteraceae	Small white aster	N	none	FAC	HP
<i>Symphyotrichum undulatum</i>	Asteraceae	Clasping heart-leaved aster	N	none	N	HP
<i>Symphyotrichum urophyllum</i>	Asteraceae	Aster	N	none	N	HP
<i>Symphytum officinale</i>	Boraginaceae	Comfrey	I	none	N	HP
<i>Symplocarpus foetidus</i>	Araceae	Skunk cabbage	N	none	OBL	HP
<i>Symplocos paniculata</i>	Symplocaceae	Sapphire-berry	I	none	N	SD
<i>Syringa vulgaris</i>	Oleaceae	Common lilac	I	none	N	SD
<i>Taenidia integerrima</i>	Apiaceae	Yellow pimpinell	N	none	N	HP
<i>Tanacetum parthenium</i>	Asteraceae	Feverfew	I	none	N	HP
<i>Tanacetum vulgare</i>	Asteraceae	Common tansy	I	none	N	HP

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<i>Taraxacum erythrospermum</i>	Asteraceae	Red-seeded dandelion	I	none	N	HP
<i>Taraxacum officinale</i>	Asteraceae	Common dandelion	I	none	FACU-	HP
<i>Taxus canadensis</i>	Taxaceae	Canadian yew	N	TU/SP	FAC	SE
<i>Tephrosia virginiana</i>	Fabaceae	Goat's-rue	N	none	N	HP
<i>Teucrium canadense</i> var. <i>virginicum</i>	Lamiaceae	Wild germander	N	none	FACW	HP
<i>Thalictrum dioicum</i>	Ranunculaceae	Early meadow-rue	N	none	FAC	HP
<i>Thalictrum pubescens</i>	Ranunculaceae	Tall meadow-rue	N	none	FACW+	HP
<i>Thalictrum revolutum</i>	Ranunculaceae	Purple meadow-rue	N	none	UPL	HP
<i>Thalictrum thalictroides</i>	Ranunculaceae	Rue anemone	N	none	FACU-	HP
<i>Thaspium trifoliatum</i> var. <i>trifoliatum</i>	Apiaceae	Meadow-parsnip	N	none	N	HP
<i>Thelypteris noveboracensis</i>	Polypodiaceae	New York fern	N	none	FAC	HP
<i>Thelypteris palustris</i>	Polypodiaceae	Marsh fern	N	none	FACW+	HP
<i>Thlaspi alliaceum</i>	Brassicaceae	Garlic pennycress	I	none	N	HA
<i>Thlaspi arvense</i>	Brassicaceae	Field pennycress	I	none	N	HA
<i>Thymus pulegioides</i>	Lamiaceae	Creeping thyme	I	none	N	HP
<i>Tilia americana</i> var. <i>americana</i>	Malvaceae	Basswood	N	none	FACU	TD
<i>Tipularia discolor</i>	Orchidaceae	Cranefly orchid	N	PR/PR	FACU	HP
<i>Torilis leptophylla</i>	Apiaceae	Hedge-parsley	I	none	N	HA
<i>Torreyochloa pallida</i> var. <i>pallida</i>	Poaceae	Pale meadowgrass	N	none	OBL	HP
<i>Toxicodendron radicans</i>	Anacardiaceae	Poison-ivy	N	none	FAC	VW
<i>Toxicodendron vernix</i>	Anacardiaceae	Poison sumac	N	none	OBL	TD
<i>Tradescantia ohiensis</i>	Commelinaceae	Spiderwort	N	TU/SP	FAC	HP
<i>Tradescantia virginiana</i>	Commelinaceae	Spiderwort	N	none	FACU	HP
<i>Tragopogon dubius</i>	Asteraceae	Yellow goatsbeard	I	none	N	HB
<i>Tragopogon porrifolius</i>	Asteraceae	Oyster-plant	I	none	N	HB
<i>Tragopogon pratensis</i>	Asteraceae	Meadow salsify	I	none	N	HB
<i>Trapa natans</i>	Lythraceae	Water-chestnut	I	none	OBL	HA
<i>Triadenum fraseri</i>	Hypericaceae	Marsh St. Johns-wort	N	none	OBL	HP
<i>Triadenum virginicum</i>	Hypericaceae	Marsh St. John's-wort	N	none	OBL	HP
<i>Tribulus terrestris</i>	Zygophyllaceae	Caltrop	I	none	N	HA
<i>Trichophorum planifolium</i>	Cyperaceae	Club-rush	N	none	N	HP
<i>Trichostema brachiatum</i>	Lamiaceae	False pennyroyal	N	none	N	HP
<i>Trichostema dichotomum</i>	Lamiaceae	Blue-curlys	N	none	N	HA
<i>Tridens flavus</i>	Poaceae	Purpletop	N	none	FACU	HP

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<i>Trientalis borealis</i>	Myrsinaceae	Star-flower	N	none	FAC	HP
<i>Trifolium arvense</i>	Fabaceae	Rabbit's-foot clover	I	none	N	HA
<i>Trifolium aureum</i>	Fabaceae	Large yellow hop-clover	I	none	N	HA
<i>Trifolium campestre</i>	Fabaceae	Low hop-clover	I	none	N	HA
<i>Trifolium dubium</i>	Fabaceae	Little hop-clover	I	none	UPL	HA
<i>Trifolium hybridum</i>	Fabaceae	Alsike clover	I	none	FACU-	HP
<i>Trifolium incarnatum</i>	Fabaceae	Crimson clover	I	none	N	HA
<i>Trifolium pratense</i>	Fabaceae	Red clover	I	none	FACU-	HP
<i>Trifolium repens</i>	Fabaceae	White clover	I	none	FACU-	HP
<i>Trillium cernuum</i> var. <i>cernuum</i>	Melanthiaceae	Nodding trillium	N	N/PT	FACW	HP
<i>Trillium cernuum</i> var. <i>macranthum</i>	Melanthiaceae	Nodding trillium	N	N/PT	FACW	HP
<i>Trillium cuneatum</i>	Melanthiaceae	Huger's trillium	N	none	N	HP
<i>Trillium erectum</i> var. <i>erectum</i>	Melanthiaceae	Purple trillium	N	none	FACU-	HP
<i>Triodanis perfoliata</i> var. <i>perfoliata</i>	Campanulaceae	Venus's looking- glass	N	none	FAC	HA
<i>Triosteum angustifolium</i>	Caprifoliaceae	Horse-gentian	N	TU/PE	FAC+	HP
<i>Triosteum aurantiacum</i>	Caprifoliaceae	Wild-coffee	N	none	N	HP
<i>Triosteum perfoliatum</i>	Caprifoliaceae	Horse-gentian	N	none	N	HP
<i>Triphora trianthophora</i>	Orchidaceae	Nodding pogonia	N	PE/PE	UPL	HP
<i>Triplasis purpurea</i>	Poaceae	Purple sandgrass	N	PE/PE	N	HA
<i>Triticum aestivum</i>	Poaceae	Wheat	I	none	N	HA
<i>Trollius laxus</i>	Ranunculaceae	Spreading globe-flower	N	PE/PE	OBL	HP
<i>Tsuga canadensis</i>	Pinaceae	Canada hemlock	N	none	FACU	TE
<i>Tulipa sylvestris</i>	Liliaceae	Dutch-lily	I	none	N	HP
<i>Tussilago farfara</i>	Asteraceae	Coltsfoot	I	none	FACU	HP
<i>Typha angustifolia</i>	Typhaceae	Narrow-leaved cat-tail	N	none	OBL	HP
<i>Typha latifolia</i>	Typhaceae	Common cat-tail	N	none	OBL	HP
<i>Ulmus americana</i>	Ulmaceae	American elm	N	none	FACW-	TD
<i>Ulmus pumila</i>	Ulmaceae	Siberian elm	I	none	N	TD
<i>Ulmus rubra</i>	Ulmaceae	Red elm	N	none	FAC-	TD
<i>Urtica dioica</i> ssp. <i>dioica</i>	Urticaceae	Great nettle	I	none	FACU	HP
<i>Urtica dioica</i> ssp. <i>gracilis</i>	Urticaceae	Great nettle	N	none	FACU	HP
<i>Urtica urens</i>	Urticaceae	Dog nettle	I	none	N	HA
<i>Utricularia geminiscapa</i>	Lentibulariaceae	Bladderwort	N	N/SP	OBL	HP
<i>Utricularia gibba</i>	Lentibulariaceae	Humped bladderwort	N	none	OBL	HA
<i>Utricularia intermedia</i>	Lentibulariaceae	Flat-leaved bladderwort	N	PT/PT	OBL	HP

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<i>Utricularia macrorhiza</i>	Lentibulariaceae	Common bladderwort	N	none	OBL	HP
<i>Utricularia radiata</i>	Lentibulariaceae	Floating bladderwort	N	PE/PX	OBL	HA
<i>Uvularia perfoliata</i>	Colchicaceae	Bellwort	N	none	FACU	HP
<i>Uvularia sessilifolia</i>	Colchicaceae	Bellwort	N	none	FACU-	HP
<i>Vaccaria hispanica</i>	Caryophyllaceae	Cow-cockle	I	none	N	HA
<i>Vaccinium angustifolium</i>	Ericaceae	Low sweet blueberry	N	none	FACU-	SD
<i>Vaccinium corymbosum</i>	Ericaceae	Highbush blueberry	N	none	FACW-	SD
<i>Vaccinium macrocarpon</i>	Ericaceae	Cranberry	N	none	OBL	SE
<i>Vaccinium pallidum</i>	Ericaceae	Lowbush blueberry	N	none	N	SD
<i>Vaccinium stamineum</i>	Ericaceae	Deerberry	N	none	FACU-	SD
<i>Valeriana officinalis</i>	Valerianaceae	Garden heliotrope	I	none	N	HP
<i>Valerianella locusta</i>	Valerianaceae	Corn-salad	I	none	N	HA
<i>Valerianella radiata</i>	Valerianaceae	Beaked corn-salad	N	none	FAC	HA
<i>Valerianella umblicata</i>	Valerianaceae	Corn-salad	N	none	FAC	HA
<i>Vallisneria americana</i> <i>var. americana</i>	Hydrocharitaceae	Tape-grass	N	none	OBL	HP
<i>Veratrum latifolium</i>	Melanthiaceae	Bunchflower	N	none	FACU	HP
<i>Veratrum virginicum</i>	Melanthiaceae	Bunchflower	N	N/PE	FACW+	HP
<i>Veratrum viride</i>	Melanthiaceae	False hellebore	N	none	FACW+	HP
<i>Verbascum blattaria</i>	Scrophulariaceae	Moth mullein	I	none	UPL	HB
<i>Verbascum lychnitis</i>	Scrophulariaceae	White mullein	I	none	N	HB
<i>Verbascum phlomoides</i>	Scrophulariaceae	Mullein	I	none	N	HB
<i>Verbascum thapsus</i>	Scrophulariaceae	Common mullein	I	none	N	HB
<i>Verbena bracteata</i>	Verbenaceae	Prostrate vervain	I	none	UPL	HA
<i>Verbena hastata</i>	Verbenaceae	Blue vervain	N	none	FACW+	HP
<i>Verbena simplex</i>	Verbenaceae	Narrow-leaved vervain	N	none	N	HP
<i>Verbena urticifolia</i> <i>var. leiocarpa</i>	Verbenaceae	White vervain	N	none	FACU	HA
<i>Verbena urticifolia</i> <i>var. urticifolia</i>	Verbenaceae	White vervain	N	none	FACU	HA
<i>Verbena x engelmannii</i>	Verbenaceae	Vervain	N	none	N	HP
<i>Verbesina alternifolia</i>	Asteraceae	Wingstem	N	none	FAC	HP
<i>Vernonia noveboracensis</i>	Asteraceae	New York ironweed	N	none	FACW+	HP
<i>Veronica americana</i>	Plantaginaceae	American brooklime	N	none	OBL	HP
<i>Veronica anagallis-aquatica</i>	Plantaginaceae	Brook-pimpernel	I	none	OBL	HB
<i>Veronica arvensis</i>	Plantaginaceae	Corn speedwell	I	none	N	HA
<i>Veronica beccabunga</i>	Plantaginaceae	European brooklime	I	none	OBL	HP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Veronica chamaedrys</i>	Plantaginaceae	Bird's-eye	I	none	UPL	HP
<i>Veronica filiformis</i>	Plantaginaceae	Creeping speedwell	I	none	N	HP
<i>Veronica hederifolia</i>	Plantaginaceae	Ivy-leaved speedwell	I	none	N	HA
<i>Veronica longifolia</i>	Plantaginaceae	Speedwell	I	none	N	HP
<i>Veronica officinalis</i>	Plantaginaceae	Common speedwell	N	none	FACU-	HP
<i>Veronica peregrina</i> ssp. <i>peregrina</i>	Plantaginaceae	Neckweed	N	none	FACU-	HA
<i>Veronica peregrina</i> ssp. <i>xalapensis</i>	Plantaginaceae	Neckweed	N	none	FACU-	HA
<i>Veronica persica</i>	Plantaginaceae	Bird's-eye speedwell	I	none	N	HA
<i>Veronica polita</i>	Plantaginaceae	Speedwell	I	none	N	HA
<i>Veronica scutellata</i>	Plantaginaceae	Marsh speedwell	N	none	OBL	HP
<i>Veronica serpyllifolia</i>	Plantaginaceae	Thyme-leaved speedwell	I	none	FAC+	HP
<i>Veronicastrum virginicum</i>	Plantaginaceae	Culver's-root	N	none	FACU	HP
<i>Viburnum acerifolium</i>	Adoxaceae	Maple-leaved viburnum	N	none	N	SD
<i>Viburnum cassinoides</i>	Adoxaceae	Witherod	N	none	FACW	SD
<i>Viburnum dentatum</i>	Adoxaceae	Southern arrow- wood	N	none	FAC	SD
<i>Viburnum dilatatum</i>	Adoxaceae	Linden viburnum	I	none	N	SD
<i>Viburnum lentago</i>	Adoxaceae	Nannyberry	N	none	FAC	SD
<i>Viburnum nudum</i>	Adoxaceae	Possum-haw	N	PE/PE	OBL	SD
<i>Viburnum opulus</i>	Adoxaceae	Guelder-rose	I	none	N	SD
<i>Viburnum plicatum</i>	Adoxaceae	Doublefile viburnum	I	none	N	SD
<i>Viburnum prunifolium</i>	Adoxaceae	Black-haw	N	none	FACU	SD
<i>Viburnum rafinesquianum</i>	Adoxaceae	Downy arrow- wood	N	none	N	SD
<i>Viburnum recognitum</i>	Adoxaceae	Northern arrow- wood	N	none	FACW-	SD
<i>Viburnum setigerum</i>	Adoxaceae	Tea viburnum	I	none	N	SD
<i>Viburnum sieboldii</i>	Adoxaceae	Siebold viburnum	I	none	N	SD
<i>Vicia americana</i>	Fabaceae	Purple vetch	N	none	N	VP
<i>Vicia caroliniana</i>	Fabaceae	Wood vetch	N	none	FACU-	VP
<i>Vicia cracca</i>	Fabaceae	Canada pea	I	none	N	VP
<i>Vicia sativa</i> ssp. <i>nigra</i>	Fabaceae	Common vetch	I	none	FACU-	HA
<i>Vicia tetrasperma</i>	Fabaceae	Slender vetch	I	none	N	HA
<i>Vicia villosa</i> ssp. <i>varia</i>	Fabaceae	Hairy vetch	I	none	N	HA
<i>Vicia villosa</i> ssp. <i>villosa</i>	Fabaceae	Hairy vetch	I	none	N	HA
<i>Vinca minor</i>	Apocynaceae	Common periwinkle	I	none	N	HP
<i>Vincetoxicum nigrum</i>	Apocynaceae	Black swallow- wort	I	none	N	VP

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Viola affinis</i>	Violaceae	LeConte's violet	N	none	FACW	HP
<i>Viola arvensis</i>	Violaceae	European field pansy	I	none	N	HA
<i>Viola bicolor</i>	Violaceae	Field pansy	N	none	N	HA
<i>Viola blanda</i>	Violaceae	Sweet white violet	N	none	FACW	HP
<i>Viola brittoniana</i> ssp. <i>brittoniana</i>	Violaceae	Coast violet	N	PE/PE	FAC	HP
<i>Viola canadensis</i>	Violaceae	Canada violet	N	none	N	HP
<i>Viola cucullata</i>	Violaceae	Blue marsh violet	N	none	FACW+	HP
<i>Viola hirsutula</i>	Violaceae	Southern wood violet	N	none	N	HP
<i>Viola labradorica</i>	Violaceae	American dog violet	N	none	FACW	HP
<i>Viola lanceolata</i> var. <i>lanceolata</i>	Violaceae	Lance-leaved violet	N	none	OBL	HP
<i>Viola macloskeyi</i> ssp. <i>pallens</i>	Violaceae	Sweet white violet	N	none	OBL	HP
<i>Viola palmata</i>	Violaceae	Early blue violet	N	none	N	HP
<i>Viola pedata</i>	Violaceae	Birdfoot violet	N	none	N	HP
<i>Viola primulifolia</i>	Violaceae	Primrose violet	N	none	FAC+	HP
<i>Viola pubescens</i> var. <i>pubescens</i>	Violaceae	Downy yellow violet	N	none	FACU-	HP
<i>Viola pubescens</i> var. <i>scabriuscula</i>	Violaceae	Downy yellow violet	N	none	N	HP
<i>Viola rostrata</i>	Violaceae	Long-spurred violet	N	none	FACU	HP
<i>Viola sagittata</i> var. <i>ovata</i>	Violaceae	Ovate-leaved violet	N	none	FACW	HP
<i>Viola sagittata</i> var. <i>sagittata</i>	Violaceae	Arrow-leaved violet	N	none	FACW	HP
<i>Viola sororia</i>	Violaceae	Common blue violet	N	none	FAC-	HP
<i>Viola striata</i>	Violaceae	Striped violet	N	none	FACW	HP
<i>Viola subsinuata</i>	Violaceae	Violet	N	none	N	HP
<i>Viola tricolor</i>	Violaceae	Johnny-jump-up	I	none	N	HA
<i>Vitis aestivalis</i>	Vitaceae	Summer grape	N	none	FACU	VW
<i>Vitis labrusca</i>	Vitaceae	Fox grape	N	none	FACU	VW
<i>Vitis riparia</i>	Vitaceae	Frost grape	N	none	FACW	VW
<i>Vitis vulpina</i>	Vitaceae	Frost grape	N	none	FAC	VW
<i>Vitis x labruscana</i>	Vitaceae	Fox grape	I	none	N	VW
<i>Vulpia myuros</i> var. <i>hirsuta</i>	Poaceae	Foxtail fescue	I	none	UPL	HA
<i>Vulpia myuros</i> var. <i>myuros</i>	Poaceae	Foxtail fescue	I	none	UPL	HA
<i>Vulpia octoflora</i> var. <i>glauca</i>	Poaceae	Six-weeks fescue	N	none	UPL	HA
<i>Waldsteinia fragarioides</i>	Rosaceae	Barren strawberry	N	none	N	HP
<i>Wisteria floribunda</i>	Fabaceae	Japanese wisteria	I	none	N	VW

Species	Family	Common name	Native/ Introduced	PNHP status*	USFWS Wetlands indicator**	Growth habit***
<i>Wisteria frutescens</i>	Fabaceae	American wisteria	N	none	FACW-	VW
<i>Wisteria sinensis</i>	Fabaceae	Chinese wisteria	I	none	N	VW
<i>Wolffia brasiliensis</i>	Araceae	Pointed water-meal	N	none	OBL	HP
<i>Wolffia columbiana</i>	Araceae	Water-meal	N	none	OBL	HP
<i>Woodsia ilvensis</i>	Polypodiaceae	Rusty woodsia	N	none	N	HP
<i>Woodsia obtusa</i>	Polypodiaceae	Blunt-lobed woodsia	N	none	N	HP
<i>Woodwardia areolata</i>	Polypodiaceae	Netted chain fern	N	N/PT	FACW+	HP
<i>Woodwardia virginica</i>	Polypodiaceae	Virginia chain fern	N	none	OBL	HP
<i>Xanthium strumarium</i>	Asteraceae	Common cocklebur	N	none	FAC	HA
<i>Xanthorhiza simplicissima</i>	Ranunculaceae	Shrub yellowroot	I	none	FACW	SD
<i>Xyris difformis</i>	Xyridaceae	Yellow-eyed-grass	N	none	OBL	HP
<i>Xyris torta</i>	Xyridaceae	Yellow-eyed-grass	N	N/PT	OBL	HP
<i>Yucca flaccida</i>	Agavaceae	Adam's needle	I	none	N	HP
<i>Zannichellia palustris</i>	Potamogetonaceae	Horned pondweed	N	none	OBL	HP
<i>Zanthoxylum americanum</i>	Rutaceae	Prickly-ash	N	none	FACU	SD
<i>Zizania aquatica</i>	Poaceae	Wild-rice	N	PR/PR	OBL	HA
<i>Zizia aptera</i>	Apiaceae	Golden-alexander	N	none	FAC	HP
<i>Zizia aurea</i>	Apiaceae	Golden-alexander	N	none	FAC	HP

* PE=Pennsylvania endangered, PT=Pennsylvania threatened, PR=Pennsylvania rare, PV=Pennsylvania vulnerable, PX=Pennsylvania extirpated, TU=tentatively undetermined, SP=special population, WA=watch list. (Pennsylvania Natural Heritage Program. 2010. <http://naturalheritage.state.pa.us>)

**OBL=Obligate Wetland, Occurs almost always (estimated probability 99%) under natural conditions in wetlands; FACW=Facultative Wetland, Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non wetlands; FAC=Facultative, Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%); FACU=Facultative Upland, Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%); UPL=Obligate Upland, Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands; N=No listing (Source: U.S. Fish and Wildlife Service, 2010; accessed at <http://plants.usda.gov/wetinfo.html>)

***HA=herbaceous annual; HB=herbaceous biennial; HP=herbaceous perennial; VA=annual vine; VB=biennial vine; VP=perennial vine; VW=woody vine; SD=deciduous shrub; SE=evergreen shrub; TD=deciduous tree; TE=evergreen tree

Appendix B.

**Herpetological Inventory of the
Designated Natural Areas of Bucks County, Pennsylvania**



Conducted By Marlin D. Corn

Prepared for the Bucks County Natural Areas Inventory Update Project

December 22, 2010

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Introduction

This inventory was carried out as a component of the Bucks County Natural Areas Inventory Update, which is a follow-up to the original inventory completed in 1999. An inventory of reptiles and amphibians that occur within Bucks County, Pennsylvania was initiated in February 2009. Surveys were focused on thirteen ‘Conservation Landscapes’, areas of contiguous forest cover, riparian corridors, and exceptional value watersheds. The goal was to inventory all reptile and amphibian species that currently exist, and estimate their relative population size and distribution within these areas. Surveys were conducted from February 2009 through October 2010, under Pennsylvania Fish & Boat Commission Scientific Collecting Permit No. 156, Type I. In addition, reptile and amphibian occurrence data collected by the author since the year 2000 was included. During the course of this inventory, 44 herpetological species were documented within Bucks County.

Project Objectives

1. Compile a list of expected species

Before field investigations began a list of potential species was compiled from existing records based primarily on voucher specimens currently held at the Carnegie Museum of Natural History and the results of surveys previously conducted within the county. Field notes of acquaintances, conversations with park personnel and local enthusiasts, and personal records were also utilized.

2. Document species and compile relevant data

During the course of field surveys efforts were made to document observed species with digital photographs and GPS coordinates; notes were taken on population size, breeding status, and behavior.

3. Determine and propose conservation and management measures

General recommendations for the conservation of the county’s herpetofauna and specific recommendations for the conservation of species of concern were developed based on survey results.

Methods

Seasonally Important Habitat Assessment

Habitat reconnaissance visits to the thirteen designated conservation landscapes began in late February of 2009 in an effort to locate seasonally important habitat (e.g. seasonal pools, wetlands, and rock outcrops), subsequently time/area-constrained searches were conducted at the sites. Seasonally important sites discovered after the appropriate season in 2009 were visited during 2010. Seasonal pools are the sites of the earliest herpetological activity in a year and so received priority in late winter/early spring. Areas with records of rarer species generally received special attention, with repeat visits during the study, or until presence was confirmed.

Field Methods

General Herpetological Collecting (GHC), also known as ‘search and seizure’, during time/area constrained searches, was the primary method used for species detection during this inventory. Anuran Calling Surveys (ACS) were also conducted on occasions during breeding months. Numbers of calling individuals were noted, and in the case of large choruses (primarily spring peepers), population sizes were estimated. ACS outings were conducted primarily via automobile, by slowly driving past known wetlands and back roads on moist evenings, listening for calling frogs. GHC methods included:

- a) travelling through survey areas on foot and observing exposed, active animals, searching under cover objects (stones, logs, human debris, etc.), wading through wetlands, streams and other water bodies.
- b) searching wetlands at night with flashlights; slowly driving roads at night during wet weather (conducive to amphibian movements – usually in conjunction with ACS)
- c) paddling waterways via canoe/kayak to search for basking aquatic turtles and snakes, and to access islands.
- d) scanning potential habitat for a variety of species with binoculars before close approaches.

Terrestrial herpetological specimens were generally captured by hand for documentation, but dip nets were also employed in the capture of aquatic species. Specimens found dead on roadways were also recorded and are noted DOR (Dead on Road). Weather conditions and the names of all surveyors present were recorded. Latitude/longitude coordinates were recorded for each site and additional GPS points were recorded at the exact locations where rare or uncommon species were observed. Digital photographs were taken for at least one representative of each species (and/or their eggs) in each survey location, on each survey date whenever possible. Notes were taken on habitat, microhabitat, species populations, and behavior. At least one representative photograph of habitat was taken at each site visited.

List of Expected Species

Caudata

Spotted Salamander, *Ambystoma maculatum*
 Marbled Salamander, *A. opacum*
 Red-spotted Newt, *Notophthalmus viridescens viridescens*
 Northern Redback Salamander, *Plethodon cinereus*
 Northern Slimy Salamander, *P. glutinosus*
 Northern Dusky Salamander, *Desmognathus fuscus fuscus*
 Northern Red Salamander, *Psuedotriton ruber ruber*
 Northern Two-lined Salamander, *Eurycea bislineata*
 Longtail Salamander, *E. longicauda longicauda*
 Four-toed Salamander, *Hemidactylium scutatum*

Anura

Eastern Spadefoot Toad, *Scaphiopus holbrookii holbrookii*
 American Toad, *Anaxyrus americanus americanus*
 Fowler's Toad, *A. fowleri*
 Spring Peeper, *Psuedacris crucifer*
 New Jersey Chorus Frog, *P. triseriata kalmi*
 Northern Cricket Frog, *Acris crepitans crepitans*
 Gray Treefrog, *Hyla versicolor*
 Wood Frog, *Lithobates sylvaticus*
 Southern Leopard Frog, *L. sphenoccephalus utricularius*
 Pickerel Frog, *Lithobates palustris*
 Green Frog, *L. clamitans melanota*
 Bullfrog, *L. catesbeianus*

Chelonia

Common Snapping Turtle, *Chelydra serpentina serpentina*
 Common Musk Turtle, *Sternotherus odoratus*
 Spotted Turtle, *Clemmys guttata*
 Bog Turtle, *Glyptemys muhlenbergii*
 Wood Turtle, *G. insculpta*
 Eastern Box Turtle, *Terrapene carolina carolina*
 Map Turtle, *Graptemys geographica*
 Red-eared Slider, *Trachemys scripta elegans*
 Redbelly Turtle, *Psuedemys rubriventris*
 Painted Turtle, *Chrysemys picta /marginata*
 Eastern Spiny Softshell Turtle, *Apalone spinifera spinifera*

Order Squamata, sub-order Lacertilia

Northern Fence Lizard, *Sceloporus undulatus*
 5-Lined Skink, *Plestiodon fasciatus*

Order Squamata, sub-order Serpentes

Northern Water Snake, *Nerodia sipedon sipedon*
 Eastern Smooth Earth Snake, *Virginia valeriae valeriae*
 Northern Brown Snake, *Storeria dekayi dekayi*
 Eastern Garter Snake, *Thamnophis sirtalis sirtalis*
 Northern Ringneck Snake, *Diadophis punctatus edwardsii*
 Eastern Hognose Snake, *Heterodon platyrhinos*
 Northern Black Racer, *Coluber constrictor constrictor*
 Eastern Rat Snake, *Elaphe alleghaniensis*
 Eastern Milksnake, *Lampropeltis triangulum*
 Northern Copperhead, *Agkistrodon contortrix mokasen*

Inventory of Species Detected

<u>Species</u>	<u>Number of Observations</u>	
	<u>2009 – 2010</u>	<u>2000 - 2010</u>
<u>Order Caudata</u>		
Spotted Salamander, <i>Ambystoma maculatum</i>	44+	151+
Marbled Salamander, <i>A. opacum</i>	1	7+
Red-spotted Newt, <i>Notophthalmus viridescens viridescens</i>	9	12
Northern Redback Salamander, <i>Plethodon cinereus</i>	381+	886+
Northern Slimy Salamander, <i>P. glutinosus</i>	4	43
Northern Dusky Salamander, <i>Desmognathus fuscus fuscus</i>	117	412+
Northern Red Salamander, <i>Psuedotriton ruber ruber</i>	28	47
Northern two-lined Salamander, <i>Eurycea bislineata</i>	374	674+
Four-toed Salamander, <i>Hemidactylum scutatum</i>	0	1
Longtail Salamander, <i>E. longicauda longicauda</i>	4	17
<u>Order Anura</u>		
Eastern Spadefoot Toad, <i>Scaphiopus holbrookii holbrookii</i>	3	3
American Toad, <i>Anaxyrus americanus americanus</i>	172+	384+
Fowler's Toad, <i>A. fowleri</i>	53+	154+
Spring Peeper, <i>Psuedacris crucifer</i>	658+	7140+
New Jersey Chorus Frog, <i>P. triseriata kalmi</i>	5	5
Northern Cricket Frog, <i>Acris crepitans crepitans</i>	15+	28+
Gray Treefrog, <i>Hyla versicolor</i>	242+	858+
Wood Frog, <i>Lithobates sylvaticus</i>	155+	424+
Southern Leopard Frog, <i>L. sphenoccephalus utricularius</i>	8	32
Pickerel Frog, <i>L. palustris</i>	272+	650+
Green Frog, <i>L. clamitans melanota</i>	1409+	2429+
Bullfrog, <i>L. catesbeianus</i>	119+	425+
<u>Order Chelonia</u>		
Common Snapping Turtle, <i>Chelydra serpentina serpentina</i>	43	259
Common Musk Turtle, <i>Sternotherus odoratus</i>	12	25
Eastern Mud Turtle, <i>Kinosternon subrubrum subrubrum</i>	8	8
Spotted Turtle, <i>Clemmys guttata</i>	18	35
Wood Turtle, <i>G. insculpta</i>	5	10
Eastern Box Turtle, <i>Terrapene carolina carolina</i>	26	82
Map Turtle, <i>Graptemys geographica</i>	12	56
Yellowbelly Slider, <i>Trachemys scripta scripta</i>	1	1
Red-eared Slider, <i>T. scripta elegans</i>	102	155
Redbelly Turtle, <i>Pseudemys rubriventris</i>	128	380
Painted Turtle, <i>Chrysemys picta /marginata</i>	441	1255
Eastern Spiny Softshell Turtle, <i>Apalone spinifera spinifera</i>	19	38
<u>Order Squamata, sub-order Lacertilia</u>		
5-Lined Skink, <i>Plestiodon fasciatus</i>	5	10
<u>Order Squamata, sub-order Serpentes</u>		
Northern Water Snake, <i>Nerodia sipedon sipedon</i>	48	97
Northern Brown Snake, <i>Storeria dekayi dekayi</i>	9	11
Eastern Garter Snake, <i>Thamnophis sirtalis sirtalis</i>	60	171
Northern Ringneck Snake, <i>Diadophis punctatus edwardsii</i>	30	64
Northern Black Racer, <i>Coluber constrictor constrictor</i>	21	42
Eastern Rat Snake, <i>Pantherophis alleghaniensis</i>	2	15
Eastern Milksnake, <i>Lampropeltis triangulum</i>	14	22
Northern Copperhead, <i>Agkistrodon contortrix mokasen</i>	3	3

Species Accounts – Species Detected

In many cases the numbers of species detected at a given site could only be estimated. This includes cases of large frog choruses, large congregations of basking turtles that dive into the water upon detection, large emergences of frog or toad metamorphs, or large numbers of fast swimming amphibian larvae. The numbers of those species are accompanied by a '+'.

In situations where only larvae were encountered, the species was only given a single number value for each water body; at least one adult had to be present to deposit eggs, but entire broods of amphibian larvae can perish if the natal water body dries up before metamorphosis is complete; something that has been observed numerous times by the lead surveyor of this project.

At the beginning of the account for each species, the number of specimens detected during the NAI update project (2009 – 2010) is noted to the right of each species name. The number of observations since 2000 follows that number, in parenthesis. All photos were taken by Marlin D. Corn unless otherwise noted.

Order Caudata

Spotted Salamander, *Ambystoma maculatum* – 44+ specimens detected (151+ since 2000)

Spotted salamanders were found in all 13 designated natural landscapes. Adults, larvae, eggs or spermatophores were present in most vernal pools surveyed during the late winter – early spring months. Population size was generally, but not always, commensurate with vernal pool size. In several instances there was evidence of breeding in other types of water bodies (e.g. streams, swamps, man-made ponds). Occasionally adults were found under logs in upland forest habitat during diurnal surveys. During nocturnal surveys breeding events were sometimes witnessed; adults were encountered traversing wet forest floors and congregating in vernal pools, engaging in courtship rituals. On a few occasions adult spotted salamanders were observed swimming in small streams during breeding migrations.



Large vernal breeding pool



Spotted salamander



spotted salamander egg cluster



spotted salamander metamorph

Marbled Salamander, *Ambystoma opacum* – 1 specimen detected (7+ since 2000)

The first documentation of marbled salamanders in Bucks County occurred in 2002 when PHAP volunteer Jack Sliwinski found two larval stage specimens in the Coffman Hill landscape. During subsequent surveys targeting the same area in the spring of 2006, more than 20 larvae were found in a stream pool (one collected and reared to adult stage in captivity). An adult specimen was found during a survey in the same general location the following September, and another adult was found there in September of 2007. A visit to the same location turned up another adult specimen on September 3, 2010. All three of these adults were males, found during diurnal surveys under small pieces of bark on the ground in a section of forest that is seasonally flooded. Several miles to the east in the Coffman Hill landscape, Harry McGarrity found several marbled salamander larvae in a small vernal pool on his property during March 2008. An adult female, guarding eggs under a thick mat of moist deciduous leaves, was found by Harry in the same pool the following October. Reports of past marbled salamander observations were received for two other locations in the Coffman Hill landscape, but these are yet to be confirmed.



Marbled salamander, top rt: female guarding eggs (photo by H, McGarrity); bottom left: larva; bottom rt: metamorph

Red-spotted Newt, *Notophthalmus viridescens viridescens* – 9 specimens detected (12 since 2000)

Red-spotted newts are a common species throughout much of Pennsylvania, but appear to be relatively uncommon in Bucks County. Only five specimens were found during the past two years, and the surveyor had only recorded four specimens previously in Bucks County during the past ten years. No sizable populations were observed in any of the numerous lakes, ponds, canals, vernal pools or other water bodies included in surveys. However, red-spotted newts are probably much more common than the data in this report might suggest. There is abundant private property with appropriate habitat that has yet to be surveyed. The species can be transient, disappearing from one location, and colonizing new locations via movements in stream courses by adults, and overland travel by the eft stage. They were documented in Bucks County during the original NAI project, and a number of anecdotal reports from various locations have been received through the years. Since 2000 they have been found in the Coffman Hill, Mid-county Ridges, Neshaminy Creek, and Upper Tohickon Creek landscapes. Five of these specimens were efts, found wandering in the open or under logs in woodland habitat, while the remaining four were adults in aquatic environs. Additional surveys targeting this species, particularly aquatic trapping surveys, would likely increase the known range of the red-spotted newt in Bucks County.



Red-spotted newt, left: red-spotted salamander; right: red eft stage

Northern Redback Salamander, *Plethodon cinereus* – 381 specimens detected (886 since 2000)

As expected, the extremely common northern redback salamander was found in abundance in all thirteen landscapes. The majority of observations were made in woodlands during the spring and fall, and most specimens were found under a variety of cover objects. Occasionally specimens were encountered under streamside rocks during the summer months. Several were encountered actively moving about in the open during nocturnal surveys. They were found in nearly all woodland habitat surveyed during spring and fall months the northern redback salamander is undoubtedly one of the most common herpetological species in Bucks County.



Northern redback salamander

Northern Slimy Salamander, *Plethodon glutinosus* – 4 specimens detected (43 since 2000)

All specimens of northern slimy salamanders were found under cover objects (usually stone, less often under logs, occasionally under bark or debris) in woodland habitat during spring or fall months. Northern slimy salamanders can pose a challenge to the surveyor, particularly in Bucks County. This species is only above ground for short periods in the spring and fall, and populations appear to be sporadic. The northern slimy salamander appears to be most numerous in the northern parts of Bucks County where diabase boulders often represent the predominate cover objects; much of the forest in this area contains massive exposures of diabase. Such a landscape offers premium salamander habitat, but can prove challenging to survey; diabase boulders are often difficult to lift, either being too heavy, or embedded into the substrate due to their round shape. When other types of cover object were available, large numbers of slimy salamanders were found in some of these areas. During the past ten years northern slimy salamanders have been found in the Coffman Hill, Lower Tohickon Creek, Neshaminy Creek, Nockamixon-Haycock, Paunacussing and Tinicum Creek Landscapes. A second-hand report of a northern slimy salamander in Five Mile Woods (Atlantic Coastal Plain landscape) was received, but surveys in that preserve during this study did not turn up any specimens. It is not unreasonable to believe that additional surveys, focused on woodland salamanders, would detect northern slimy salamanders in additional landscapes.



Northern slimy salamander

Northern Dusky Salamander, *Desmognathus fuscus fuscus* – 117 specimens detected (412+ since 2000)

Northern dusky salamanders were found in all but two conservation landscapes; Delaware River and Lake Galena/Pine Run. However they were found in only a few locations in the Neshaminy Creek landscape, and one location in the Atlantic Coastal Plain landscape. The apparent lack of northern dusky salamanders in these landscapes may reflect the reduced water quality in the more intensively developed areas in the county. The majority of observations were made in the northern, less populated regions where they were often found in abundance. Additional surveys would likely expand their known range within the county.

All northern dusky salamanders were found associated with seeps, springs or small to medium size streams. Specimens were usually found under rocks along the water's edge, and some neotenic forms were found under rocks in stream beds. On one occasion several adults were observed wandering out in the open on the bottom of a small woodland stream in warm sunny weather on an early spring day. On several occasions females were found guarding eggs under large slabs of stone on stream banks. An adult male was usually in close proximity to the female and her eggs in these cases.



Northern slimy salamander; left: female guarding eggs; right: female with young

Northern Red Salamander, *Pseudotriton ruber ruber* – 28 specimens detected (47 since 2000)

Northern red salamanders were not difficult to find in watersheds noted for their exceptionally pristine condition, but appear to be uncommon or possibly absent throughout much of Bucks County. They are considered one of the best indicator species for stream water quality, yet they have turned up in unlikely places. George Carmichael, of southern Bucks County, knows of a small population of northern red salamanders that thrives in a tiny stream that runs through the middle of a Levittown neighborhood (documented prior to 2000 during the Pennsylvania Herpetological Atlas Project). Since 2000 they have been documented by the surveyor of this project in the Coffman Hill, Cooks Creek, Mid-County Ridges, Neshaminy Creek, Nockamixon-Haycock, and Paunacussing Creek landscapes. A large portion of these observations were made in the Rapp Creek and Cooks Creek drainages. Most specimens were found under cover objects (rocks, logs, mats of wet leaves) in seeps, or alongside streams. Some, including both adult and neotenic forms were found under rocks in the water of streams. One specimen was found inside a large rotting log several yards from a stream. Additional surveys could increase the number of landscapes that Northern Red Salamanders are known to inhabit.



Northern red salamander; right: adult; left: neotenic form

Northern 2-lined Salamander, *Eurycea bislineata* – 374 specimens detected (674+since 2000)
 Northern two-lined salamander the most common streamside salamander in Bucks County. Apparently tolerant of less than pristine water quality, this species was found in abundance in all conservation landscapes. Most specimens were found under rocks along stream edges, or in seeps, but some were found several yards from the water's edge. It is easy to find northern two-lined salamanders by flipping over a few rocks along the edge of a stream anywhere in Bucks County.



Northern two-lined salamander

Four-toed Salamander, *Hemidactylium scutatum* – 0 specimens detected (1 since 2000)
 Only a single four-toed salamander has ever been found in Bucks County by the lead surveyor of this project. This specimen was found in the Upper Unami Conservation Landscape in late-October of 2005. It was found in a small burrow atop a septic sand mound in the front yard of a private residence. The location is adjacent to classic four-toed salamander habitat; a hardwood swamp and associated open wetland with abundant sphagnum moss. No other official documentation of four-toed salamanders could be found for Bucks County, but Brandon Ruhe reported that he found one in the Atlantic Coastal Plain landscape in the early 1990s (pers. communication). This species was added to the state's no-take list in recent years due to apparent population declines. Additional surveys focused on this species in appropriate habitat might yield more specimens of four-toed salamanders in Bucks County.



Four-toed salamander, left: dorsum; right: venter

Longtail Salamander, *Eurycea longicauda longicauda* – 4 specimens detected (17 since 2000)
 A relatively uncommon species in Bucks County, longtail salamanders were found in the Coffman Hill, Delaware River, Lower Tohickon Creek, Neshaminy Creek, Paunacussing Creek, and Tincum Creek Conservation Landscapes. In most situations, only a single longtail salamander was detected during the course of a survey, but seven specimens were found in one location in the Tincum Creek Conservation Landscape. Most specimens were found under rocks associated with streams and creeks, but several Longtail Salamanders were found in terrestrial habitat. One specimen was actively moving through the leaf litter of a forest floor.



Longtail salamander

Order Anura

Eastern Spadefoot Toad, *Scaphiopus holbrookii holbrookii* – 7 specimens detected (7 since 2000)

The detection of spadefoot toads during the course of this study constitutes a new herpetological record for Bucks County. All seven specimens were found by Brandon Ruhe, who is currently conducting a state-wide research project to determine the distribution of eastern spadefoot toad

in Pennsylvania. Five adult specimens were found actively moving at night during rain events in the Delaware River Conservation Landscape, and two metamorphs were spotted in a small pool, in open meadow habitat adjacent to a wetland, in the Atlantic Coastal Plain.

It has long been suspected that this extremely secretive species might reside in Bucks County, as anecdotal reports have been received through the years. George Carmichael related second hand reports about spadefoot toads being at a site in the Atlantic Coastal Plain during the 1960's. Retired Council Rock High School teacher Bob Assetto reported students from the Washington Crossing area bringing numerous specimens in to his science class during the 1980's. Searches during nocturnal rain events revealed no specimens in either of those localities during this study. However, continued searches in appropriate habitat during rain events might yield additional eastern spadefoot toad discoveries in Bucks County.



Eastern spadefoot toad, photo by Brandon Ruhe

American Toad, *Bufo americanus americanus* – 172+ specimens detected (384+since 2000)
The cosmopolitan American toad is widespread and common throughout Bucks County. It was found in all landscapes, in a variety of habitats. In the majority of cases, a single specimen was found under a cover object or moving through forest habitat. In some cases, larger numbers resulted from hearing small choruses, or witnessing breeding events on spring evenings. One large emergence of over 100 metamorphs was observed along the Neshaminy Creek in Dark Hollow County Park. A number of observations were made in gardens and lawns.



Left: American toad, right: pair of American toads in amplexus

Fowler's Toad, *Bufo fowleri* – 53+ specimens detected (154+ since 2000)

Considered a species of concern in Pennsylvania, Fowler's toads seems to be better represented in Bucks County than anywhere else in the state. They were found in the Atlantic Coastal Plain, Delaware River, Lower Tohickon Creek and Neshaminy Creek landscapes. Most observations were made along creeks that drain directly into the Delaware River, or in floodplains associated with the Delaware River. Breeding choruses were heard during nocturnal surveys, but most visual observations occurred during diurnal surveys. Most of these specimens were found under cover objects, several were observed actively moving overland. It is likely that more populations of Fowler's toads exist along the Delaware drainage in Bucks County than were detected during this study.



Fowlers toad



Fowlers toad, toadlet

Spring Peeper, *Pseudacris crucifer crucifer* – 658+ specimens detected (7140+ since 2000)

Found in all landscapes, spring peepers are clearly one of the most abundant herpetological species in Bucks County. They were heard calling from most wetlands or other bodies of water that had ample emergent vegetation along the shore during evening surveys in early spring. The diversity of wetland habitat populated by spring peepers in Bucks County includes lake and pond shores, emergent wetlands of all sizes, woodland swamps, vernal pools, the Delaware Canal, and roadside ditches. Specimens were also heard calling sporadically during surveys on cloudy days during the spring and fall. Occasionally individual spring peepers were encountered moving overland in forests during summer and fall months. The numbers of individual frogs in larger choruses could only be estimated.



Spring peepers, center: calling male; right: pair in amplexus

New Jersey Chorus Frog, *Psuedacris triseriata kalmi* – 1 specimen detected (1 since 2000)

A single New Jersey chorus frog was captured in a wooded wetland in the Atlantic Coastal Plain on March 18, 2010 by Brandon Ruhe. Up to five chorus frogs were detected by call in a wetland pool of water (approx. 3 ft.) with emergent vegetation, including woody shrubs, at approximately 11:30 a.m., in mild but cloudy weather. Brandon also found an egg cluster, believed to be deposited by a female chorus frog, attached to a submerged plant stem.

The last documented observation of a New Jersey chorus frog in Pennsylvania was in the Yardley area in the mid-1980s, and the species has since been regarded as extirpated from the state. The new observation is significant in that it not only resurrects the species as extant in Pennsylvania, but is a significant distance from the Yardley site. Older historical records from the Bristol area the species exist, but the locality is vague. It is possible that this find represents a new site. Critically-timed surveys in appropriate habitat throughout the southern end of Bucks County may well yield additional undetected populations.



New Jersey chorus frog

Northern Cricket Frog, *Acris crepitans crepitans* – 15+ specimens detected (28+ since 2000)

Because northern cricket frog populations appear to have declined drastically in Pennsylvania, the documentation of an extant population in Bucks County is significant. The locations where specimens were found are all in relatively close proximity to each other (entire area approx. 2 square miles) in the Delaware River Conservation Landscape. Interestingly, the area is one of the most heavily impacted by industry in the county, yet this delicate species continues to thrive. In all instances the frogs were detected actively moving through habitat, or by calling choruses. In the summer of 2001 George Carmichael discovered a small group of northern cricket frogs calling from a roadside ditch. At another location numerous frogs were observed hopping through spatterdock and hunting small flies on a wetland mudflat during the month of September. Another site is a recently constructed mitigation wetland that was colonized by northern cricket frogs. During a morning visit in early July, males were heard chorusing and several adults, tadpoles and metamorphs were observed moving through emergent vegetation. At another site several specimens were found moving about in upland forest habitat, also in late-September.

Intensive surveys in the southern region of the county could yield additional populations of northern cricket frogs. Anecdotal reports of populations in the northern end of the county have

been received, but follow-up investigations have failed to confirm them. A locality in northeastern Bucks County was reported in the final report of the Pennsylvania Herpetological Atlas Project (Hulse 2002), but the exact site could not be determined and it is not clear if the volunteer(s) who reported it provided a voucher specimen or photograph.



Northern cricket frog, center: metamorph; right: adult in upland habitat

Gray Treefrog, *Hyla versicolor* – 242+ specimens detected (858+ since 2000)

Gray treefrogs are abundant and widespread in Bucks County. During this project they were detected in all but two of the Conservation Landscapes; the Mid-county Ridges and Upper Unami. It would not be surprising to learn that Gray Treefrogs do in fact, reside in these landscapes as well.

Nearly all gray treefrogs were detected by their calls. The majority of observations were made on moist-to-wet nights while driving slowly through the county. However, many were detected by diurnal calling, particularly on cloudy days. Most were calling from the branches of trees, but they were also occasionally detected on the ground. On very rare occasions they were detected visually. One specimen was found hibernating in a depredated painted turtle nest during a late winter turtle-nesting habitat survey in the southeastern tip of the county.



Gray Treefrog, photos by Shaun Hicks

Wood Frog, *Lithobates sylvaticus* – 155+ specimens detected (424+ since 2000)

Wood frogs, their eggs, or their tadpoles were observed at most vernal pools visited during late-winter or spring months, often in the company of spotted salamanders. Breeding activity was observed on numerous occasions. Varying-sized adult phase frogs were occasionally found moving overland in forested habitat during spring, summer and fall months. Only a few times were wood frogs found under cover objects. They were documented in all but one Conservation Landscape; the Lake Galena/Pine Run landscape.



Wood frog, left: female; right: male

Southern Leopard Frog, *Lithobates sphenoccephalus utricularius* – 8 specimens detected (32 since 2000)

Southern leopard frogs are currently known to exist in the Atlantic Coastal Plain and Delaware River Conservation Landscapes. Breeding populations that were observed at two different sites, one in each landscape, during the spring of 2001 and 2002 were reconfirmed in 2009-2010. In addition southern leopard frogs were found at three additional sites in the Atlantic Coastal Plain by Brandon Ruhe. Males were heard calling on most visits during early spring. A single frog was observed leaping through a grassy area of another site in the southern tip of the county in 2001. Intensive searches of appropriate habitat in the southern region of the county could yield additional populations.



Southern leopard frog

Pickerel Frog, *Lithobates palustris* – 272+ specimens detected (650+since 2000)

Pickerel frogs are very common in Bucks County; the most robust numbers were encountered in the northern region where they seemed to be ubiquitous. Abundance decreased to the south. Pickerel frogs have been encountered in a variety of habitats, particularly in moist conditions; they were one of the most commonly observed species crossing roadways during nocturnal rain event surveys. They were also observed actively moving through forests, wetlands, and wet meadows, and were often found beneath streamside rocks, especially during fall surveys. Males were often heard calling from lakes, ponds, creek oxbows, vernal pools, wooded swamps and open wetlands during nocturnal surveys in early spring. Males were sometimes observed calling while sitting on a pool bottom, under several feet of water.



Pickerel frog

Green Frog, *Lithobates clamitans melanota* – 1409+ specimens detected (2429+ since 2000)

Green frogs are undoubtedly one of the most common herpetological species in Bucks County. They were observed in most aquatic situations in all Conservation Landscapes. Adults and/or tadpoles were generally obvious in most wetlands with standing water including swamps, lakes, artificial water gardens, creeks, the Delaware River, and Delaware Canal. They were also one of the most commonly observed species crossing roads at night during rain events. Green frogs were sometimes present in vernal pools, and occasionally were observed moving overland through forest or meadow habitat. Green frogs were often heard calling, night and day, throughout the summer months; they are often seen evenly spaced along shorelines where ‘wrestling matches’ are occasionally observed between males defending calling territories.



Green frog

Bullfrog, *Lithobates catesbeianus* – 119+ specimens detected (425+ since 2000)

Bullfrogs were found in all conservation landscapes. Almost always observed sitting on the bank or in the shallow water of ponds, lakes, or creeks, they were occasionally the only frog species seen in these situations. They were found in the same habitat types that other *Lithobates* species, and were occasionally observed feeding on the other species. This includes an observation of a bullfrog swallowing a pickerel frog, a species considered relatively toxic. Males were often heard calling, both night and day and bullfrogs were frequently observed stationed in relatively even intervals along the shores of most ponds and small lakes.



Bullfrog

Order Chelonia

Common Snapping Turtle, *Chelydra serpentina* – 43 specimens detected (259 since 2000)

Found in all landscapes, snapping turtles can be found with patient searching of aquatic habitats. Due to its cryptic habits, the species is almost certainly much more common than the survey results might suggest. Typically only one or two ‘snappers’ were observed during numerous surveys of the Churchville Reservoir; but when a dead deer ended up in the lake during the summer of 2008, at least eight large snapping turtles were observed tearing chunks of flesh from the decomposing carcass. At least three more snappers could be seen heading through the water towards the carcass from different directions.

Snapping turtles were usually observed moving slowly on the bottom of water bodies, but were also often seen float-basking. Occasionally common snapping turtles were observed basking on logs or shores. A number of specimens were encountered moving overland, and females were occasionally observed nesting. Numerous depredated snapping turtle nests were observed in close proximity to lake and pond shores. Hatchlings were usually encountered in shallow water conditions (e.g. in shallow streams, emergent wetlands and emergent plant zones of ponds and lakes).



Common snapping turtle

Common Musk Turtle, *Sternotherus odoratus* – 12 specimens detected (25 since 2000)
 Due to the secretive habits of the common musk turtle, this species is likely much more common than the number of observations suggest. Most specimens were found grazing on algae or submerged plant growth on the bottom of shallow pools in creeks, streams, or the Delaware Canal. Algae growth on the shells of many specimens provides excellent camouflage for these turtles. Some were observed actively swimming with the downstream flow of creeks. Several specimens were discovered moving overland near a large pond after a heavy rain. Two shells of dead specimens were found. An egg was found lying in the open along the railroad tracks at the Churchville Reservoir, possibly a survivor of nest depredation. The jellybean-sized egg was collected and it hatched several days later. The hatchling was released in the emergent plant zone of the reservoir, close to where it was found.



*Common musk turtle, above left and right: adult;
 lower left: hatchling and egg shell*

Eastern Mud Turtle, *Kinosternon subrubrum subrubrum* – 2 specimens detected (2 since 2000)

The discovery of eastern mud turtles in the Atlantic Coastal Plain and Delaware River Conservation Landscapes represents the most significant herpetological find for Bucks County, if not for the entire state of Pennsylvania, in recent history. Prior to the observations described here, the eastern mud turtle had not been documented in Pennsylvania since 1963. Prior to that single observation, it had not been seen since 1906.

In July of 2008, Brandon Ruhe discovered a DOR specimen in the Delaware River landscape. This discovery led to the funding of a study, headed by Mr. Ruhe and Dr. Tom LaDuke of East Stroudsburg University, as an attempt to determine the status of eastern mud turtle populations in Pennsylvania. In the late summer of 2009, a specimen was observed basking on a shrub hammock in a wetland located in the Atlantic Coastal Plain, and was hand-captured by Mr. Ruhe (witnessed by lead herpetologist of the Bucks County NAI update project). The following March, an old female mud turtle was discovered by Mr. Ruhe in the same vicinity. This specimen was apparently emerging from a hibernaculum in forest habitat adjacent to the wetland. Trapping (aquatic hoop traps), and subsequent radio tracking efforts in the same wetland led to the discovery of six more eastern mud turtles.



Eastern mud turtle, right: plastron

Eastern Box Turtle, *Terrapene carolina carolina* – 26 specimens detected (82 since 2000)

Eastern box turtles have been found in all conservation landscapes, an encouraging observation as this species is regarded as having suffered drastic declines state-wide in recent years. Most specimens were observed actively moving through forest, meadow, and wetland habitat. One was discovered inadvertently while conducting a streamside salamander survey on a hot, dry summer day; the turtle was at the bottom of a pool of water in a small stream. Several other specimens were found swimming or wading in the shallows of ponds, artificial water gardens and flooded tire ruts of dirt roads. Some were observed feeding on berries, slugs, and earthworms. Harry McGarrity reported observing two males fighting on his property, and one observation of a female nesting in a flower garden was made. Several observations were the shells of expired specimens, and a few were DOR casualties.



Eastern box turtle

Spotted Turtle, *Clemmys guttata* – 18 specimens detected (35 since 2000)

Spotted turtles were found in the Atlantic Coastal Plain, Coffman Hill, Nockamixon/Haycock, Upper Tohickon Creek, and Upper Unami Conservation Landscapes. Not an easy species to detect, spotted turtles likely reside in additional landscapes. A species that has apparently suffered significant declines in Pennsylvania during recent years, spotted turtle is present in at least two noteworthy populations in the County. Significant numbers of turtles were observed at two sites in the Atlantic Coastal Plain. In addition, small numbers of spotted turtles were observed at two sites in the northern end of the county where large tracts of wetland habitat exist.

Spotted turtles were most often observed basking on logs or hummocks, and some were observed actively moving overland, or swimming in open water of wetlands or wooded swamps. One individual was observed moving across a mudflat during a drought period in late summer heavily caked in mud, suggesting it had just emerged from aestivation. The earliest observation of a spotted turtle was in mid-April and the latest in late-October when a specimen was observed swimming underwater in a woodland swamp. Several specimens at a site in the southern end of the county exhibited severe limb deformities.



Spotted turtle

Wood Turtle, *Glyptemys insculpta* – 5 specimens detected (10 since 2000)

Wood turtles are uncommon in Bucks County; and as with many other herpetological species in our region, probably much rarer than in the past. On the other hand, they may not be quite as rare as the number documented in this study suggests. Most specimens were found in the northern end of the county, where large tracts of ideal habitat still exist, much of it privately owned. As with spotted turtles, the spatial distribution of wood turtles in Bucks County is interesting. They were detected in the Atlantic Coastal Plain, Delaware River, Nockamixon/Haycock, Paunacussing Creek, and Upper Unami Creek Conservation Landscapes. In addition, several specimens were found on a tract that lies between the Mid-county Ridges and Paunacussing Creek Landscapes. These locations are widely distributed across the county with large gaps between the confirmed sites; the Atlantic Coastal Plain site is the most isolated. A report of a wood turtle in the same general vicinity as the recent Atlantic Coastal Plain observation was received by Bobby Moyer in June of 2004. For many years, anecdotal reports were received that wood turtles were found in the Neshaminy Creek landscape as recently as the 1970's. A reliable source reported a wood turtle in Penndel in the early 1990's. During the current project, a wood turtle was observed basking in the Delaware Canal in the northeastern reaches of the county. This canal runs the entire length of the county. Further investigations would almost certainly add more landscapes to the list in which wood turtles are known to inhabit, particularly in the northern region of the county.

Most wood turtles were observed actively moving overland. Some were found resting in the shade of vegetation, and one was found feeding on the fruit of skunk cabbage. Three were observed basking on downed trees at the edges of water bodies. A DOR specimen, observed in the region between the Mid-county Ridges and the Paunacussing Creek Conservation Landscapes, was reported by Joe Mihok in the spring of 2009.



Wood turtle, right: plastron

Common Map Turtle, *Graptemys geographica* – 12 specimens detected (56 since 2000)

Common map turtles can be observed in the Delaware River in the southern half of Bucks County. Large numbers bask on bridge abutments and large rocks jutting out of the water, particularly in the rapids between Morrisville and Trenton. Map turtles were also observed basking or swimming in the Neshaminy Creek and the Delaware Canal. Several specimens were observed at the Churchville Nature Center; one was basking on a log in the lake and a female

was found nesting during a mid-day rain event. The common map turtle is generally considered a river turtle; the Churchville specimens have likely been artificially introduced.



Common map turtle

Yellowbelly Slider, *Trachemys scripta scripta* – 1 specimen detected (1 since 2000)

A single observation of this non-native species was made in Lake Galena on May 30, 2010. Yellow-bellied sliders are native to the southeastern U.S.; southeastern Virginia is the closest locale where this species occurs naturally. They occasionally turn up in Pennsylvania waters, possibly released by pet owners who purchased them at pet shops, or collected wild specimens while on vacation.

Red-eared Slider, *Trachemys scripta elegans* – 102 specimens detected (155 since 2000)

Red-eared sliders are an introduced species in Pennsylvania, the result of pet-owners releasing captive pets. In years past local pet shops and dime stores sold hatchlings by the thousands across the country. Growing to a burdensome size several years later, many ended up getting released into the wild. At the Churchville Nature Center in southern Bucks County the staff regularly encounters visitors seeking to release pet turtles into the pond and reservoir. Specimens of all sizes have been observed, as have numerous nesting females. Silver Lake, to the south, and Lake Galena, to the north, both have large populations of breeding red-eared sliders. During one visit 30 large red-eared sliders were observed in the eastern end of Lake Galena. Specimens have been detected throughout the county in most large water bodies.

The red-eared slider is an aggressive competitor which competes with native turtle species for feeding, nesting, and basking sites. Of particular concern is the impact on the redbelly turtle, a threatened species in Pennsylvania, which occupies the same ecological niche. Red-eared sliders have been observed in the Atlantic Coastal Plain, Coffman Hill, Delaware River, Lake Galena-Pine Run, Neshaminy Creek and Nockamixon-Haycock Conservation Landscapes; precisely the same areas inhabited by redbelly turtles. The removal of this aggressive, invasive species whenever possible is advisable to reduce competition for resources with native turtle species.



Red-eared slider, left: plastron

Redbelly Turtle, *Pseudemys rubriventris* – 128 specimens detected (380 since 2000)

This large aquatic turtle species is found in most large water bodies in Bucks County, including Lake Nockamixon, Lake Galena, Churchville Reservoir, Van Sciver Lake, and the Delaware River. They were also observed in smaller lakes, ponds, open wetlands, and the Delaware Canal. The conservation landscapes redbelly turtles are currently known to inhabit include the Atlantic Coastal Plain, Coffman Hill, Delaware River, Lake Galena/Pine Run, Neshaminy Creek and Nockamixon/Haycock landscapes. The original distribution of redbelly turtles prior to the draining of the Great Swamp of the Quakertown area, and the creation of large, dammed lakes in Bucks County is an interesting question. Evidence of nesting has been observed numerous times through the years, usually in open areas with vegetation that is low at nesting season such as mowed fields and lawns, agricultural fields, athletic fields, and open floodplain.



Redbelly turtle, above: plastron of hatchling

Painted Turtle, *Chrysemys picta/marginata* – 441 specimens detected (1255 since 2000)

Specimens that fit the description of both eastern painted turtle, *Chrysemys picta*, and midland painted turtle, *Chrysemys marginata*, have both been found in Bucks County. Since these two species are known to hybridize, all painted turtles in this inventory are viewed as a

picta/marginata complex, and are generally referred to as painted turtles, although the majority of painted turtles observed resemble the species *picta*. Painted turtles are clearly the most common turtle in Bucks County, and were observed in most water bodies, in all of the Conservation Landscapes. Evidence of nesting by painted turtles was observed often, usually in the form of depredated nests. Numerous hatchlings, and DOR specimens have been observed.



Painted turtle, left: plastron of hatchling

Eastern Spiny Softshell Turtle, *Trionyx spiniferus spiniferus* – 19 specimens detected (38 since 2000)

Eastern spiny softshell turtles were observed in the Delaware River and Neshaminy Creek Conservation Landscapes. Most specimens were observed swimming, float-basking, or basking on the banks of Neshaminy Creek. Swimming specimens were usually seen in large, calm pools with ample submerged vegetation. When sightings of spiny softshell turtles in Bucks County were first relayed to the field coordinator of the Pennsylvania Herpetological Project, the reports were met with skepticism until voucher photographs were provided. They are referred to in the final report as a probable introduced species. If spiny softshell turtles have been introduced to Bucks County, it was at least 25 years ago or more. In the mid-1980s, the Bucks County Courier Times newspaper featured an article showing a young boy holding a hatchling softshell that he had caught in the Neshaminy Creek. Anecdotal accounts softshell turtle captures and sightings from as far back as the 1960s have been received from several county residents.



Eastern spiny softshell turtle

Order Squamata, sub-order Lacertilia

Five-Lined Skink, *Plestiodon fasciatus* – 5 specimens detected (10 since 2000)

Five-lined skinks have been observed in only one locality since 2000, in southern Bucks County, just outside of the Neshaminy Creek Conservation Landscape. Jack Sliwinski located the population in August of 2002, and they were reconfirmed in 2009. All specimens were found within 50 yards of an active railroad line. A robust population of northern brown snakes exists at the same site. A five-lined skink was reported at a local residence in a suburban neighborhood, approximately one-quarter mile from the site. Approximately half of the specimens were observed basking, while the rest were found under cover objects. Most specimens were juveniles, but several large males with breeding coloration were also observed. Workers at a business adjacent the site reported seeing five-lined skinks on a regular basis during summer months.



Five-lined skink, right: breeding coloration in male

Order Squamata, sub-order serpentes

Northern Water Snake, *Nerodia sipedon sipedon* – 48 specimens detected (97 since 2000)

The northern water snake was observed in all conservation landscapes, usually in association with wetlands, swamps, streams, creeks, ponds, lakes, the Delaware River, and Delaware Canal. Most were observed basking on waterside banks, or in the branches of trees overhanging water, but many were located under large, flat rocks bordering stream and creek banks. Some were observed actively swimming, and a few moving overland, sometimes more than 200 yards from the nearest water body. Some northern water snakes were observed attacking frogs or other prey items; one was observed swallowing a 6 – 8” catfish. One small specimen was found dead on a pond shore with a small perch lodged in its mouth, apparently too large for the snake to swallow.



Northern water snake

Northern Brown Snake, *Storeria dekayii dekayii* – 9 specimens detected (11 since 2000)

Northern brown snakes were found at a few locations, scattered across the county. They were observed in the Delaware River, Lake Galena/Pine Run, Lower Tohickon, and Neshaminy Creek Conservation Landscapes. Documentation was also received from Lahaska and Perkasio. A site outside of, but near the Neshaminy Creek Landscape produced the largest number of observations. All northern brown snakes were found under cover objects, including boards, bark, shingles and leaf mats.



Northern brown snake

Eastern Garter Snake, *Thamnophis sirtalis srtalis* – 60+ specimens detected (171+ since 2000)

Eastern garter snakes were the most commonly observed snake species in Bucks County; they were seen frequently in all landscapes in nearly every habitat type surveyed. Most specimens were observed out in the open basking or actively moving across the landscape, but many were also found under a variety of cover objects. Several mating balls were observed, a situation in which it was difficult to make an accurate count of all the male snakes present.



Eastern garter snake

Northern Ringneck Snake, *Diadophis punctatus edwardsii* – 30 specimens detected (64 since 2000)

Many northern ringneck snakes have been observed through the years in Bucks County; most specimens were located by flipping rocks. They were found in old stone walls, under stones in gardens, and in the basements of old houses. Only one snake was observed actively moving out in the open. Northern ringneck snakes were detected in all areas of the county except the Delaware River Conservation Landscape, where continued searches would undoubtedly yield specimens of this secretive, but common species.



Northern ringneck snake

Northern Black Racer, *Coluber constrictor constrictor* – 21 specimens detected (42 since 2000)

Northern black racers are probably much more common than the numbers suggest. Alert and fast-moving, most racers observed out in the open bolted from the scene before they could be captured or photographed. Generally, only when they were found under cover objects and taken by surprise were they captured. Most specimens were found in open meadow, scrub, or edge habitat. They were detected in all areas of the county except the Paunacussing Creek and

Tinicum Creek Conservation Landscapes. Continued searches in those landscapes would undoubtedly yield specimens.



Northern black racer, left: adult; right juvenile

Eastern Rat Snake, *Pantherophis alleghaniensis* – 2 specimens detected (15 since 2000)
A common snake throughout much of Pennsylvania, eastern rat snake is uncommon to rare in Bucks County. They were found only in the Nockamixon/Haycock Conservation Landscape. Most specimens were found at a single location, during multiple visits. Most live specimens were observed basking in the open on the ground, or in trees. One large specimen was observed basking at the entrance of a cavity in a large tree, approximately 15 feet off the ground in the back yard of a home, where a resident reported seeing it on a regular basis. Several additional observations are represented by DOR specimens, and others by skin sheds.



Eastern rat snake, left: adult; right: juvenile

Eastern Milksnake, *Lampropeltis triangulum triangulum* – 14 specimens detected (22 since 2000)
A common but secretive species, eastern milksnakes were typically found under large, flat rocks. A few were found in the basements of old homes and one was seen crawling into the stone foundation of an old carriage house. Another was observed in a storm drain adjacent to a busy

shopping center. Several specimens were observed basking in open sunlight on early spring days. Eastern milksnakes were observed in all target areas except the Delaware River and Mid-county Ridges Conservation Landscapes; however, a specimen was found in Lahaska, just outside of the Mid-county Ridges landscape.



Eastern milksnake, left: adult; right: juvenile

Copperhead, *Agkistrodon contortrix mokasen* – 3 specimens detected (3 since 2000)

The northern copperhead is possibly the rarest snake in Bucks County. Three specimens, a medium-sized female and two neonates, were located at a site in the Lower Tohickon Creek Landscape. This site is well known by local snake enthusiasts, and anecdotal reports have been received through the years. Reports have also been received for two other sites in northeastern Bucks County, but these have not been verified. Both are private residences and the homeowner of one residence displayed the preserved skin of a large copperhead that she said bit and killed a pet dog several years ago. Ample habitat is present at that site, in the form of open, shale outcrops on a south-facing forested slope above a small stream.



Copperhead, left adult; right: adult with neonate (photo by A. Rhoads)

Species Accounts - Undetected Species

Only three predicted species were not found during the course of this inventory: northern fence lizard, smooth earth snake, and eastern hognose snake. A single specimen of northern fence lizard was observed along the Delaware Canal in northern Bucks County by Brandon Ruhe and several other members of the Lehigh Valley Herpetological Society during a survey being conducted for the Pennsylvania Herpetological Atlas Project. However, no other evidence of a population of fence lizards has been obtained, nor is appropriate habitat present at the site.

The occurrence of smooth earth snake in Bucks County is documented by a museum specimen collected by Bob Hudson in the Warrington area in 1948.

Three specimens of eastern hognose snake collected in Bucks County between 1942 and 1947 are held in a museum collection. Two were collected from the Point Pleasant area and one from Treasure Island in the Delaware River. The species is listed as a resident of Neshaminy State Park; however, the last sighting is thought to have been in the 1960s. An anecdotal report was recently received from a resident of the Cooks Creek landscape, who claimed to have caught an eastern hognose snake approximately fifteen years ago.

In addition to these three species, an anecdotal report was received for northern spring salamander (*Gyrinophilus porphyriticus porphyriticus*) in the Cooks Creek watershed in recent years. According to the final report of the PHAP, this species was documented in southern Lehigh County, close to the Bucks County border.

Discussion

Home to 44 of the approximately 75 species of reptiles and amphibians currently known to occur in Pennsylvania, Bucks County is indeed herpetologically diverse. Observations of all species for which historical records exist, with the exceptions the hognose snake and smooth earth snake, were made during the course of this two-year study, or since the year 2000. To the best of our knowledge, three species described in this report had not previously been documented in Bucks County and two species had been considered extirpated from the Commonwealth.

Since these surveys focused on the designated conservation landscapes, a considerable amount of territory was not surveyed. However, the majority of the county's undeveloped land lies within the boundaries of the landscapes. It is possible, however, that additional, undetected, native herpetological species reside within the borders of Bucks County.

General Recommended Conservation Measures

At least 44 species of reptiles and amphibians are present in Bucks County. Of the species documented during this and other surveys in recent years one, the bog turtle, is currently listed as federally threatened species. (Bog turtle locations are not discussed in this report in order to comply with U.S. Fish and Wildlife Service data security requirements.) Six species are listed

by the state as endangered (eastern spadefoot toad, New Jersey chorus frog, northern cricket frog, southern leopard frog, eastern mud turtle, and bog turtle) one as threatened (redbelly turtle); and eight are currently considered vulnerable by the state (marbled salamander, four-toed salamander, Fowler's toad, spotted turtle, wood turtle, eastern box turtle, five-lined skink, and northern copperhead). The northern cricket frog was just recently elevated to state endangered status. Outside of Bucks County there are only two other populations of northern cricket frogs currently considered extant in Pennsylvania; at one of those sites the frogs have not been observed for more than eight years.

The eastern mud turtles discovered during the course of this study are the first specimens observed in Pennsylvania since 1963; it is very possible that this is the only population still surviving in Pennsylvania. While all of the other species listed in this report are regarded more or less as common in the state, reptiles and amphibians in general are sensitive to ecological disturbances. Below are some suggestions for the protection of Bucks County's Herpetofauna.

Preserving and Protecting Habitat

In 2004 the population of Bucks County was determined to be over 600,000 people, ranking it the fourth most populous county in Pennsylvania. Besieged by industry and the resultant waves of human population growth since the 1950s, the natural landscape Bucks County has suffered immense ecological impact, and the population continues to grow. From a herpetological perspective the changes were devastating for some species, particularly in the Atlantic Coastal Plain and Delaware River landscapes where herpetological diversity was likely greatest. Some large tracts of relatively undeveloped natural and agricultural land still exist, particularly in the northern reaches of the county, and conservation efforts have protected much of it. As of November 2010, the Bucks County Open Space Program had protected a total of 19,420 acres. However, the majority of the rare species occur in the southern end of the county where most open space is privately controlled and industrial impact has been, and continues to be, greatest.

Unknown populations of rare herpetological species may still reside, undetected, in some of the natural habitat that remains. Many herpetological species are seasonal wanderers, instinctively following age-old travel routes over relatively large distances. Many require specific types of breeding and nesting habitat. Some of Bucks County rarest herpetological species rely on very specific habitat types, such as certain types of wetlands or rock outcrops. Many amphibian species are particularly sensitive to water quality degradation. Protecting and improving remaining natural spaces and the quality of water in creeks, streams and other water bodies should be considered vital for protecting Bucks County's most imperiled herpetofauna. Efforts should be made to reduce pesticide and fertilizer use, both in commercial agriculture, and from non-point sources.

Controlling Invasive Species

Non-native, invasive species of plants and animals were observed at virtually every site visited during this inventory. Invasive species are known to degrade habitat, reduce biodiversity, and ultimately impact native species in a given landscape. Invasive plants can alter and degrade terrestrial and aquatic herpetological habitat. Control of invasive plants is important but the use

of pesticides in herpetologically sensitive areas should be avoided. Some rapid, large scale declines in certain amphibian species in Bucks County coincide suspiciously with the advent of large-scale pesticide use in agriculture.

Non-native, invasive earthworms, observed in all landscapes and on most sites, impact forest ecology by reducing detritus. This may hold long-term consequences for woodland salamanders which depend on humus for moist cover, and as a food source of their prey species. This situation should be monitored while the search for a solution continues. An overabundance of white-tailed deer continues to severely impact forest ecology, particularly at the ground level where most woodland herpetological species reside. Drastic reductions to in the population of deer in Bucks County should be considered paramount in any effort to improve ecological conditions for herpetological species.

Red-eared slider, *Trachemys scripta elegans*, is an introduced species of turtle; it is an aggressive competitor for resources with native species, particularly the state-threatened redbelly turtle. Red-eared sliders were found throughout the county in all large bodies of water and in all conservation landscapes. At Lake Galena the count of red-eared sliders exceeded that of native turtles during all visits. Trapping campaigns to remove this species from Bucks County's waters are recommended. The installation of artificial basking platforms in redbelly turtle habitat may help reduce competition for basking sites.

Awareness and Enforcement of Laws Prohibiting the Collection of Species

Public awareness campaigns about the plight of Bucks County's imperiled herpetological species could have a positive impact. Vigilance on the part of land owners and land managers, and sharing information with the local Wildlife Conservation Officer about poaching and other illegal activities helps protect wildlife resources.

Reducing Roadkill

The relatively large home ranges of some reptiles and amphibians often bring them into contact with roads. Numerous DOR specimens were observed during the course of this survey. During nocturnal summer rain events, scores of dead DOR frogs and toads were observed in numerous locations. Turtles represented the second most frequently observed DOR group; fresh kills were most often observed following a significant rain event. Numerous DOR snakes were also observed due in part to the fact that snakes utilize roads for basking. Proactive measures to reduce the road mortality include installation of traffic-calming measures in areas of known populations and the installation of culverts under roads and railroad lines at sites where herpetological species are frequently observed crossing (generally where roads traverse wetlands). Off-road activities should be strictly regulated in sensitive areas to minimize direct mortality and also to protect habitat from the severe erosion that often result from such activities.

References

- Behler, J.L., and F.W. King. 1996. *The Audubon Society Field Guide to North American Reptiles and Amphibians*. Alfred A. Knopf, Inc., New York, NY.
- Carnegie Museum of Natural History, 4400 Forbes Avenue, Pittsburgh, PA. Collections, Section of Reptiles and Amphibians. Stephen P. Rogers, Collection Manager.
- Conant, R. and J.T. Collins. 1998. *A Field Guide to Reptiles and Amphibians: Eastern and Central North America*, 3rd edition. Houghton Mifflin Company, Boston, MA.
- Corn, M.D. 2003. Herpetological Survey of the Price Tract, Fallsington Township, PA. Churchville Nature Center.
- Corn, M.D. 2004. Herpetological Inventory of Nockamixon State Park, PA. Churchville Nature Center.
- Corn, M.D. 2007. Herpetological Inventory of the Roaring Rocks/Swamp Creek Watersheds, Tincum Township, Bucks County, PA.
- Genoways, H.H. and F.J. Brenner (eds.). 1985. *Species of Special Concern in Pennsylvania*. Carnegie Museum of Natural History special publication No. II, Pittsburg, PA.
- Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.-A.C. Hayek, and M.S. Foster (Eds.). 1994. *Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians*. Smithsonian Institution Press, Washington, DC. xix + 364 pp."
- Hulse, A.C., C.J. McCoy, and E.J. Censky. 2001. *Amphibians and Reptiles of Pennsylvania and the Northeast*. Comstock Publishing Associates, Cornell University Press, Ithaca, New York.
- Hulse, A.C. 2002. Final Report of the Pennsylvania Herpetological Atlas Project. Indiana University of Pennsylvania
- Mertz, L. (Ed.). 1999. Protocols and Strategies for Monitoring North American Amphibians: Calling Surveys. North American Amphibian Monitoring Program, USGS.
- Mitchell, J.C., A.R. Breisch, and K.A. Buhlman. 2006. Habitat Management Guidelines for Amphibians and Reptiles of the Northeastern United States. Partners in Amphibian and Reptile Conservation, Technical Publication HMG-3, Montgomery Alabama. 108pp.
- Ruhe, B.M., and T.C. LaDuke. 2010. Status Assessment and Range Determination of the Eastern Mud Turtle (*Kinosternon subrubrum subrubrum*) in Pennsylvania. Prepared for The Pennsylvania Fish and Boat Commission, 450 Robinson Lane, Bellefonte, PA 18623.
- Halliday, T.R., S. Blomberg, and R. Shrine. 2006. *Ecological Census Techniques*, 2nd edition (ed. W.J. Sutherland). Cambridge University Press, U.K.

Urban, C.A., R.T. Morgan, H.W. Avery, and J.R. Spotila. 2006. Distribution of the Invasive Red-Eared Slider Turtle (*Trachemys scripta elegans*) in the Lower Delaware River Basin. Drexel University, Philadelphia, PA.

Appendix C. List of the Birds of Bucks County
Prepared by August Mirabella with assistance from Kenneth Kitson

<i>Common Name</i>	<i>PNHP status</i>	<i>WAP</i>	<i>Frequency</i>	<i>Residency</i>	<i>Comments</i>
Pink-footed Goose			X		
Greater White-fronted Goose			O	V	
Snow Goose			U	V	
Ross's Goose			X		
Brant			R	T	
Barnacle Goose			X		
Cackling Goose			O	V	
Canada Goose			A	Res	
Mute Swan			O	Res	
Tundra Swan	G5, S3N	R	O	T	
Wood Duck			U	Res	Rare in winter
Gadwall			O	V	
Eurasian Wigeon			X		
American Wigeon			U	V	
American Black Duck	G5, S4B, S3N	MC	U	Res	Rare in summer
Mallard			A	Res	
Blue-winged Teal			O	T	
Northern Shoveler			O	V	
Northern Pintail			U	V	
Green-winged Teal	G5, S1S2B, S3N, N/CA	V	U	V	Possible Rare Breeder (one time)
Canvasback			O	T	
Redhead			O	T	
Ring-necked Duck			U	V	
Tufted Duck			X		
Greater Scaup			O	V	
Lesser Scaup			O	V	
King Eider			X		
Harlequin Duck			X		
Surf Scoter			R	T	
White-winged Scoter			O	T	
Black Scoter			O	T	
Long-tailed Duck			O	T	
Bufflehead			U	V	
Common Goldeneye			U	V	
Barrow's Goldeneye			X		
Hooded Merganser			U	V	Possible Rare Breeder (one time?)
Common Merganser			C	Res	
Red-breasted Merganser			O	T	
Ruddy Duck	G5, S3N	MC	U	V	
Northern Bobwhite	G5, S1B, N/CA	IC	Ex		Releases only?
Ring-necked Pheasant			R	Res	Most if not all are releases.
Ruffed Grouse			R	Res	Rare Breeder or Extirpated?
Wild Turkey			U	Res	

Common Name	PNHP status	WAP	Frequ ncy	Residency	Comments
Red-throated Loon			O	T	
Pacific Loon			X		
Common Loon			U	T	
Pied-billed Grebe	G5, S3B, S4N, N/CR		U	Res	Rare Breeder (one site currently known)
Horned Grebe			O	T	
Red-necked Grebe			O	T	
Northern Gannet			X		
Double-crested Cormorant			U	V	Attempted breeding three times(not recently)
Great Cormorant			O	V	
Anhinga			X		
American White Pelican			X		
American Bittern	G4, S1B, PE/PE	HLC	R	SR	Probable Rare Breeder per 2nd PA BBA
Least Bittern	G5, S1B, PE/PE	V	R	SR	Probable Rare Breeder per 2nd PA BBA
Great Blue Heron	G5, S3S4B, S4N	MC	C	Res	
Great Egret	G5, S1B, PE/PE	V	U	V	
Snowy Egret			O	V	
Little Blue Heron			O	V	
Tricolored Heron			X		
Cattle Egret			R	V	
Green Heron			U	SR	
Black-crowned Night-Heron	G5, S2S3B, PE/PE	V	O	V	Former Breeder
Yellow-crowned Night-Heron	G5, S1B, PE/PE	V	R	V	
White Ibis			X		
Glossy Ibis			R	V	
Black Vulture			U	Res	
Turkey Vulture			C	Res	
Osprey	G5, S2B, PT/PT		U	SR	Rare Breeder
Mississippi Kite			X		
Bald Eagle	G4, S2B, PT/PT	HLC	U	Res	
Northern Harrier	G5, S3B, S4N, N/CA	HLC	U	V	
Sharp-shinned Hawk	G5, S4B, S5N	MC	U	Res	Rare Breeder
Cooper's Hawk			U	Res	
Northern Goshawk	G5, S2S3B, S3N, N/CR	V	R	V	
Red-shouldered Hawk	G5, S4B, S3S4N	MC	O	Res	
Broad-winged Hawk	G5, S5B	MC	O	SR	Rare Breeder
Swainson's Hawk			X		
Red-tailed Hawk			C	Res	
Rough-legged Hawk			R	V	
Golden Eagle	G5, SNA	V	R	T	
American Kestrel			U	Res	
Merlin			O	V	
Peregrine Falcon	G4, S1B, S1N, PE/PE	HLC	O	Res	
Yellow Rail			X		
Black Rail			X		

Common Name	PNHP status	WAP	Frequ ncy	Residency	Comments
Clapper Rail			X		
King Rail	G4, S1B, PE/PE	V	X		Possible rare breeder twice
Virginia Rail	G5, S3B	HLC	R	SR	
Sora	G5, S3B, N/CR	MC	R	SR	Rare Breeder
Purple Gallinule			X		
Common Moorhen	G5, S3B, N/CA	MC	R	SR	Rare Breeder at one site recent years but not 2010
American Coot	G5, S3B, S3N, N/CR	MC	U	V	
Sandhill Crane			X		
Black-bellied Plover			R	T	
American Golden-Plover			R	T	
Semipalmated Plover			U	T	
Piping Plover	G3, SX, PX LE	IC	X		
Killdeer			C	Res	
American Oystercatcher			X		
Black-necked Stilt			X		
American Avocet			X		
Spotted Sandpiper			U	SR	
Solitary Sandpiper	G5, SNA	MC	U	T	
Greater Yellowlegs			U	T	
Willet			X		
Lesser Yellowlegs			U	T	
Upland Sandpiper	G5, S1S2B, PT/PT	IC	X		Former Breeder
Whimbrel			X		
Hudsonian Godwit			X		
Marbled Godwit			X		
Ruddy Turnstone			R	T	
Red Knot			X		
Sanderling			R	T	
Semipalmated Sandpiper			O	T	
Western Sandpiper			R	T	
Least Sandpiper			C	T	
White-rumped Sandpiper			R	T	
Baird's Sandpiper			R	T	
Pectoral Sandpiper			O	T	
Purple Sandpiper			X		
Dunlin			O	T	
Curlew Sandpiper			X		
Stilt Sandpiper			R	T	
Buff-breasted Sandpiper			R	T	
Ruff			X		
Short-billed Dowitcher			R	T	
Long-billed Dowitcher			X		
Wilson's Snipe	G5, S3B, S3N, N/CR	MC	O	YR	
American Woodcock	G5, S5B	MC	O	Res	
Wilson's Phalarope			R	T	
Red-necked Phalarope			R	T	
Red Phalarope			X		
Bonaparte's Gull			O	T	

Common Name	PNHP status	WAP	Frequ ency	Residency	Comments
Black-headed Gull			X		
Little Gull			X		
Laughing Gull			C	V	
Franklin's Gull			X		
Mew Gull			X		
Ring-billed Gull			C	YR	
California Gull			X		
Herring Gull			C	YR	
Thayer's Gull			R	V	
Iceland Gull			O	V	
Lesser Black-backed Gull			C	YR	
Slaty-backed Gull			X		
Glaucous Gull			O	V	
Great Black-backed Gull			C	YR	
Caspian Tern			O	T	
Black Tern	G4, S1B, PE/PE	HLC	R	T	
Common Tern	G5, SXB, PE/PE	V	R	T	
Arctic Tern			X		
Forster's Tern			O	T	
Royal Tern			X		
Black Skimmer			X		
Pomarine Jaeger			X		
Sooty Tern			X		
Long-tailed Jaeger			X		
Dovekie			X		
Least Tern			X		
Thick-billed Murre			X		
Long-billed Murrelet			X		
Rock Pigeon			C	Res	
White-winged Dove			X		
Mourning Dove			A	Res	
Passenger Pigeon	Extinct				
Common Ground-Dove			X		
Yellow-billed Cuckoo			U	SR	
Black-billed Cuckoo	G5, S5B	MC	O	SR	
Barn Owl	G5, S3B, S3N, N/CR	MC	R	Res	Rare Breeder or Extirpated?
Eastern Screech-Owl			C	Res	
Great Horned Owl			C	Res	
Snowy Owl			X		
Barred Owl			O	Res	
Great Gray Owl			X		
Long-eared Owl	G5, S2B, S2S3N, N/CU	HLC	O	V	
Short-eared Owl	G5, S1B, S3N, PE/PE	IC	R	V	
Northern Saw-whet Owl			O	Res	Rare Breeder (3 times?)
Common Nighthawk	G5, S3S4B	MC	O	T	Former Breeder
Chuck-will's-widow			X		
Eastern Whip-poor-will	G5, S4B	MC	R	T	Former Breeder
Chimney Swift	G5, S5B	MC	C	SR	

Common Name	PNHP status	WAP	Frequ ncy	Residency	Comments
Ruby-throated Hummingbird			C	SR	
Rufous Hummingbird			X		
Belted Kingfisher			C	Res	
Red-headed Woodpecker	G5, S4B, S4N	MC	R	Res	Rare Breeder
Red-bellied Woodpecker			C	Res	
Yellow-bellied Sapsucker			O	V	
Downy Woodpecker			C	Res	
Hairy Woodpecker			U	Res	
Black-backed Woodpecker			X		
Northern Flicker			C	Res	
Pileated Woodpecker			O	Res	
Olive-sided Flycatcher	G4, SXB, N/PX	IC	O	T	
Eastern Wood-Pewee			C	SR	
Yellow-bellied Flycatcher	G5, S2S3B, PE/PE	V	R	T	
Acadian Flycatcher	G5, S5B	MC	O	SR	
Alder Flycatcher	G5, S3S4B	MC	R	T	
Willow Flycatcher	G5, S5B	MC	U	SR	
Least Flycatcher			O	T	Former Breeder
Eastern Phoebe			C	SR	
Ash-throated Flycatcher			X		
Great Crested Flycatcher			U	SR	
Western Kingbird			X		
Eastern Kingbird			C	SR	
Scissor-tailed Flycatcher			X		
Fork-tailed Flycatcher			X		
Loggerhead Shrike	G4, T3Q, S1B, PE/PE	IC	X		
Northern Shrike			I	V	
White-eyed Vireo			U	SR	
Yellow-throated Vireo	G5, S4B	MC	O	SR	
Blue-headed Vireo	G5, S5G	MC	O	T	
Warbling Vireo			C	SR	
Philadelphia Vireo			O	T	
Red-eyed Vireo			C	SR	
Blue Jay			A	Res	
American Crow			A	Res	
Fish Crow			C	Res	
Common Raven			R	Res	Rare Breeder at least 2 times recently
Horned Lark			O	V	
Purple Martin			O	SR	
Tree Swallow			C	SR	
Northern Rough-winged Swallow			U	SR	
Bank Swallow	G5, S4B	MC	O	SR	
Cliff Swallow			U	SB	
Cave Swallow			X		
Barn Swallow			C	SR	
Carolina Chickadee			C	Res	
Black-capped Chickadee			R	Res	Rare Breeder?/Irruptive winter visitor

Common Name	PNHP status	WAP	Frequ ncy	Residency	Comments
Boreal Chickadee			X		
Tufted Titmouse			C	Res	
Red-breasted Nuthatch			O	SR	Rare Breeder- 2 times recently/Irruptive winter visitor
White-breasted Nuthatch			C	R	
Brown Creeper			U	Res	Rare Breeder?
Carolina Wren			C	Res	
Bewick's Wren			X		
House Wren			C	SR	
Winter Wren	G5, S4B, S4N	MC	O	V	
Sedge Wren	G5, S1B, PE/PE	IC	R	T	
Marsh Wren	G5, S2S3B, N/CR	HLC	R	T	Rare Breeder in past
Blue-gray Gnatcatcher			U	SR	
Golden-crowned Kinglet			U	V	Rare Breeder-one time 2010
Ruby-crowned Kinglet			U	V	
Northern Wheatear			X		
Eastern Bluebird			U	Res	
Townsend's Solitaire			X		
Veery			U	SR	
Gray-cheeked Thrush			O	T	
Bicknell's Thrush			X		
Swainson's Thrush	G5, S2S3B, S5N, N/CR	V	U	T	
Hermit Thrush			U	V	
Wood Thrush	G5, S5B	R	C	SR	
Redwing			X		
American Robin			A	Res	
Varied Thrush			X		
Gray Catbird			C	SR	Rare in winter
Northern Mockingbird			C	Res	
Brown Thrasher	G5, S4B	MC	U	SR	Rare in winter
European Starling			A	Res	
American Pipit			O	V	
Bohemian Waxwing			X		
Cedar Waxwing			U	Res	Common transient
Lapland Longspur			R	V	
Snow Bunting			O	V	
Blue-winged Warbler	G5, S4B	R	U	SR	
Golden-winged Warbler	G4, S4B	HLC	R	T	
Tennessee Warbler			U	T	
Orange-crowned Warbler			R	T	
Nashville Warbler			U	T	
Northern Parula			U	SR	
Yellow Warbler			C	SR	
Chestnut-sided Warbler			U	SR	Rare Breeder
Magnolia Warbler			C	T	
Cape May Warbler			O	T	
Black-throated Blue Warbler	G5, S4B	MC	U	T	
Yellow-rumped Warbler			C	V	
Black-throated Green Warbler	G5, S5B	MC	U	T	

<i>Common Name</i>	<i>PNHP status</i>	<i>WAP</i>	<i>Frequency</i>	<i>Residency</i>	<i>Comments</i>
Blackburnian Warbler	G5, S4B	MC	U	T	
Yellow-throated Warbler			R	SR	
Pine Warbler			O	SR	
Prairie Warbler	G5, S4B	MC	U	SR	
Palm Warbler			U	T	
Bay-breasted Warbler			O	T	
Blackpoll Warbler	G5, S1B, PE/PE	V	U	T	
Cerulean Warbler	G4, S4B	HLC	R	T	Former Breeder
Black-and-white Warbler			U	SR	
American Redstart			U	SR	
Prothonotary Warbler	G5, S2S3B, N/CR	HLC	R	SR	
Worm-eating Warbler	G5, S4B	R	O	SR	
Ovenbird			U	SR	
Northern Waterthrush			U	T	
Louisiana Waterthrush	G5, S5B	R	U	SR	
Kentucky Warbler	G5, S4B	MC	R	SR	
Connecticut Warbler			O	T	
Mourning Warbler			O	T	
Common Yellowthroat			C	SR	
Hooded Warbler			R	SR	
Wilson's Warbler			O	T	
Canada Warbler	G5, S4B	MC	U	T	
Yellow-breasted Chat	G5, S5B	MC	R	SR	
Green-tailed Towhee			X		
Eastern Towhee			C	Res	Rare in winter
American Tree Sparrow			O	V	
Chipping Sparrow			C	SR	Rare in winter
Clay-colored Sparrow			R	V	
Field Sparrow			C	Res	
Vesper Sparrow			O	T	
Lark Sparrow			X		
Lark Bunting			X		
Savannah Sparrow			U	Res	
Grasshopper Sparrow	G5, S4B	MC	O	SR	
Henslow's Sparrow	G4, S4B	HLC	X		
Le Conte's Sparrow			X		
Nelson's Sparrow			O	T	
Saltmarsh Sparrow			X		
Fox Sparrow			U	V	
Song Sparrow			C	Res	
Lincoln's Sparrow			O	T	
Swamp Sparrow			U	Res	
White-throated Sparrow			C	V	
Harris's Sparrow			X		
White-crowned Sparrow			O	V	
Dark-eyed Junco			C	V	
Summer Tanager	G5, S3B, N/CR	HLC	X		
Scarlet Tanager	G5, S5B	R	U	SR	
Western Tanager			X		
Northern Cardinal			C	Res	

Common Name	PNHP status	WAP	Frequ ncy	Residency	Comments
Pyrrhuloxia			E		
Rose-breasted Grosbeak			U	SR	
Blue Grosbeak			O	SR	
Indigo Bunting			C	SR	
Painted Bunting			X		
Dickcissel	G5, S2B, PE/PE	HLC	R	SR	Rare Breeder-one site 2009-2010/Rare transient & winter visitor
Bobolink	G5, S4B	MC	U	SR	
Red-winged Blackbird			C	Res	
Eastern Meadowlark	G5, S5B, S4N	MC	O	Res	Rare in winter
Western Meadowlark			X		
Yellow-headed Blackbird			X		
Rusty Blackbird			O	V	
Brewer's Blackbird			X		
Common Grackle			A	Res	
Brown-headed Cowbird			C	Res	
Orchard Oriole			U	SR	
Bullock's Oriole			X		
Baltimore Oriole			C	SR	Rare Winter
Pine Grosbeak			I	V	
Purple Finch			I	V	A few transients/visitors even in most off years.
House Finch			A	Res	
Red Crossbill	G5, SNA, N/CU	V	X		
White-winged Crossbill			I	V	
Common Redpoll			I	V	
Hoary Redpoll			X		
Pine Siskin	G5, SNA, N/CU	V	I	V	A few transients/visitors even in most off years.
American Goldfinch			C	Res	
Evening Grosbeak			R	T	
House Sparrow			C	Res	

PNHP Status

Global status: G3=vulnerable, G4=apparently secure, G5=secure; T=infraspecific taxon

State status: S1=critically imperiled in Pennsylvania, S2=imperiled, S3=vulnerable, S4=apparently secure, S5=secure (B=breeding population, N=non-breeding population), SNA=not ranked, accidental.

PNHP status: PE=endangered in Pennsylvania, PT=threatened in Pennsylvania, PX=extirpated in Pennsylvania, CA=candidate at risk, CR=candidate rare, CU=condition undetermined. N/CA=no current status/proposed candidate at risk. Source: Pennsylvania Natural Heritage Program <http://www.naturalheritage.state.pa.us/>,

WAP Priority

IC=immediate concern, HLC=high level concern, R=responsibility species, V=Pennsylvania vulnerable, MC=maintenance concern. Source: Pennsylvania Game Commission and Pennsylvania Fish and Boat Commission 2008. Pennsylvania's Wildlife Action Plan, Version 1.0a.. http://www.fish.state.pa.us/promo/grants/swg/nongame_plan.pdf.

Frequency

An indication of relative abundance of a species A=abundant-should see in high numbers, C=common-probably will see, U=uncommon-might see, O=occasional-lucky to see, R=rare-very lucky to see, I=irregular-intermittent irruptions often years apart, usually based on winter food supply, x=Accidental-only one to a few reports over 135 yrs.

Residency

A general indication of the time a species spends here during the year and whether or not it breeds here Res=Resident-usually here all year and breeds here, SR=summer resident, breeds here but here all year, YR=year round- Usually here all year but not breeding here, V=Visitor-usually here for a period of time, T=Transient-usually passing through in migration, Ex=Extirpated-a species that bred here regularly in the past but does not do so now.

Appendix G

Fact Sheets for Selected PNHP-listed Plants of Bucks County

WATER-HEMP RAGWEED
Amaranthus cannabinus (L.) Sauer
 Amaranth Family (Amaranthaceae)

State status S3, PR
Global status G5

Description - Water-hemp ragweed is an erect branched annual that can reach 2 m in height. The leaves are arranged alternately on the stem and are narrow with a long, tapering tip. The flowers are small and are clustered on short branches from the axils of the upper leaves. Male and female flowers are produced on separate plants, making the species dioecious. The fruits are small, dry utricles.



Habitat - This species occupies the upper zone of the riverbank freshwater intertidal zone, where only the base of the plant is likely to be inundated at high tide. It also grows in high marsh communities that are flooded only by the highest tides.

Range - Water-hemp ragweed grows in tidal marshes along the Atlantic coast from Maine to Florida. It is ranked as S3 (vulnerable) in Pennsylvania, S4 (apparently secure) in New Jersey, and S5 (secure) in New York and Virginia.

In Pennsylvania it is limited to the tidal portions of the Delaware River and its tributaries.

Traditional uses - None recorded.

Management issues - This species is one of the most tenacious of the PNHP-listed tidal marsh plants; as long as intertidal habitat exists it will persist. However, riverbank erosion caused by turbulence from passing boats, bulk heading, and filling all threaten the overall marsh community and have eliminated this plant in areas where it formerly grew.

water-hemp ragweed



female flower



male flower



References

Flora of North America Editorial Committee. 2003. *Flora of North America*, Vol. 4. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.

SHADBUSH, SERVICEBERRY

Amelanchier canadensis (L.) Medik.

State status S1, N/PE
Global status: G5

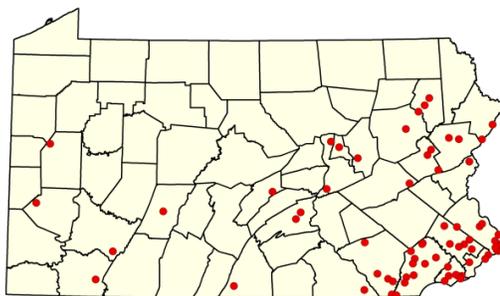
Description – *Amelanchier canadensis* is one of 8 species of serviceberry known to grow in Pennsylvania. It is typically a small tree or a shrub with a cluster of erect stems to about 2 m tall. Leaves are simple and alternately arranged on the stems; they are folded along the midrib at the time of flowering and very pubescent on the lower surface. When fully expanded they are elliptic to obovate and 3–8 cm long. Flowers and fruits are borne in short racemes. Important characteristics of the flowers and fruits are the lack of pubescence on the apex of the ovary and the somewhat recurved, but not strongly reflexed sepals. Ripe fruits are dark purple to black.

Amelanchier is a challenging group due to the frequency of hybridization, polyploidy, and apomixis (the ability to form seeds without sexual recombination). Species are not always well defined. Some currently recognized “species” include both diploids and polyploids. The population at Delhaas Woods appears to have at least some diploids, which would make it especially useful in understanding the origin of *A. canadensis* as a species. There is some confusion about the application of the name *Amelanchier canadensis*; Weigand applied it to what we now know as *A. arborea* (Michx.f.) Fern. The result is that plants offered for sale in the nursery trade as *A. canadensis* may actually be *A. arborea*.



Habitat – *Amelanchier canadensis* is a plant of moist woods and hummocky bogs or swamps on or near the coastal plain.

Range – The range of *Amelanchier canadensis* extends along the Atlantic coast from Quebec and Nova Scotia to Florida. This plant is ranked S1 (critically imperiled) in Pennsylvania; S4 (apparently secure) in Nova Scotia, New Jersey, and North Carolina; and S5 (secure) in New York, Delaware, and Virginia.



Traditional uses – Native Americans had uses for all parts of the serviceberry plant. The fruits were dried for winter use as a food. The fruits were also used as a blood remedy. An infusion of the bark was prepared to treat intestinal worms in children. The inner bark was the basis for preparation of a disinfectant. A compound decoction of the roots was employed to treat dysentery.

Management issues – Hydrology is a critical factor in maintaining habitat for *Amelanchier canadensis*. Over browsing by deer is another serious problem.

References

- Fernald, M.L. 1950. Gray's Manual of Botany, 8th edition. American Book Company, New York, NY.
 Burgess, M.B. 2010. Systematics and evolution of *Amelanchier*. PhD dissertation, University of Maine, Orono, ME.
 Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 22 February 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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TOOTHCUP

Ammannia coccinea Rott.

Loosestrife Family (Lythraceae)

State status S3, PE/PT

Global status G5

Description – Toothcup is an herbaceous annual; its stems are upright to decumbent and bear opposite, linear leaves. The flowers, which are 4-merous, occur in small clusters in the leaf axils; they bloom in mid to late summer.

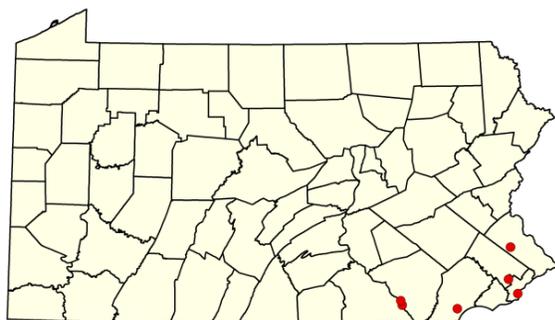
Habitat – Toothcup is a plant of wet, sandy or silty shores; this plant often doesn't appear until early summer when the water level has dropped exposing a wet substrate along the shoreline.

Range – Toothcup is a plant of the United States, except for Maine and the mountain west. It also occurs in adjacent areas of Canada. It is ranked SX (presumed extirpated) in New Hampshire; S1 (critically imperiled) in Ontario, Massachusetts, Rhode Island and Connecticut; S2 (imperiled) in New York; S3 (vulnerable) in Pennsylvania, New Jersey, Delaware, and West Virginia; S4 (apparently secure) in Maryland; and S5 (secure) in Virginia and North Carolina.

In Pennsylvania it occurs in just a few locations in the southeast, from Bucks to Lancaster Counties.

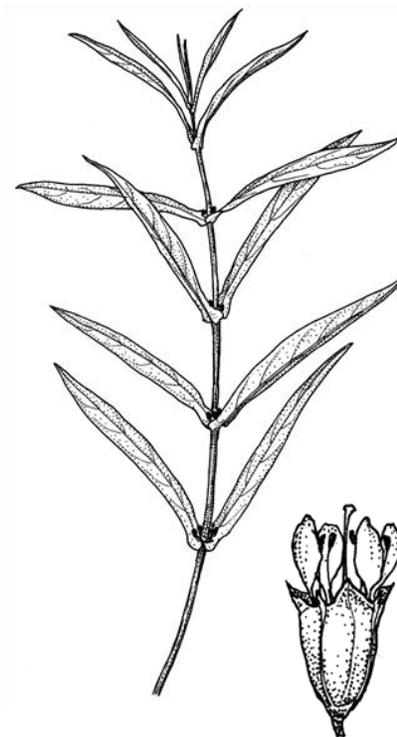
Traditional Uses – None recorded.

Management issues - Toothcup requires early successional habitat with minimal competition from other plants. It is frequently found in shallow water along shorelines of lakes or reservoirs where dropping water levels in mid-summer expose suitable substrate.



References:

- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflo.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*. University of Pennsylvania Press, Philadelphia, PA.



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BROOM-SEDGE, BUSHY BLUESTEM
Andropogon glomeratus (Walter) Britton, Stearns & Poggenb.
 Grass Family (Poaceae)

State status S3, TU/PR
Global status G5

Description - Although this perennial, warm season grass doesn't bloom until late in the season (August–October), the old flowering stalks from the previous year, which are 1—1.5 m tall, often persist making it easy to spot almost any time of the year. The densely clustered tuft of flowers at the stem tip is distinctive, there are only two grasses in our region with this appearance. The other, Elliott's beardgrass (*A. gyrans*) is also a species of concern (TU). Elliott's beardgrass is more slender and shorter than bushy bluestem; the 2 species occasionally grow together.



In some manuals broom-sedge is referred to as *Andropogon virginicus* var. *abbreviatus*.

Habitat - Broom-sedge occurs in moist, acidic fields, meadows, and old fields.

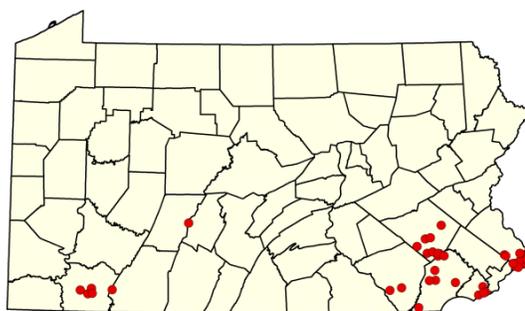
Range - Broom-sedge occurs on or near the coastal plain from Massachusetts to North Carolina. It is ranked S1 (critically imperiled) in Ohio and S2 (imperiled) in New York and West Virginia.

Traditional uses – Native Americans used the roots of bushy bluestem to treat backache, in addition an infusion of the roots was applied to the rash caused by poison-ivy to reduce itching..

Management issues - The open fields and meadows where broom-sedge grows will become forested through the natural process of secondary succession if steps are not taken to suppress woody growth. Regular mowing in the fall or winter or periodic burning are recommended to maintain appropriate habitat for this and other wet meadow species. A powerline right-of-way on the coastal plain in Bucks County provides prime habitat.

References

- Flora of North America Editorial Committee. 2003. *Flora of North America* Vol. 25. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 4 March 2011).
- NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/4/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

SCREWSTEM

Bartonia paniculata (Michx.) Muhl.

Gentianaceae (Gentian Family)

State status: S3, N/PR

Global status: G5



Description – Screwstem is a small, inconspicuous annual that doesn't appear until late summer or early fall (July to October). The slender, upright stems range from 5 to 20 cm tall and bear only a few short branches. Leaves are reduced to tiny bracts and the flowers and fruits are also very small.

Screwstem (*Bartonia paniculata*) is distinguished from the very similar (*Bartonia virginica*) by its alternate leaves and branches, and the ragged margins of the petals. *Bartonia virginica* has (mostly) opposite leaves and entire petals.

Habitat – This tiny plant grows in acidic bogs and swamps in northeastern Pennsylvania and on the coastal plain, often in sphagnum moss. Many populations are small and localized.

Range – The range of screwstem extends along the Atlantic coast from Newfoundland to Florida and Mississippi and inland to Missouri and Oklahoma. The species is classified as critically imperiled (S1) in New York and Ohio, imperiled (S2) in Delaware, and vulnerable (S3) in Maryland and Virginia. In Pennsylvania screwstem is known primarily from a cluster of sites in the southeast; however, several populations have recently been discovered in the northeastern region of the state.

Traditional Uses – None recorded

Management issues – In most cases, the acidic, boggy wetlands where screwstem grows are well protected by their general inaccessibility. However, hydrology is a factor that could be affected by off-site land use or development. Efforts should be made to identify critical hydrological features and secure their protection both on and off-site. Nutrient enrichment derived from highway runoff has resulted in competition by aggressive, non-native plants at one site.



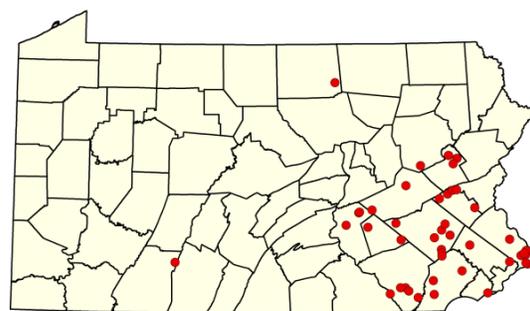
References:

NatureServe Explorer. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org, accessed 3/18/2011.

Rhoads, Ann Fowles and Timothy A. Block. 2007. *The Plants of Pennsylvania*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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SWAMP BEGGAR-TICKS***Bidens bidentoides* (Nutt.) Britton****Aster Family (Asteraceae)****State status S1, PT/PE****Global status G3**

Description - Swamp beggar-ticks is a smooth, branched annual that grows to a height of 0.3—0.6 m. Its narrow, toothed leaves may be green or reddish in color; they are simple and are arranged in pairs along the stem. Flowers appear in the fall. The flowering heads are entirely composed of yellow disk flowers, there are no rays.

Swamp beggar-ticks can be confused with other species of *Bidens* that also grow in the intertidal zone along the Delaware River. *Bidens frondosa* and *B. discoidea* have compound leaves. The most important feature distinguishing swamp beggar-ticks from *B. connata* and *B. tripartita*, which also have simple leaves, is the upward-pointing barbs on the awns of the achenes (single-seeded fruits).

Habitat - Swamp beggar-ticks is a plant of fresh water intertidal marshes, the portion of riverbank that is exposed at low tide and inundated when the tide is high. It tends to occupy the upper part of the intertidal zone.

Range - This species has a very restricted range; it occurs in tidal portions of coastal rivers from New York to Maryland, including the Hudson, Delaware, and Potomac. It is ranked S1 (critically imperiled) in Pennsylvania and Delaware, S2 (imperiled) in New Jersey, and S3 (vulnerable) in New York and Maryland.

In Pennsylvania freshwater tidal marshes occur along the Delaware River from the Delaware state line to Morrisville. The lower portions of several tributary streams are also part of the estuary.

Traditional uses - None recorded.

Management issues – Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the river, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*) are also serious threats.

References:

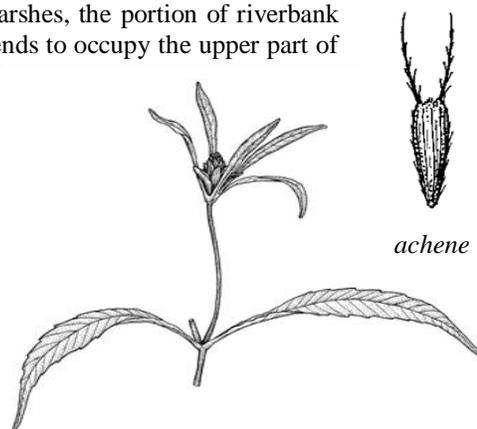
Flora of North America Editorial Committee. 2006. *Flora of North America*, Vol. 21. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org, accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



flowering head with surrounding bracts



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SMALL BEGGAR-TICKS
***Bidens discoidea* (Torr. & A.Gray) Britton**
Aster Family (Asteraceae)

State status S3, N/PR
Global status G5

Description – Small beggar-ticks is an annual plant; its erect branched form ranges in height from a 10 cm to 1 m. It has opposite leaves, most of which are trifoliate. The flowering heads are small and lack ray flowers; the disk flowers are yellow. Each head is surrounded by 3–5 leafy bracts that have smooth margins. The common name, beggar-ticks, describes the fruits of *Bidens*, which are flat achenes with 2–4 barbed awns that function in seed dispersal.

Small beggar-ticks is very similar to the more common *Bidens frondosa*; but *B. frondosa* has 5–10 bracts surrounding each head and the bracts have tiny hairs along their margins.

Habitat – Small beggar-ticks grows on tidal or non-tidal shores, or on hummocks in bogs and swamps. While it does not actually grow in standing water, it seems to prefer saturated soil or peat as a substrate. It has also been found growing out of mossy floating logs, shoreline stumps, and saturated wood of old docks.

Range – This species occurs in eastern North America from Nova Scotia, southern Quebec, and Minnesota south to Alabama, Oklahoma, and Texas. It is ranked S1 (critically imperiled) in Maine and West Virginia; S2 (imperiled) in Vermont; S3 (vulnerable) in Quebec, New Hampshire, and Pennsylvania; and S4 (apparently secure) in Ontario, New York, New Jersey, Delaware and Virginia.

In Pennsylvania small beggar-ticks occurs in the glaciated area of northeastern Pennsylvania, a 2003 search of 28 lakes in northeastern part of the state, it was documented at 17 locations (Petzold 2004). It is also known from Presque Isle in the northwest, vernal ponds in Franklin County, and tidal and non-tidal shores in southern Bucks County in the southeast.

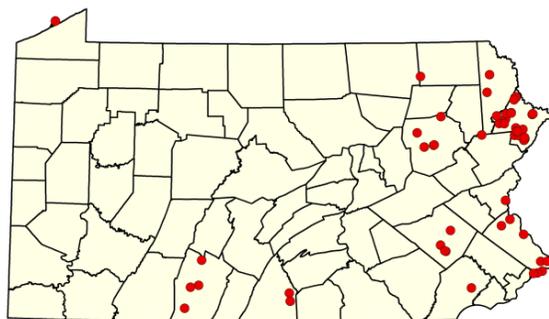
Traditional uses – Species of *Bidens* have been used by Native Americans to treat fever, sore throat, and general debility.

Management issues – Small beggar-ticks could be threatened by shoreline development including bulkheading, boat ramps, vegetation clearing, and trampling. Normal fluctuations in water level may actually favor this species by providing a zone of exposed soil where seeds can germinate.

References:

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Petzold, J. L. 2004. Status of the proposed rare species *Bidens discoidea* in Pennsylvania. Final Intern Project Reports for 2003-2004, Morris Arboretum of the University of Pennsylvania, Philadelphia, PA..
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

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SHOWY BUR-MARIGOLD

Bidens laevis (L.) Britton, Stearns & Poggenberg
Aster Family (Asteraceae)

State status S1, N/PE
Global status G3

Description – Showy bur-marigold is a smooth, branched annual, or short-lived perennial, that grows to a height of about 1 m. Its simple, coarsely-toothed, leaves are arranged in pairs along the stem. Flowering occurs in late summer and fall. The flowering heads consist of numerous tiny disk flowers surrounded by showy yellow rays that are about 2.5 cm long.

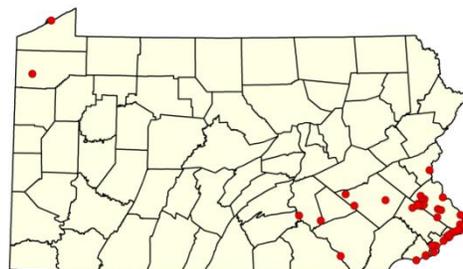
Showy bur-marigold can be confused with *Bidens cernua*, a more wide-ranging species that also grows along the margins of rivers and streams. *Bidens cernua* is typically a smaller plant and has shorter, less showy rays. In addition, the flowering and fruiting heads of *Bidens cernua* are often nodding. Another distinguishing characteristic is the reddish tinge of the tips of the bracts which occur between the disk flowers in the heads of showy bur-marigold; in *Bidens cernua* the bracts are greenish-yellow throughout.

Habitat – Showy bur-marigold grows in freshwater tidal marshes and shores and along non-tidal streams in areas of diabase geology. In Pennsylvania it reaches its best development in the high marsh portion of the freshwater tidal marshes and along the non-tidal Ridge Valley Creek in Bucks and Montgomery Counties.

Range – Showy bur-marigold occurs throughout the eastern United States and west to Nevada and southern California. It is ranked S2 (imperiled) in New York, S3 (vulnerable) in Pennsylvania, S4 (apparently secure) in Delaware, and S5 (secure) in New Jersey. In Pennsylvania it grows in the southeastern corner of the state along the Delaware Estuary and several non-tidal streams.

Traditional uses – Showy bur-marigold was a food plant for some Native American groups in the west.

Management issues – Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the river, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*) are also serious threats. Non-tidal population of showy bur-marigold should be protected from inappropriate stream edge management such as mowing or filling.



References:

- Flora of North America Editorial Committee. 2006. *Flora of North America*, Vol. 21. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

BULL SEDGE*Carex bullata* Wild.**Cyperaceae (Sedge Family)****State status: S1, PE****Global status: G5**

Description – Bull sedge is an herbaceous perennial with narrow leaves and erect flowering/fruitletting stem(s) arising from long rhizomes. Flowering stems are 0.6—0.7 m tall. Pistillate flowers are produced in 2 or 3 well-separated cylindrical spikes; male flowers are in separate slender spikes at the tips of the flowering stems.

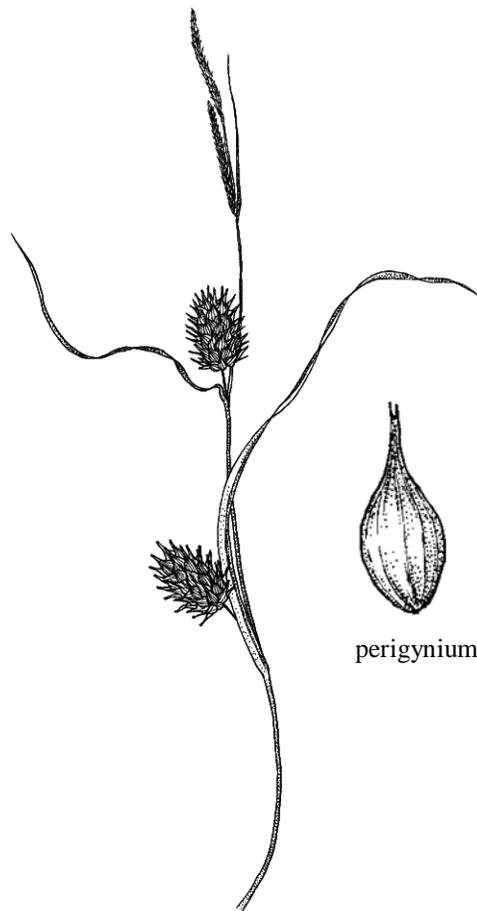
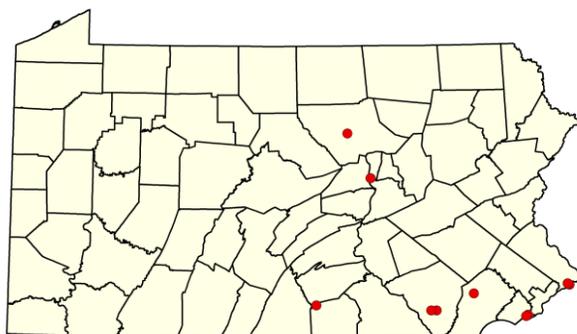
Habitat – Bull sedge is a plant of acidic soils of swamps, bogs, and boggy meadows. Because of its rhizomatous growth habit it can form dense, monospecific stands, especially in open areas.

Range – Bull sedge occurs from Maine to Georgia. It is classified as S1 (critically imperiled) in New York and Pennsylvania, S3 (vulnerable) in Delaware and Maryland, and S5 (secure) in New Jersey.

In Pennsylvania it is known from scattered sites on the Atlantic Coastal Plain and at glacial era sand deposits along the Susquehanna River .

Traditional Uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management issues – One of the largest populations of bull sedge in Pennsylvania is in a powerline right-of-way in the Atlantic Coastal Plain. At the site, control of woody vegetation has created a boggy wet meadow which supports several large patches of the plant.



perigynium

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual.*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

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BROWN SEDGE***Carex buxbaumii* Wahlenb.****Cyperaceae (Sedge Family)****State status: S3, TU/PR****Global status: G5**

Description – Brown sedge is an herbaceous perennial with clusters of narrow leaves and erect flowering/fruitletting stem(s) arising from long rhizomes. Flowering stems may be as much as 3 feet tall and are often arching at the top. Flowers are produced in 3 or 4 spikes with male flowers at the base and female flowers above. The scales that subtend the female flowers are conspicuously dark purplish-brown except for the green midrib.

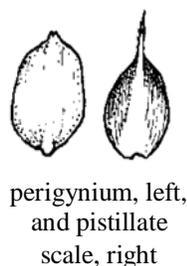
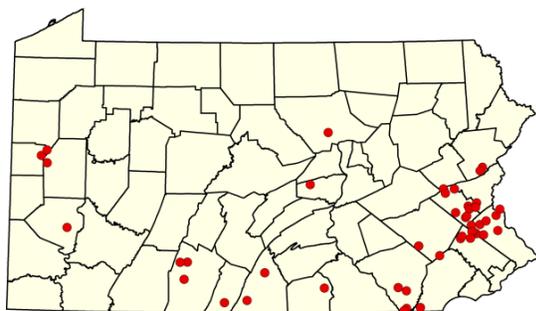
Habitat – Brown sedge is a plant of marshes, fens, or wet meadows, usually in areas with calcareous or diabase geology. Because of its rhizomatous growth habit it can form dense monospecific stands.

Range – Brown sedge is a northern plant, it ranges from Greenland to Alaska and south to South Carolina, Arkansas, and Utah. It is ranked S1 (critically imperiled) in Delaware; S2 (imperiled) in New York, Maryland, Virginia, and West Virginia; and S3 (vulnerable) in Pennsylvania and New Jersey.

In Pennsylvania, where it is approaching its southern limit of range, brown sedge is known from scattered sites in the southern half of the state.

Traditional uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage

Management issues – Maintaining wet meadow habitat requires retarding succession by woody plants such as red maple through the use of grazing or periodic mowing. Hydrology is also important.

**References:**

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.pafloa.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual.*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniřko, used with permission of University of Pennsylvania Press.

SHORT-HAIR SEDGE***Carex crinita* Lam. var. *brevicrinis* Fernald****Cyperaceae (Sedge Family)****State status: S1, PE/PE****Global status: G5T5**

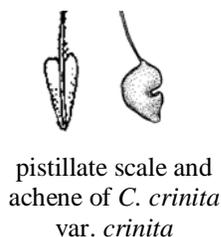
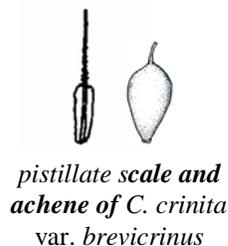
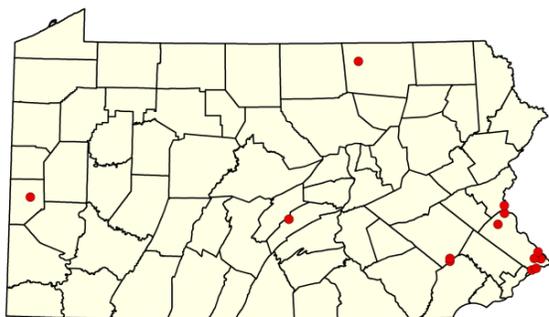
Description – Short-hair sedge is a large tufted plant with stems to 1.3 m tall accompanied by many leaves nearly as long. The 10 cm- long spikes of female flowers/fruits droop. Male flowers are in one or more separate erect spikes at the tip of the inflorescence and sometimes also at the tips of the largely pistillate spikes. It is distinguished from *Carex crinita* var. *crinita* by the shorter pistillate scales and achenes that lack an indentation on the side.

Habitat – This large sedge is found in moist, open woods, swamps, marshes, and swales.

Range – Short-hair sedge is a plant of the southeastern states from southern New York to Georgia and west to Louisiana and Texas. It is ranked SH (extirpated) in New York, S1 (critically imperiled) in Pennsylvania and Ohio, S4 (apparently secure) in New Jersey, and S5 (secure) in Delaware. In Pennsylvania it is known from only a very few sites in the southeastern region.

Traditional uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management issues –Short-hair sedge often occupies early successional habitat created by human disturbance. Maintenance of the hydrology, it is an obligate wetland plant, and retarding succession are both critical to the ability of the sedge to continue to grow at a site.

**References:**

Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual.*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, February 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.

CLOUD SEDGE
Carex haydenii Dewey
 Cyperaceae (Sedge Family)

State status: S1S2, TU/PT
Global status: G5

Description – Cloud sedge is a tufted herbaceous perennial with narrow leaves and erect flowering/fruitlet stem(s). Flowering stems are about 1 m tall. Pistillate flowers are produced in 2 or 3 well-separated cylindrical spikes; male flowers are in separate spike(s) at the tips of the flowering stems.

Cloud sedge is often confused with tussock sedge (*Carex stricta*) which often grows at the same site. Distinguishing characters include the inflated perigynia and acute pistillate scales of cloud sedge. A key should be used to make a positive identification.

Habitat – Cloud sedge is a plant of moist, seasonally saturated, open sites. It grows with slender blue flag, downy phlox, brown sedge (*Carex buxbaumii*), and tussock sedge in alluvial meadows at 2 sites in Bucks County.

Range – Cloud sedge is primarily a plant of northeastern North America. It is known from Quebec and Ontario south to Missouri and West Virginia. It is ranked SX (presumed extirpated) in Michigan, SH (possibly extirpated) in Michigan, and S1 (critically imperiled) in New York, Pennsylvania, New Jersey, West Virginia, and Maryland.

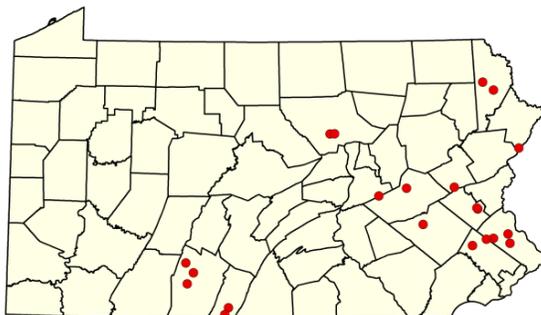
In Pennsylvania it is known from scattered sites in the eastern and south central regions of the state.

Traditional Uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management issues – Cloud sedge persists in former pastures and wet meadows. It will only persist if action is taken to prevent successional growth of woody species. The 2 locations where it is currently known in southeastern Pennsylvania are privately owned and have no formal protection in place.



perigynium (left) and
 pistillate scale (right)



References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, February 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.

LONG'S SEDGE*Carex longii* Mack

Cyperaceae (Sedge Family)

State status: S2S3, TU/PT

Global status: G5

Description – Long's sedge is an herbaceous perennial with narrow leaves and erect flowering/fruiting stem(s) arising from long rhizomes. Flowering stems are 0.6—0.7 m tall. Pistillate flowers are produced in 2 or 3 well-separated cylindrical spikes; male flowers are in separate slender spikes at the tips of the flowering stems.

Long's sedge is a member of Section Ouales of the genus *Carex*, a challenging group. A good key and careful observation are necessary to make a positive identification.

Habitat – Long's sedge is a plant of seasonally wet sandy soils of swamps, thickets, and meadows.

Range – Long's sedge occurs from Ontario and Nova Scotia south to Florida and Texas. It is ranked as S1 (critically imperiled) in Nova Scotia, Ohio, and West Virginia, S3 (vulnerable) in New York, S4 (apparently secure) in New Jersey and Delaware, and S5 (secure) in Virginia.

In Pennsylvania it is known from scattered sites in the eastern third of the state .

Traditional Uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management issues – One of the largest populations of Long's sedge in Pennsylvania is in a powerline right-of-way in the Atlantic Coastal Plain. At the site, control of woody vegetation has created a boggy wet meadow which supports a large population of this plant.

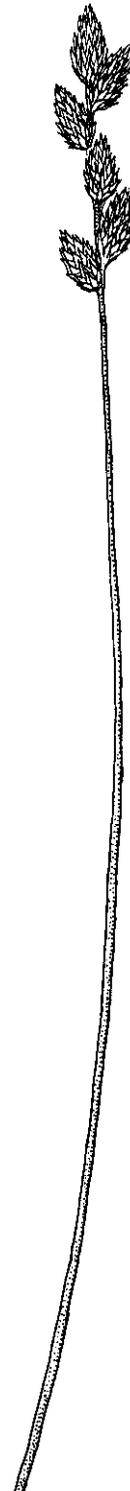


perigynium and pistillate scale

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.



MEAD'S SEDGE

Carex meadii Wild.

Cyperaceae (Sedge Family)

State status: S1, TU/PE

Global status: G4

Description – Mead's sedge is an herbaceous perennial with narrow leaves and flowering/fruiting stem(s) arising from long rhizomes. Flowering stems are erect and 0.6–0.7 m tall; the leaves and stems are bluish. Pistillate flowers are produced in 2 or 3 well-separated cylindrical spikes; male flowers are in separate spikes at the tips of the flowering stems.

Habitat – Mead's sedge is a plant of moist meadows, often on diabase geology. Because of its rhizomatous growth habit it can form dense patches.

Range – Mead's sedge is primarily a mid-western prairie plant. It ranges from Saskatchewan to Texas and east to New York and North Carolina. It is ranked SH (possibly extirpated) in New York; S1 (critically imperiled) in Pennsylvania, New Jersey, West Virginia, Delaware, and Maryland; and S3 (vulnerable) in Virginia.

In Pennsylvania it is known from scattered sites in the eastern half of the state. Its status as a native plant in Pennsylvania may date from the hypsithermal interval 8000 to 4000 years ago, when warmer, drier conditions prevailed.

Traditional Uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management issues – Mead's sedge persists in former pastures and powerline rights-of-way where the growth of woody plants is controlled.



above: perigynium
right: rhizomes



References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawing by Anna Aniśko, used with permission of University of Pennsylvania Press.

A SEDGE

Carex sprengelii Spreng.
Sedge Family (Cyperaceae)

State status SR, N/PR
Global status G5?



Description – *Carex sprengelii* is a perennial with narrow, grass-like leaves and a short, creeping rhizome. Flowering stems bear several male spikes at the tip and 2–3 drooping female spikes below. The sac-like structure (perigynium) surrounding the female flower and seed has a very pronounced long slender beak.

Habitat – *Carex sprengelii* grows on limey cliffs, forests, moist thickets, and river and stream banks.

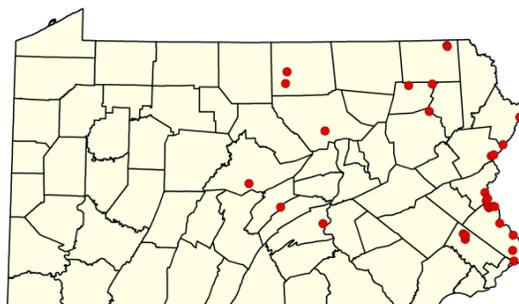
Range - *Carex sprengelii* occurs from New Brunswick to British Columbia and south to New Jersey, Pennsylvania, Iowa, and Colorado. It is classified as S1 (critically imperiled) or S2 (imperiled) at the edges of its range including New Brunswick, British Columbia, Colorado, Missouri, Ohio, Pennsylvania, and Maine. It reaches its southern limit of the range in Bucks County, Pennsylvania. Other Pennsylvania occurrences are scattered throughout the eastern half of the state including several sites on cliffs along the Delaware River.

Traditional Uses – Although there is no specific record of uses of this species, many sedges were used by Native Americans for basketry and cordage.

Management Issues – Locations where *Carex sprengelii* is growing should be protected from excessive foot traffic or climbers which could damage the habitat of this rare sedge.



beaked
perigynium of
Carex
sprengelii

**References:**

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniřko, used with permission of University of Pennsylvania Press.

INDIAN-PAINTBRUSH

Castilleja coccinea (L.) Spreng.

Broom-rape Family (Orobanchaceae)

State status S2, TU/PT

Global status G5

Description – Indian-paintbrush is an herbaceous annual with unbranched stems up to 0.6 m tall. The inflorescence is a dense, terminal spike in which each flower is subtended by a showy crimson bract. The flowers themselves are greenish yellow.

Castilleja is one of a group of parasitic or hemi-parasitic genera, which obtain all or part of their nutrition by attaching to other plants by means of modified roots known as haustoria. These species were traditionally included in the snapdragon family (Scrophulariaceae) but molecular data support moving them in the Orobanchaceae.

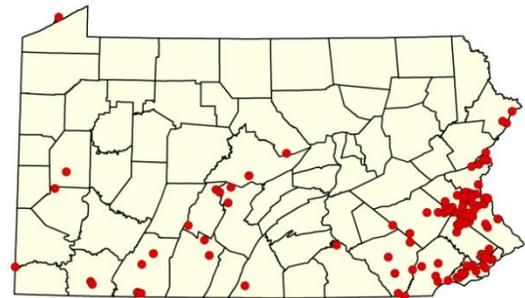
Habitat – Indian-paintbrush is a plant of moist meadows; in Pennsylvania it occurs primarily on limestone or diabase geology. Indian-paintbrush parasitizes a range of herbaceous meadow species including goldenrods, hawkweeds, panic grasses, yarrow, and wild strawberry.

Range – Indian –paintbrush is a plant of eastern North America; it occurs from New Brunswick to Saskatchewan and south to Florida and Louisiana. It is ranked SX (presumed extirpated) in Maine and Delaware, SH (possibly extirpated) in Massachusetts and Rhode Island, S1 (critically imperiled) in New York and Maryland, S2 (imperiled) in Connecticut, Pennsylvania and New Jersey, S3 (vulnerable) in Virginia and North Carolina. In Pennsylvania it is known primarily from the southern half of the state.



Traditional Uses – An infusion of the flowers of Indian paintbrush was used by Native American groups as a cold remedy. In addition, a concoction of the flowers was used to treat paralysis. Other uses included preparation of a poison and a love potion.

Management Issues – Invasive species such as reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), and Japanese knotweed (*Fallopia japonica*) could compete with this species for habitat.



References:

- Judd, W.S., C.S. Campbell, E.A. Kellogg, P.F. Stevens, and M.J. Stevens. 2008. *Plant Systematics*, 3rd edition. Sinauer Associates, Inc, Sunderland, MA.
- Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 1 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.
- Shenk, G. and K. Holsinger. 2001. *Castilleja coccinea* (L.) Sprengel (Indian paintbrush) conservation and research plan. New England Wildflower Society, Framingham, MA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

FRINGETREE

Chionanthus virginicus L.

Olive Family (Oleaceae)

State status S3, N/PT

Global status G5

Description – Fringetree is a small tree or large shrub with simple, entire, deciduous leaves that are arranged in pairs (opposite) along the stem. Twigs are stout and bear numerous lenticels. Flowering occurs in May, the conspicuous clusters of white flowers hang from the branches below the leafy shoots produced by the terminal buds. Male and female flowers occur on separate plants making the species dioecious. The fruits, which are limited to female plants, are dark blue drupes.

Habitat – Fringetree is a plant of moist, open woods, streambanks and the margins of wooded swamps.

Range – The range of fringetree extends from New York and Ohio to Florida and Texas. It is ranked S2 (imperiled) in Ohio, S3 (vulnerable) in Pennsylvania and New Jersey, S4 (apparently secure) in West Virginia and Kentucky, and S5 (secure) in Delaware.

In Pennsylvania fringetree occurs at scattered locations across the southern part of the state including sites in the Atlantic Coastal Plain and on serpentine barrens in the Piedmont.

Traditional uses – Native Americans prepared a decoction of the roots or bark of fringetree for washing or dressing cuts and bruises.

Management issues – Fringetree requires moist, fertile soil and is often found along streambanks or the margins of swamps. It will grow in full sun or partial shade. Overbrowsing by deer may be the most severe problem in maintaining populations of this species in the wild in Pennsylvania. Fringetree is also frequently grown as a landscape ornamental.

References

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

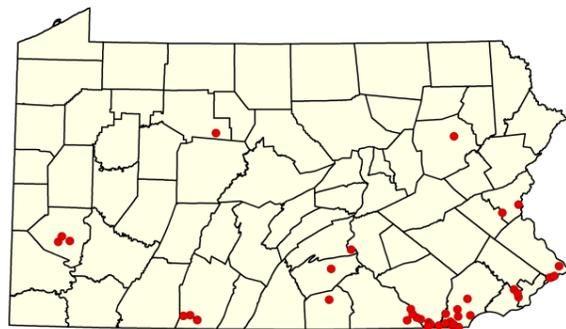
NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 4 March 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/25/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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DODDER

Morning-glory Family (Convolvulaceae)

Cuscuta campestris Yunck

Cuscuta cephalanthii Engelm.

Cuscuta compacta Juss. Ex Choisy

Cuscuta pentagona Engelm.

Cuscuta polygonorum Engelm.

Global status G5; State status S2, N/PT

Global status G5; State status S2, TU/PT

Global status G5; State status S2, N/PT

Global status G5; State status S2, N/PT

Global status G5; State status S2, TU/PT

Description – The dodders are non-photosynthetic annual plants that live by parasitizing other plants. Their yellow or orange stems develop haustoria that penetrate the tissues of green plants and obtain water and nutrients directly from the host. Dodders do not have roots. Most species of dodder are not host specific, rather they can parasitize a wide range of herbaceous or woody plants. The stems of dodder form a tangled mass wrapped around the host plant; by mid to late summer small white flowers are formed, which are followed by globular fruiting capsules. Flowers and fruits are necessary for identification; magnification helps to reveal the distinguishing characters.

Not all dodder s are species of concern, a good key is needed to distinguish the species. *Cuscuta gronovii* is a common species that forms conspicuous masses of orange stems draped over vegetation in low, wet areas throughout the state.

Habitat – Dodders are typically found in wet meadows, moist thickets, and along streambanks.

Range – Most of these dodder species have a broad range in North America. The 5 species listed above occur as scattered locations across Pennsylvania, primarily in the southern half of the state.

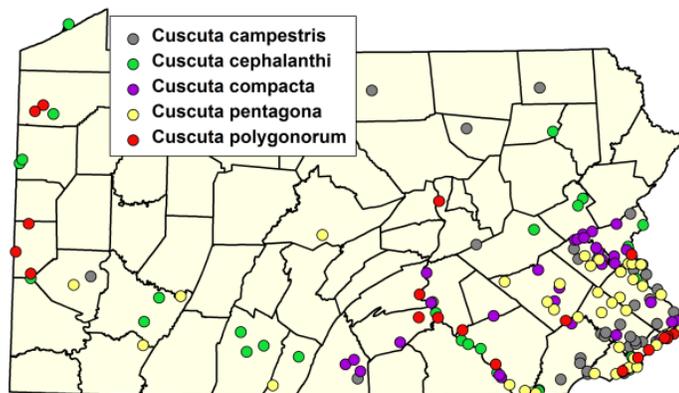
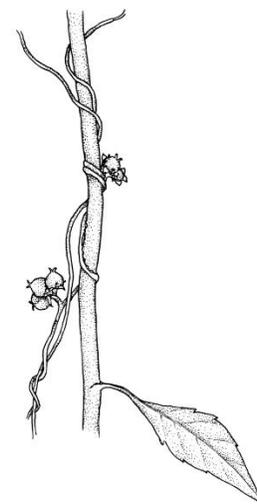
Traditional uses – Unspecified species of dodder were used by Native American women as a contraceptive; *Cuscuta compacta* was also used as a love potion and the stems were boiled to make an orange dye.

Management issues – Wetland protection efforts should benefit dodder species.

References

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 12 March 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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REFLEXED FLATSEEDGE

Cyperus refractus Engelm.

Sedge Family (Cyperaceae)

State status S1, PE
Global status G5

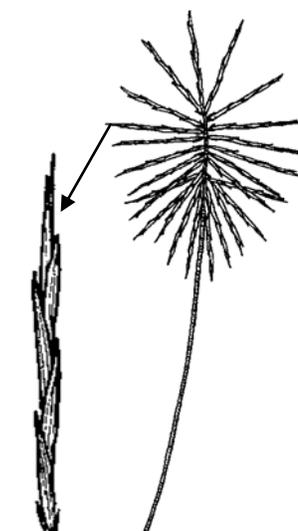
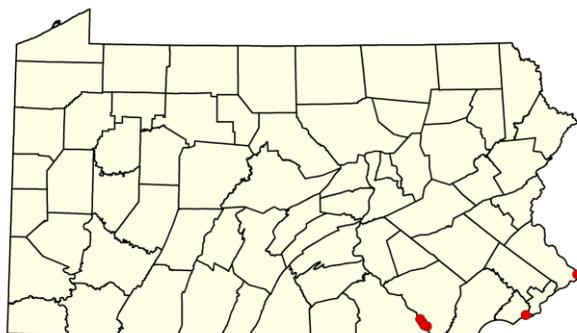
Description – Reflexed flatsedge is an herbaceous perennial with short, knotty rhizomes. Flowering/fruiting stems are about 0.5 m tall; the inflorescence consist of loose spikes of spikelets. *Cyperus refractus* is very similar to *Cyperus lancastrimensis*, another rare species that also occurs in southeastern Pennsylvania. Both species have strongly reflexed lower spikelets, however, those of *Cyperus lancastrimensis* are more densely arranged in the spikes compared to the loosely arranged spikes of reflexed spikerush. In addition the achenes of reflexed spikerush are up to 3 mm long while those of *C. lancastrimensis* are 2—2.6 mm long. Finally the scales that subtend the achenes of reflexed flatsedge barely overlap whereas those of *C. lancastrimensis* are obviously overlapping (see illustrations).

Habitat – Reflexed flatsedge grows in sandy alluvial banks and dry woods.

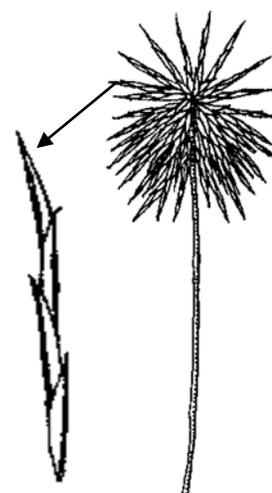
Range – Reflexed flatsedge is at its northern limit of range in Pennsylvania; it occurs from New Jersey and Pennsylvania west to Missouri and south to Florida and Texas. It is ranked SX (possibly extirpated) in New Jersey, S1 (critically imperiled) in Ohio and Pennsylvania, S2 (imperiled) in Delaware and Maryland, and S3 (vulnerable) in West Virginia and Virginia.

Traditional uses – Although *Cyperus refractus* is not mentioned specifically, other species of flatsedge were used by Native Americans for food (seeds) and fiber.

Management issues – Dry, open sandy soils are required to maintain populations of reflexed flatsedge. At the only recorded site in Bucks County they are growing in a powerline right-of-way in the coastal plain, where woody growth is suppressed.



Cyperus refractus



Cyperus lancastrimensis

References

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 23. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 12 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/12/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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VELVETY PANIC GRASS
Dichanthelium scoparium (Lam.) Gould
 Grass Family (Poaceae)

State status: S1, PE
Global status: G5

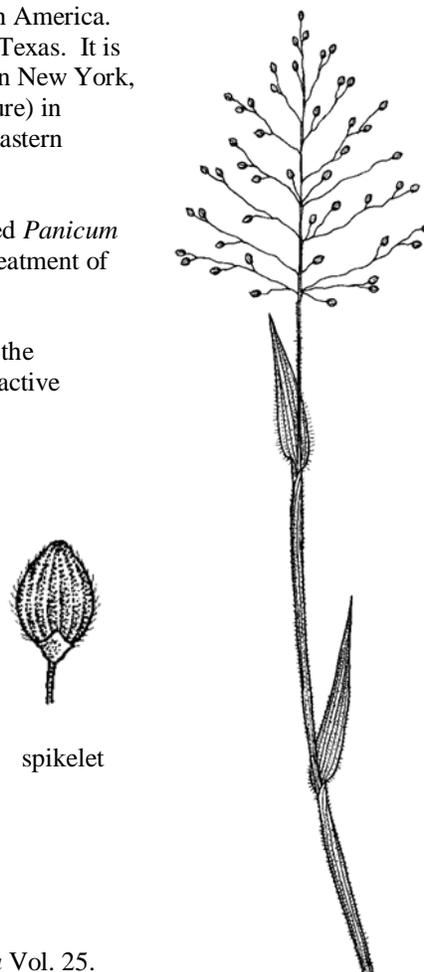
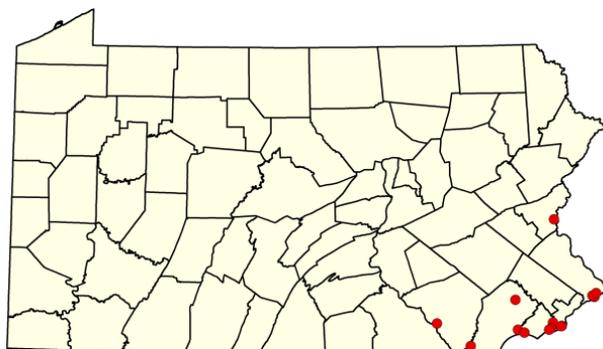
Description – Velvety panic grass is a perennial grass, like most of the panic grasses it produces a terminal inflorescence in the spring followed by autumnal inflorescences which develop at the tips of axillary shoots later in the season. Velvety panic grass is distinctive due to its coarse texture and dense velvety pubescence. A good identification key is needed to identify species with certainty. *Dichanthelium* was formerly lumped with *Panicum*.

Habitat – Velvety panic grass grows in seasonally moist, sandy soils of meadows and old fields.

Range – Velvety panic grass is a plant of the southeastern quadrant of North America. It ranges from southern New York west to Kansas and south to Florida and Texas. It is ranked SH (possibly extirpated) in West Virginia, S1 (critically imperiled) in New York, Pennsylvania, and Ohio; S4 (apparently secure) in New Jersey, and S5 (secure) in Delaware. In Pennsylvania it is known from a handful of sites in the southeastern corner of the state, on or near the coastal plain.

Traditional Uses – No specific uses are recorded for this species, unspecified *Panicum* species were used by Native Americans for medicinal purposes including treatment of fever, and as a source of fiber.

Management issues – Maintenance of wet meadow habitat is necessary for the continued existence of this plant in the state; in most cases this requires the active suppression of woody growth.



References:

- Flora of North America Editorial Committee. 2003. *Flora of North America* Vol. 25. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniřko, used with permission of University of Pennsylvania Press.

PANIC GRASS

Dichanthelium spretum (Schult.) Freckman

Grass Family (Poaceae)

State status: S1, PX/PE

Global status: G5

Description – *Dichanthelium spretum* is a perennial grass, like most of the panic grasses it produces a terminal inflorescence in the spring followed by autumnal inflorescences which develop at the tips of axillary shoots later in the season. A good identification key is needed to identify the panic grasses to species with certainty. *D. spretum* is considered a subspecies of *D. acuminatum* by some authors (FNA 2003). *Dichanthelium* was formerly lumped with *Panicum*.

Habitat – *Dichanthelium spretum* grows in moist open soils on the Atlantic Coastal Plain where it occurs with other rare coastal plain species including *Dichanthelium scoparium*, *Sisyrinchium atlanticum*, *Rhexia mariana*, and *Andropogon glomeratus*.

Range – *Dichanthelium spretum* occurs along the coast from Maine to Texas and inland to the Great Lakes region. It is ranked S1 (critically imperiled) in Pennsylvania and North Carolina, S2 (imperiled) in Ohio, S4 (apparently secure) in Delaware, and S5 (secure) in New Jersey.

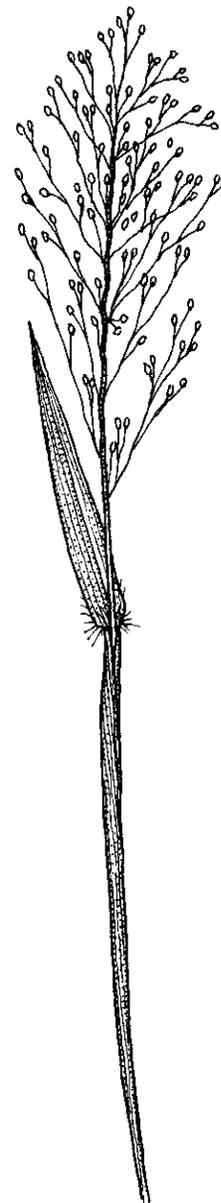
Only a single extant population is known in Pennsylvania, in the powerline right-of-way at Delhaas Woods Preserve in Bucks County. *D. spretum* could not be relocated at an earlier coastal plain site and was thought to be extirpated until the Delhaas Woods population was discovered.

Traditional Uses – No specific uses are recorded for this species; however, unspecified *Panicum* species were used by Native Americans for medicinal purposes including the treatment of fever, and as a source of fiber.

Management issues – Maintenance of wet meadow habitat is necessary for the continued existence of this plant in the state. Because of the ongoing suppression of woody growth, the powerline right-of-way is ideal.



spikelet



References:

- Flora of North America Editorial Committee. 2003. *Flora of North America* Vol. 25. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition, University of Pennsylvania Press, Philadelphia, PA.

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DWARF SPIKE-RUSH**State status S1, PE*****Eleocharis parvula* (Roehm. & Schult.) Link ex Buffon & Fingerh. Global status G5****Sedge Family (Cyperaceae)**

Description - Dwarf spike-rush is a tiny plant, 5—8 cm tall. It is a perennial with slender stems that form matted tufts connected by creeping rhizomes. This plant has no leaves, its flowering and fruiting heads are located at the tips of the stems. Dwarf spike-rush could be confused with the more common needle spike-rush (*Eleocharis acicularis*). Mature achenes are necessary to distinguish the two, needle spike-rush achenes have a well differentiated tubercle whereas those of dwarf spike-rush taper gradually from base to tip (see illustrations below).

Habitat - Dwarf spike-rush is a plant of tidal shores and mudflats.

Range - This species is known from salt marshes in eastern and western North America and at inland locations mostly east of the Mississippi River. In 1994 it was first reported in Ohio. It is ranked as S1 (critically imperiled) in Pennsylvania and S4 (apparently secure) in New York, New Jersey, and Delaware.

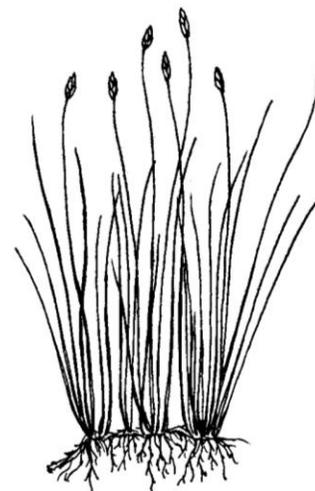
Dwarf spike-rush is apparently a recent arrival in Pennsylvania; it was first found at Neshaminy State Park in 1984. It has subsequently spread to other freshwater intertidal marshes along the Delaware River.

Traditional uses - None recorded.

Management issues - Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the Delaware River, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Polygonum cuspidatum*) and common reed (*Phragmites australis*) are also serious threats.

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 23. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011).
- NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.
- Ungar, Irwin A., Finley A. Bryan, Jackie Adams, and Carolyn H. Keiffer. 1994. *Eleocharis parvula* (R.&S.) Link., a new species record for the flora of Ohio. *Ohio J. Sci.* 94(3): 74.



dwarf spikerush
(*Eleocharis parvula*)
achene



needle spike-rush
Eleocharis acicularis
achene



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Waterpod, Aunt Lucy
***Ellisia nyctelea* L.**
Waterleaf Family (Hydrophyllaceae)

State status S2, PT
Global status G5

Description - Waterpod is a low-growing annual that reaches, at most, a height of 25–30 cm. The leaves are deeply pinnately lobed, similar to those of common ragweed; they are arranged alternately on the stem. A single white flower is borne on a stalk from the axil of each leaf. Flowering occurs in May, and by late June the plants have produced seed and disappeared until seeds germinate the following spring.

Habitat - In Pennsylvania waterpod grows in open areas along riverbanks or canals; look for it in moist, open locations where there is a minimum of competition from other plants.

Range - Waterpod is a wide-ranging plant that occurs irregularly along the north Atlantic coast from southern New York to Virginia. Its main range is in the prairie and plains states from Michigan and Indiana to Saskatchewan and the western mountains south to Nevada and New Mexico. It is ranked SX (presumed extirpated) in New York, S1 (critically imperiled) in New Jersey, S2 (imperiled) in Pennsylvania and West Virginia, and S4 (apparently secure) in Maryland and Virginia.

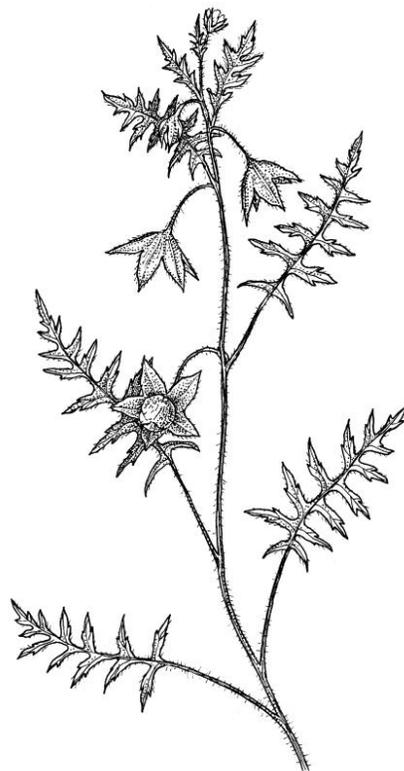
In Pennsylvania waterpod occurs at a few sites along the Delaware River and Delaware Canal corridor in Bucks County. It has also been found along the lower Schuylkill River, lower Susquehanna River, and the Brandywine Creek, all in the southeastern corner of the state.

Traditional Uses - none recorded

Management Issues - Mowing should be avoided in May and early June while waterpod is flowering and producing seed; however, later in the season mowing can help to reduce competition and maintain open conditions favorable to this species.

References:

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual.*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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HEARTS-A-BURSTING

Euonymus americanus L.

Staff-tree Family (Celastraceae)

State status: S3, N/SP

Global status: G5

Description – Hearts-a-bursting is a deciduous shrub to 6 feet tall; however it is more often encountered as low-growing leafy shoots. Only the erect stems produce flowers and fruits. The stems, which are green, bear pairs of finely toothed leaves at the nodes. The small, yellowish-green flowers arise from the leaf axils. The fruits are what give the plant its colorful name; they consist of warty red capsules that split to reveal 4 seeds that are covered with bright orange arils.

Habitat – Hearts-a-bursting is a plant of moist woods and floodplains.

Range – This species is near its northern limit of range in Pennsylvania. It occurs from southern New York and Ohio south to Florida, Missouri and Texas. It is ranked as S1 (critically imperiled) in New York, S3 (vulnerable) in Pennsylvania, S4 (apparently secure) in New Jersey, and S5 (secure) in West Virginia and Virginia.

In Pennsylvania it is known from scattered sites in the southeastern and western regions.

Traditional uses – Native Americans had many uses for heart's-a-bursting. Various preparations were employed in treating stomachache, sinus infections, and menstrual problems.

Management issues – Hearts-a-bursting is highly preferred by deer and is heavily browsed winter and summer. As a result flowering or fruiting stems are rarely produced and the plant persists at most sites only through the production of low-growing vegetative shoots.

References:

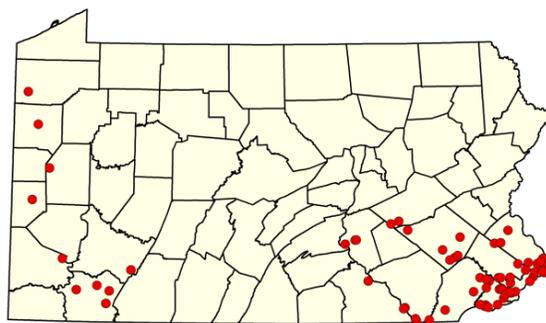
Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.



WHITE THROUGHWORT

Eupatorium album L.

Aster Family (Asteraceae)

State status S3, PX/PE

Global status G5

Description – White throughwort is an erect plant, approximately 0.5–1 m tall that branches only in the inflorescence. The numerous pairs of simple leaves are attached directly to the stem without a petiole. Tiny white flowers occur in groups of 4–5 in small heads at the ends of short branches at the top of the stem forming a flat-topped inflorescence.

Hybridization and apomixis, the formation of seeds without sexual recombination, are common in the genus *Eupatorium*, and can make species difficult to define.

Habitat – White throughwort is found in sandy, open woods and successional habitats including old fields and thickets.

Range – White throughwort occurs from New York to Florida and Louisiana. It is ranked as SH (possibly extirpated) in Pennsylvania, S1 (critically imperiled) in Connecticut, S3 in Ohio, Delaware, and West Virginia, and S5 (secure) in Virginia.

Never abundant in Pennsylvania this species was thought to be extirpated in the state. However, it was recently found to be extant at two sites, one each in Bucks and Delaware Counties.

Traditional uses – none recorded

Management issues – Open woods or successional habitat in areas of dry, sandy, acidic soils are necessary for the survival of white throughwort. At the Bucks County site it is growing on old dredge spoil near the Delaware River. Competition from non-native invasive plants such as common reed (*Phragmites australis*) is a serious threat to this species. In addition, overbrowsing by deer may also be a threat at the Delaware County site.



References:

Flora of North America Editorial Committee. 2006. *Flora of North America* Vol. 21. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1.

(<http://www.natureserve.org/explorer>, 19 February 2011).

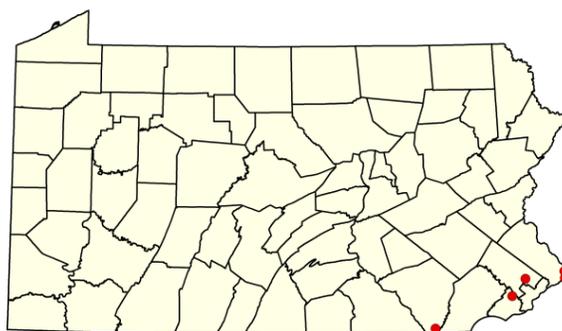
NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org.

Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of*

Pennsylvania, An Illustrated Manual, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

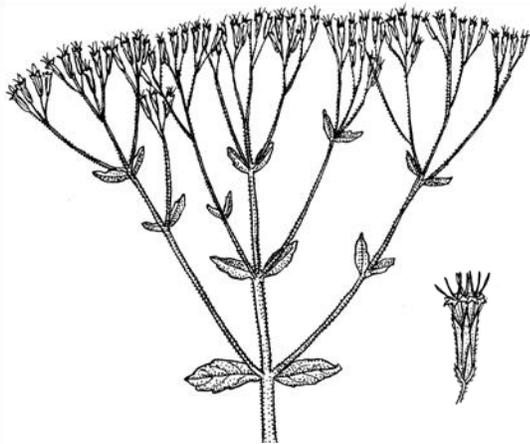


Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

ROUND-LEAVED EUPATORIUM
Eupatorium rotundifolium L. var. *rotundifolium*
 Aster Family (Asteraceae)

State status S3, TU
Global status G5

Description - Round-leaved eupatorium is an erect plant that branches only in the inflorescence. The numerous pairs of hairy leaves are attached directly to the stem without a petiole. Tiny white flowers occur in groups of 5 in small heads at the ends of short branches at the top of the 0.4—1 m tall stem forming a flat-topped inflorescence.



inflorescence and single flowering head of round-leaved eupatorium

Round-leaved eupatorium intergrades with ragged eupatorium (*Eupatorium pilosum*) and may not always be separable. Hybridization and apomixis, the formation of seeds without sexual recombination, are common in the genus *Eupatorium*, and makes species difficult to define.

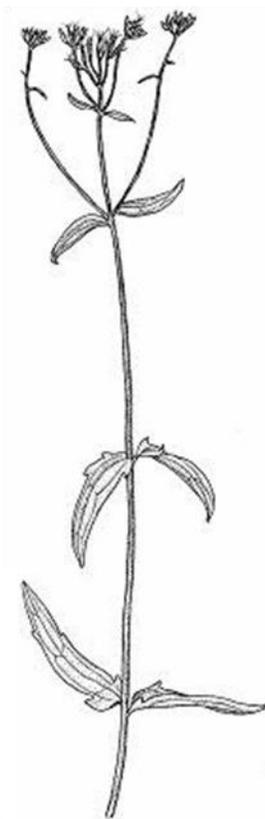
Habitat - This species is found in successional habitats including old fields, thickets, and open woods. It grows in moist, sandy or clayey soil.

Range - Round-leaved eupatorium occurs from New York to Florida and west to Indiana, Oklahoma, and Texas. It is ranked as SH (possibly extirpated) in New York, S1 (critically imperiled) in Pennsylvania, and S4 (apparently secure) in New Jersey.

In Pennsylvania is known from only a few sites in the southeast, mostly on the Atlantic Coastal Plain.

Traditional uses - *Eupatorium pilosum* was used by Native Americans to treat breast complaints, colds, urinary problems, and as a laxative and tonic.

Management issues - Open, successional habitat in areas of sandy, acidic soils is necessary for the survival of round-leaved eupatorium. At several sites the spread of non-native invasive plants including common reed (*Phragmites australis*) and mile-a-minute (*Persicaria perfoliata*) are a serious threat to this species.



ragged eupatorium

References

- Flora of North America Editorial Committee. 2006. *Flora of North America* Vol. 21. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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SOAPWORT GENTIAN

Gentiana saponaria L.

Gentian Family (Gentianaceae)

State status S1, TU/PE

Global status G5

Description – Soapwort gentian is one of the bottle gentians; the flowers do not open widely. Lobes of the corolla are joined by intervening wedge-shaped appendages to form a tube (see illustration below). Pollinating bees must crawl down into the tubular flowers from the opening at the top. Soapwort gentian is distinguished from the other bottle gentians (*Gentiana clausa* and *Gentiana andrewsii*) by features of the calyx lobes and how tightly closed the corolla remains.

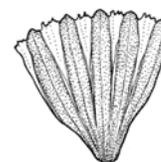
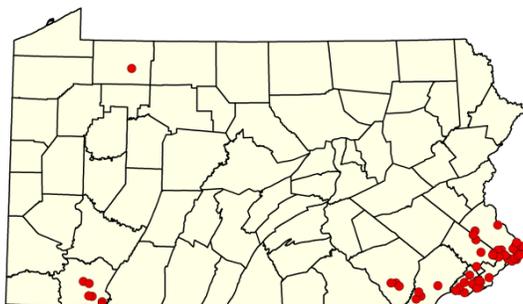
Habitat – Soapwort gentian grows in moist, open woods, wet meadows, roadsides, and swamps.

Range – Soapwort gentian occurs from New York to Michigan and south to Florida and Texas. It is ranked SX (presumed extirpated) in Michigan; S1 (critically imperiled) in New York, Pennsylvania, and Ohio; S3 (vulnerable) in Delaware; and S4 (apparently secure) in West Virginia.

In Pennsylvania soapwort gentian occurs primarily in the southeastern corner of the state on or near the coastal plain. There are also several known sites in Fayette County in southwestern Pennsylvania.

Traditional Uses – A decoction of the root of soapwort gentian was used as a tonic by several Native American tribes.

Management issues – Populations of soapwort gentian are present at several protected sites on the coastal plain, however at both locations overbrowsing by deer has become a serious threat. The tops are being nipped off many plants before the flowers can open. Deer over population may be the most serious threat to this plant statewide.



expanded corolla
showing petal lobes
and intervening
wedge-shaped
corolla appendages

References

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 22 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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GOLDENPERT

Gratiola aurea Muhl. Ex Pursh
Plantain Family (Plantaginaceae)

State status: S1, TU/PE
Global status: G5

Description – Goldenpert is an herbaceous perennial with narrow, opposite leaves; the leaves and stem are covered with glandular hairs. This plant grows in wet soils or shallow water and often produces roots at the lower nodes. The bright yellow flowers are borne singly in the axils of the upper leaves.

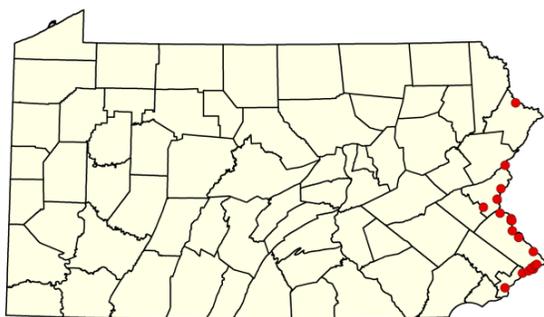
Habitat – Goldenpert grows in moist sandy soils along river and pond margins and in wet meadows.

Range – The range of goldenpert extends from Newfoundland, Quebec, and Ontario south to Florida. It is ranked S1 (imperiled) in Pennsylvania, S3 (vulnerable) in Delaware, S4 (apparently secure) in New York, and S5 (secure) in New Jersey.

In Pennsylvania, it occurred historically at scattered sites along the Delaware River from Pike County south to Philadelphia. The only recent collections of goldenpert are from Delhaas Woods, a coastal plain preserve in Bucks County where it grows in a powerline right-of-way and around the margins of a pond.

Traditional Uses – None recorded.

Management issues – It is not clear if goldenpert has disappeared from sites along the Delaware River or if the problem is just a lack of recent collections. More targeted searches should be undertaken to determine its status. It seems secure at the only known extant site, although overbrowsing could become a problem. The population should be monitored on a regular basis.



References

- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual.*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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MULTIFLOWERED MUD-PLANTAIN

Heteranthera multiflora (Griseb.) Horn
Water Hyacinth Family (Pontederiaceae)

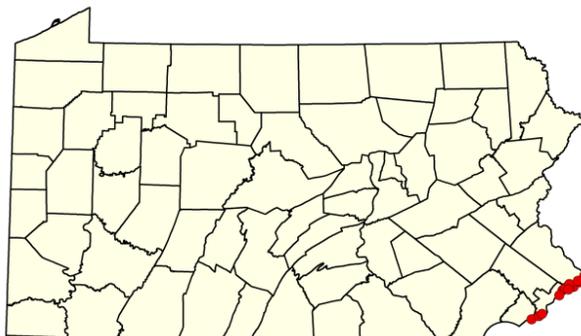
State status S1, PE
Global status G4

Description - Multiflowered mud-plantain is a low-growing, creeping annual. It may be completely inundated, with some leaves floating, or exposed on moist mud flats depending on the stage of the tide. The leaves are bright green, broadly heart-shaped, and about 2–3 inches long. The flowers are clustered in a sheathing structure borne in the leaf axil. Multiflowered mud-plantain is very similar to the more common *Heteranthera reniformis*. The most definitive distinguishing characteristics are the longer flowering spike and purple hairs on the filaments of *H. multiflora*.



Habitat - This species is a plant of freshwater tidal shores and mud flats.

Range - The main range of multi-flowered mud-plantain is in the central United States from Nebraska, Kansas, and Oklahoma to Illinois and Mississippi. It also occurs on the Atlantic Coastal Plain from New Jersey to North Carolina. It is ranked as S1 (imperiled) in Pennsylvania and Delaware and S3 (vulnerable) in New Jersey. In Pennsylvania multiflowered mud-plantain is known only from the few remaining freshwater tidal marshes along the Delaware Estuary.

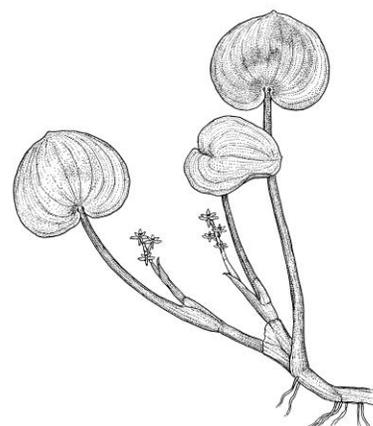


Traditional Uses - Native Americans used hot poultices of roots of multiflowered mud-plantain to treat inflamed wounds and sores.

Management issues - Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the river, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*) are also serious threats.

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*, Timber Press, Portland OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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GOLDENSEAL

Hydrastis canadensis L.

Buttercup Family (Ranunculaceae)

State status S4, PV/PV

Global status G4

Description – Goldenseal is an herbaceous perennial, it grows up to 0.5 m tall and bears 2 palmately lobed leaves at the top of an unbranched stem. The stems arise singly from a yellow rhizome and often form large colonies on the forest floor. Flowering occurs before the leaves have fully expanded; the flowers have a cluster of showy white stamens, but lack petals. The dark red fruit, which is an aggregate of single-seeded drupelets, is borne at the base of the uppermost leaf.

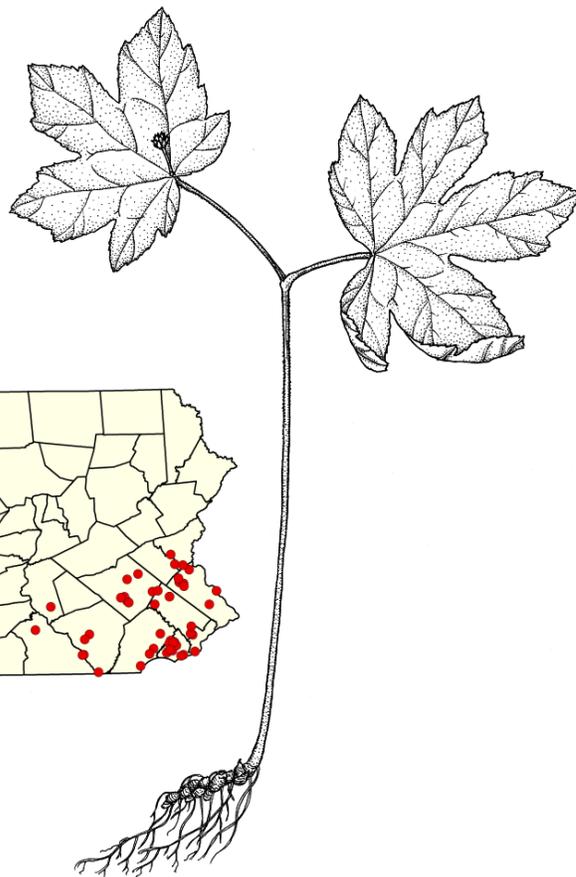
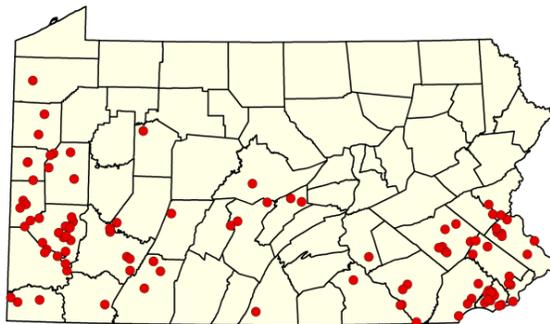
Habitat – Goldenseal grows in late successional to mature, undisturbed rich deciduous forests.

Range – The range of goldenseal extends from New York and Ontario to Georgia, Arkansas, and Kansas. It is ranked S1 (critically imperiled) in Massachusetts, Connecticut, New Jersey and Delaware; S2 (imperiled) in New York and Maryland; S3 (vulnerable) in Virginia; and S4 (apparently secure) in Pennsylvania and West Virginia.

In Pennsylvania goldenseal occurs at scattered sites across the southern half of the state, and is often associated with limestone or diabase geology.

Traditional uses – Native Americans used goldenseal to treat a wide range of conditions including cancer, diarrhea, whooping cough, fever, liver problems, pneumonia, local inflammation, sore eyes, and gas. It continues to be valued for medicinal uses.

Management issues – Goldenseal has declined throughout its range due to over collecting for medicinal uses and a decrease in mature, undisturbed deciduous forest habitat. Overbrowsing by deer may be an additional stress.



References

- Flora of North America Editorial Committee. 1997. *Flora of North America* Vol. 3. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 4 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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AMERICAN HOLLY

Ilex opaca Aiton

Holly Family (Aquifoliaceae)

State status S2, PT

Global status G5

Description - American holly is a native evergreen tree that is easily recognized by its spiny leaves and red berries used at Christmas time. Holly blooms in May, when the new leaves are expanding; male and female flowers are borne on separate trees, making the species dioecious. Only the female trees produce berries.

Habitat - Holly is an understory tree of moist, acidic forests.

Range - American holly occurs from Maine to Florida and Texas. In the north it is limited to coastal areas, further south it ranges into the interior. It is ranked S2 (imperiled) in Pennsylvania, S4 (apparently secure) in New York, and S5 (secure) in Delaware, West Virginia and Virginia.

In Pennsylvania holly grows on the Atlantic Coastal Plain in Bucks County, in the lower Susquehanna valley, and at a few other scattered sites.

American holly is also commonly planted as a landscape ornamental. The seeds, which are bird dispersed, frequently result in the appearance of naturalized holly trees in urban and suburban woodlots. This makes the determination of what constitutes a native occurrence difficult at times. However, native stands are typically characterized by mixed age populations including some older trees, whereas naturalized occurrences typically consist of a few scattered young trees.

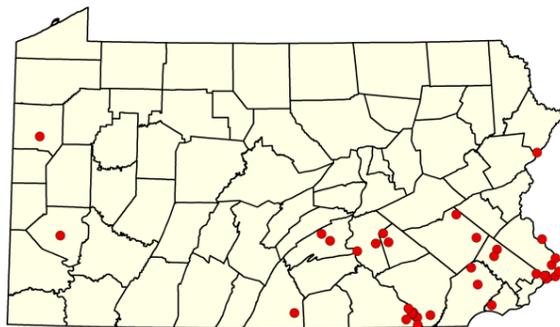
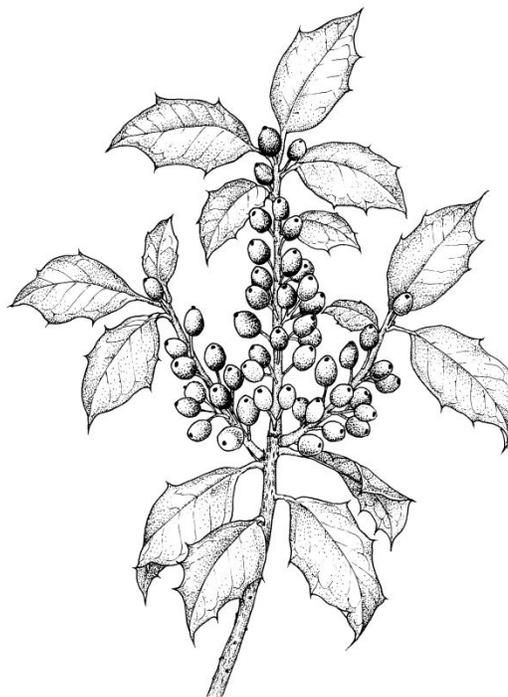
Traditional Uses - Native Americans had many uses for American holly. The wood was used to carve spoons and decorations; a decoction of the bark was prepared to treat sore eyes. The berries were chewed for relief from gastrointestinal problems and infusions of the leaves were employed to treat measles and sores.

Management issues - The few remaining native stands of American holly in Pennsylvania should be protected. The most critical issue is preventing further habitat loss or fragmentation.

References:

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawing by Anna Aniško, used with permission of University of Pennsylvania Press.



SLENDER BLUE FLAG

Iris prismatica L.

Iris Family (Iridaceae)

State status S1, PE

Global status G5

Description – Slender blue flag is an herbaceous perennial 0.5—0.7 m tall that blooms in May. The plants grow from slender rhizomes that lie at the soil surface. Flowers are pale blue-violet with spreading or recurved sepals that have a wide band of yellow hairs down the center. The fruits are a prism-shaped, 3-sided, elongate capsule. This species is much more slender than the more common northern blue flag (*Iris versicolor*). The leaves are narrower and the sharply-angled fruiting capsule contrasts with the bluntly-angled capsule of northern blue flag.

Habitat – Slender blue flag grows in floodplain meadows on or near diabase. At the 2 sites where it is currently known in southeastern Pennsylvania, it occurs with *Carex buxbaumii*, *Carex haydenii*, downy phlox (*Phlox pilosa*), and meadow phlox (*Phlox maculata*).

Range – Slender blue flag is known from Nova Scotia and Maine south to Georgia. It is ranked S1 (critically imperiled) in Nova Scotia, Pennsylvania, and Maryland; S2 (imperiled) in Maine, New York and Delaware; and S4 (apparently secure) in New Jersey.

In Pennsylvania slender blue flag is known from scattered sites in the Piedmont and 2 sites on the Allegheny Plateau in western PA.

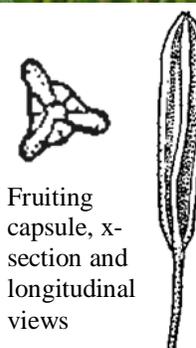
Traditional Uses – No uses are recorded for slender blue flag, but raw roots of unspecified *Iris* species were chewed for coughs and the fibers were employed for cordage.

Management issues – The 2 known populations of slender blue flag in southeastern Pennsylvania are on privately-owned, unprotected land. Both sites were pastures or hayfields in the past. One is being mowed annually, the other is not receiving any active management at present but was grazed by sheep until recently. Successional growth of woody species is a threat. Both populations should be monitored for adverse effects of deer.

References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 26. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 22 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflo.org. Accessed 2/22/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.



QUILLWORT

Isoetes valida Brunton & W.C Taylor
Quillwort Family (Isoetaceae)

State status: S1S3, NPR
Global status: GNA

Description – The quillworts are spore-bearing plants with a cluster of quill-like leaves arising from a basal root crown. Sporangia are located in the leaf bases. *Isoetes valida* was previously classified as *Isoetes engelmannii* var. *valida* or *I. engelmannii* var. *caroliniana*. Although these two varieties were once considered to be distinct, recent studies have concluded that they represent members of a single species now designated as *Isoetes valida*.

Details of the surface ornamentation of the megaspores are important characteristics for identification of quillwort species in. *Isoetes valida* is distinguished from Engelman's quillwort by its longer and wider leaves and megaspores with irregular or broken reticulate ridges that contrast with the very regular reticulate ridges of Engelman's quillwort (see illustrations below).

Habitat – This plant grows as a rooted submergent species in shallow water of small ponds, ditches, and stream beds.

Range – *Isoetes valida* occurs from south central Pennsylvania south along the Appalachians to northern Alabama and Mississippi. It is ranked SH (possibly extirpated) in Delaware, S1 (critically imperiled) in West Virginia and Georgia, S3 (vulnerable) in North Carolina, S1S3 in Pennsylvania, and S4 (apparently secure) in Virginia.

In Pennsylvania it is known from a few scattered sites in south central and southeastern counties.

Traditional Uses – None recorded.

Management Issues – Maintenance of water quality and quantity are the most critical issues.

References

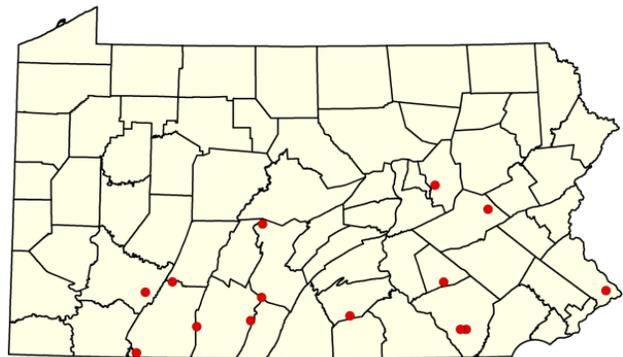
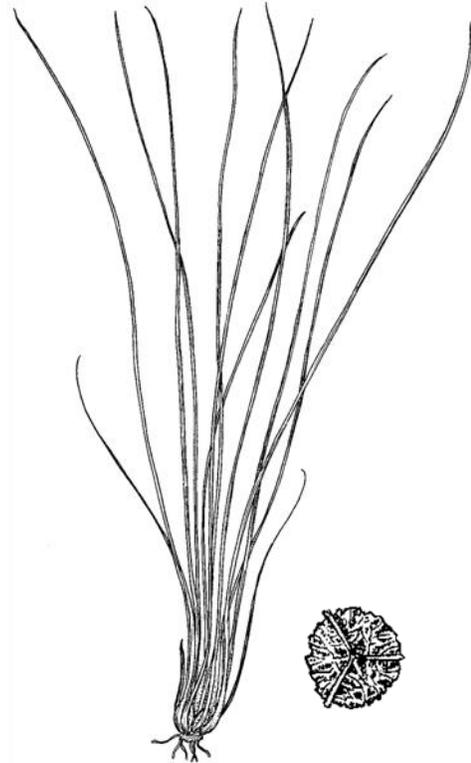
Brunton, D. F. and D.M. Britton. 1996. Taxonomy and distribution of *Isoetes valida*. *American Fern Journal* 86(1): 17-25.

Flora of North America Editorial Committee. 1993. *Flora of North America*, Vol. 2. Oxford University Press, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 25 March 2011).

NatureServe, Arlington, Virginia Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Block, T.A. and A.F. Rhoads. 2011. *Aquatic Plants of Pennsylvania*, University of Pennsylvania Press, Philadelphia, PA.



Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.

VIRGINIA-WILLOW

Itea virginica L.

Sweet-spire Family (Iteaceae)

State status S1, PX/PE

Global status G4

Description – Virginia-willow is a native deciduous shrub with slender, spreading branches; it grows to 1—2 m tall and is rhizomatous, forming large patches. The elliptical, finely-toothed leaves are arranged alternately on the twigs. Showy racemes of white flowers appear in late May to early June. The dry capsules from the previous season are visible through the winter.

Habitat – Virginia-willow grows in moist, coastal plain forest; typical associated species include fetterbush (*Leucothoe racemosa*), sweet pepperbush (*Clethra racemosa*), and sweetgum (*Liquidambar styraciflua*).

Range – Virginia-willow occurs from Pennsylvania west to Illinois and south to Florida and Texas. It is ranked S1 (critically imperiled) in Pennsylvania, S4 (apparently secure) in New Jersey, and S5 (secure) in Delaware.



In Pennsylvania, where it is at the northern limit of its natural range, Virginia-willow is known from one extant site on the coastal plain in Bucks County and a historical site along the lower Susquehanna River in Cumberland County where it was last collected in 1841.

Traditional Uses – None recorded. However, Virginia-willow is grown as a landscape ornamental and several cultivars are popular in the nursery trade.

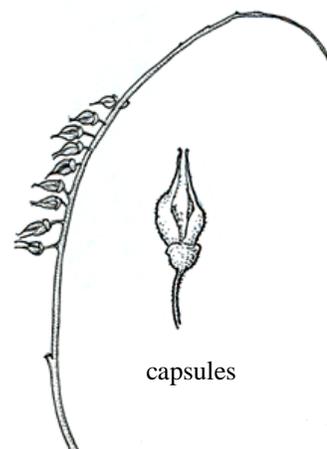
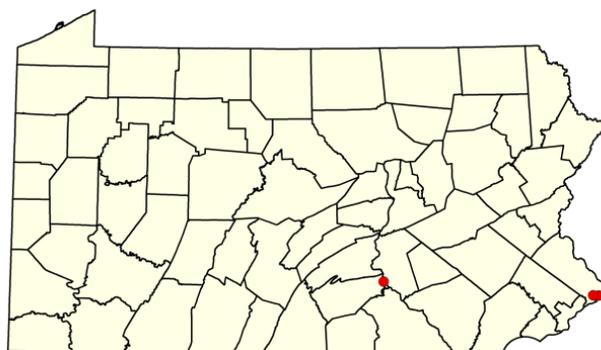
Management issues – The only known extant site for this species in the state is in a little-used part of a County Park in Bucks County. It appears to be one genetic individual which has expanded through rhizomatous growth to cover an area approximately 8 m in diameter. The most serious threat to the future of Virginia-willow in the state may be overbrowsing by deer, which inhibits regeneration and growth of seedlings.

References:

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 22 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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GRASS-LEAVED RUSH

Juncus biflorus Elliot

Rush Family (Juncaceae)

State status S2, TU/PT

Global status G5

Description - Grass-leaved rush has a slender, erect stem 0.5—1 m tall which arises from a short, knotty rhizome; its 3–4 leaves are narrow and flat or U-shaped in cross section. Flowering and fruiting take place in a branched inflorescence at the tip of the stem. The blunt seed capsules are a rich chestnut brown in color and usually occur in pairs at the ends of the inflorescence branches. The fruiting stems remain conspicuous from mid-summer to late fall.

Grass-leaved rush is classified as a variety of *Juncus marginatus* in some references [*Juncus marginatus* Rostkovicus var. *biflorus* (Elliot) Chapman], or lumped with *J. marginatus*.

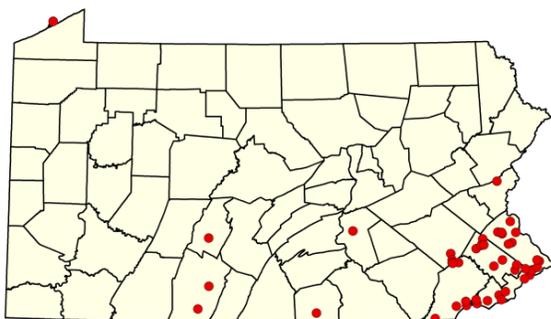


Habitat - This species grows in moist meadows or shores. It usually occurs in small, localized populations.

Range - The range of grass-leaved rush extends from Massachusetts to Ontario and south to Florida and Texas. It is ranked as S1 (critically imperiled) in New York, S2 (imperiled) in Pennsylvania and West Virginia, S4 (apparently secure) in New Jersey, and S5 (secure) in Delaware.

In Pennsylvania it occurs at only a few scattered locations in the southeastern and south-central regions of the state.

Traditional uses – No specific uses for grass-leaved rush are recorded, but many rushes were used by Native Americans for basketry and cordage.

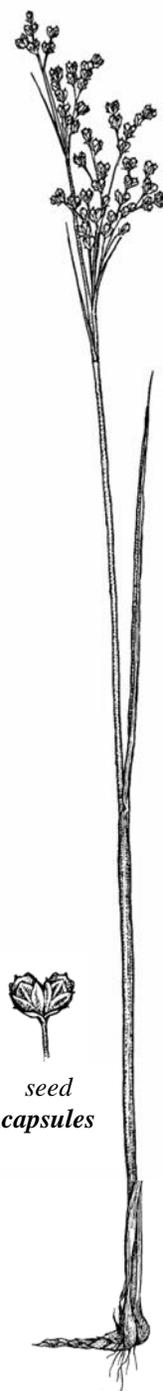


Management issues – The moist, open habitat that grass-leaved rush requires is successional. In order to persist at a given site, the species requires management to prevent succession to shrub or tree dominated conditions. Another threat is excessive mowing of roadside ditches where the plant sometimes grows.

References

- Flora of North America Editorial Committee. 2000. *Flora of North America* Vol. 22. Oxford University Press, New York, NY.
- Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011).
- NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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seed
capsules

FORKED RUSH

Juncus dichotomus Elliot
Rush Family (Juncaceae)

State status: S1, PE
Global status: G5

Description – Forked rush is an herbaceous plant with stems arising in a cluster from a crown and reaching a height of 0.5–1 m. It has narrow, channeled leaves that are shorter than the fruiting stems; the auricles are firm and rounded (see illustration below). The inflorescence is 5–7 cm long; it is subtended by an upright involucral bract. The flowers have 6 sharp-pointed tepals that surround the capsule; the tepals and capsule are of nearly the same length. The seeds are yellow-brown and lack tails or appendages.

Forked rush is very similar to path rush (*Juncus tenuis*), a very common plant of dry to moist open habitats. The two species can be distinguished by examining the ligules, which are located at the junction of the leaf sheath and the blade. The ligules of forked rush are firm and rounded, those of path rush are elongated, thin, and tongue-shaped.

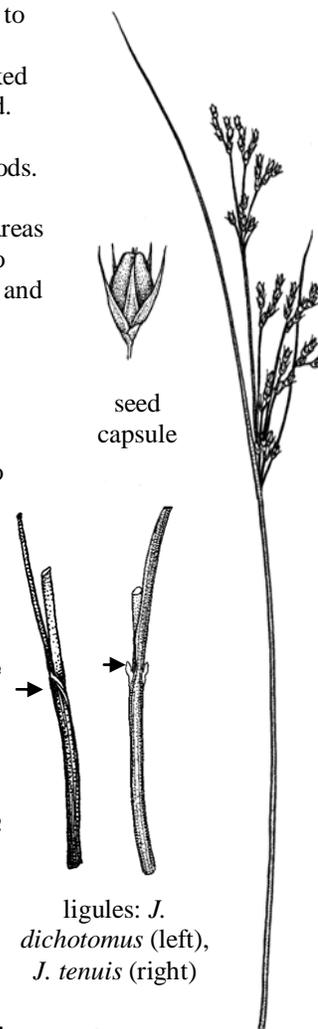
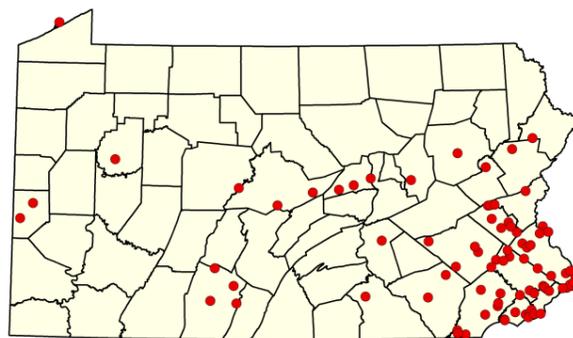
Habitat – Moist, sandy, peaty soils of old fields, ditches, wetland edges, or open woods.

Range – Forked rush is primarily a plant of the Atlantic Coastal Plain and adjacent areas ranging from Massachusetts to Florida, Texas, and Mexico. Its range also extends to Central and South America. It is ranked as S1 (critically imperiled) in Pennsylvania and West Virginia, S3 (vulnerable) in New York, and S5 (secure) in New Jersey and Delaware.

In Pennsylvania forked rush is found mainly in the southeastern counties.

Traditional Uses – No uses specific to this species are recorded; however, Native Americans gave an infusion of the very similar path rush (*Juncus tenuis*) to babies to prevent lameness. Other rush species were employed to make cordage, mats, and baskets.

Management Issues – The wet meadow habitat that forked rush requires is successional and requires periodic disturbance to prevent becoming dominated by woody plants. Another threat is excessive mowing of roadsides where the plant sometimes grows.



References:

- Flora of North America Editorial Committee. 2000. *Flora of North America* Vol. 22. Oxford University Press, New York, NY.
- Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflo.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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FETTER-BUSH, SWAMP DOG-HOBBLE
Leucothoe racemosa (L.) A.Gray
 Heath Family (Ericaceae)

State status S2S3, TU/PT
Global status G5

Description – Fetter-bush is a native deciduous shrub with slender, spreading branches that grows to 2—2.5 m tall. The elliptical, finely-toothed leaves are arranged alternately on the twigs. One-sided racemes of white, urn-shaped flowers appear in late May to early June. The dry capsules from the previous season and the buds of the coming season's flowers are visible through the winter. Some references list this plant as *Eubotrys racemosa* (L.) Nuttall.

Habitat – Fetter-bush grows in hummocky, acidic swamps and seasonally wet forests.

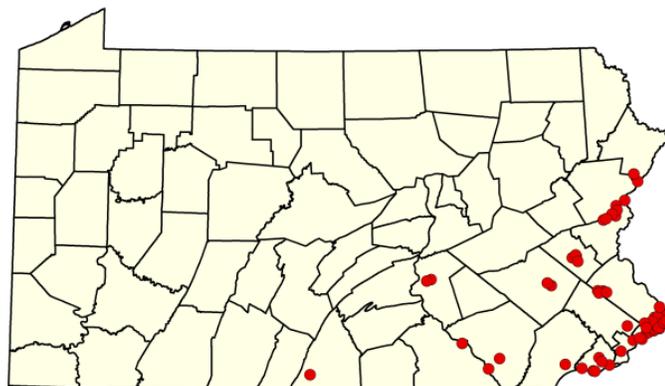
Range – Fetter-bush occurs from Massachusetts south to Florida and Texas. It is ranked S2 (imperiled) in Pennsylvania, S4 (apparently secure) in New York, and S5 (secure) in New Jersey, Delaware, and Virginia.

In Pennsylvania fetter-bush grows primarily on the coastal plain. However, there are also scattered sites in the Piedmont and the Ridge and Valley including a stand in a wet depression on the top of Blue Mountain and another along the base of the mountain on the south side in Northampton County.



Traditional Uses – None recorded.

Management issues – Two of the best coastal plain stands of fetter-bush in the state are preserved at the Delhaas Woods and Five Mile Woods Preserves in Bucks County. Other remaining native stands should be protected. The most serious threat to the future of fetter-bush in the state may be overbrowsing by deer, which inhibits regeneration and growth of seedlings. At one unprotected site off-road vehicle use is damaging the shrub layer.



References:

- Flora of North America Editorial Committee. 2009. *Flora of North America Vol. 8*. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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SANDPLAIN WILD FLAX

Linum intercursum E.P.Bicknell

Flax Family (Linaceae)

State status S1, PE

Global status G4

Description – Sandplain wild flax is an herbaceous perennial. Its stems are approximately 0.5 m tall and branch only in the inflorescence. The lower section of the stem bears numerous small, elliptical leaves in an alternate or spiral arrangement. The flowers have 5 yellow petals and 5 sepals; the fruit is a capsule. Sandplain wild flax is distinguished from several other similar *Linum* species on the basis of fruit shape; the capsule is ovoid with a rounded or pointed tip in contrast with *Linum medium*, in which the capsule is globose with a flattened top.

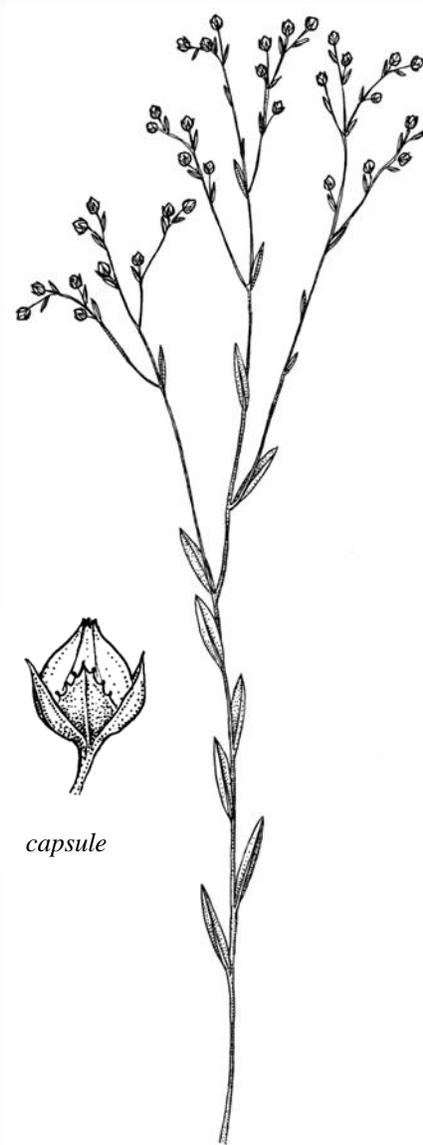
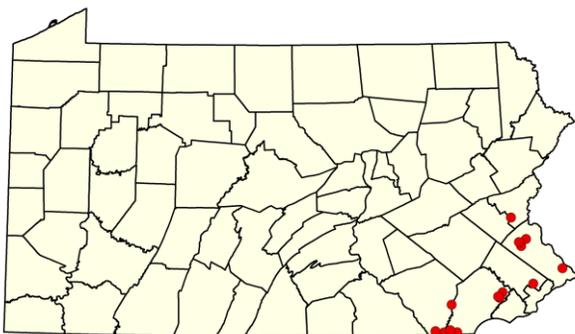
Habitat – Dry, sandy, openings or open woods.

Range – The range of sandplain wild flax extends from eastern Massachusetts and southeastern New York south to Georgia and Alabama. It is ranked SH (possibly extirpated) in Connecticut; S1 (critically imperiled) in Rhode Island, Pennsylvania, New Jersey, Delaware, and Indiana; S2 (imperiled) in New York and Maryland; S3 (vulnerable) in Massachusetts, and S4 (apparently secure) in Virginia.

Sandplain wild flax occurs at a handful of locations in the Piedmont of southeastern Pennsylvania; most of the sites are serpentine barrens or areas of diabase geology.

Traditional uses – none recorded

Management issues – Sandplain wild flax requires open conditions; succession by woody species must be retarded to maintain habitat for this species.



capsule

References

- Gleason, H.A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd edition. New York Botanical Garden, Bronx, NY.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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SOUTHERN TWAYBLADE

Listera australis Lindl.

Orchid Family (Orchidaceae)

State status S1, PE

Global status G4

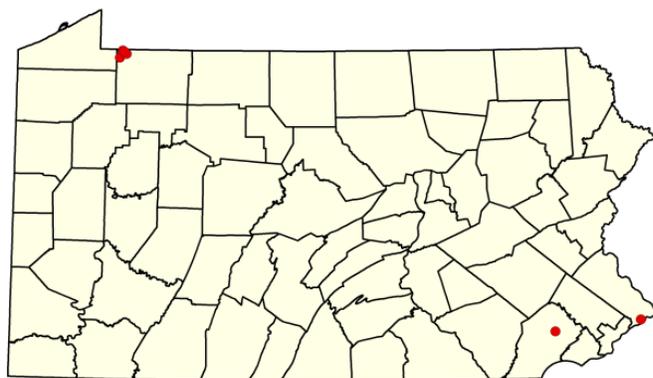
Description – Southern twayblade is one of 56 native orchids that grow in Pennsylvania. It is a small, inconspicuous plant about 10–20 cm tall with a single pair of dark green leaves and a terminal raceme of small, reddish-purple flowers. The plants bloom in late spring to early summer.

Habitat – Typical habitat for southern twayblade is low, moist woods or sphagnum bogs, often with cinnamon fern and/or royal fern.

Range – Southern twayblade occurs near the coast of eastern North America from Quebec to Florida and Texas. It is ranked S1 (critically imperiled) in Vermont, New York, Pennsylvania, and the District of Columbia; S2 (imperiled) in Quebec, New Brunswick, and New Jersey; and S3 (Vulnerable) in Delaware, Maryland, Virginia, and North Carolina. In Pennsylvania it is known from widely separated locations in the southeast and northwest. A previously unknown site was recently discovered on the coastal plain in Bucks County.

Traditional uses –None recorded.

Management issues – Sites containing this species should receive protection that includes maintenance of hydrology and buffering to secure the entire bog ecosystem.



References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 29 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/29/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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SOUTHERN BOG CLUBMOSS

Lycopodiella appressa (Chapm.) Cranfill

Lycopodiaceae (Clubmoss Family)

State status: S2, PT

Global status: G5

Description – Southern bog clubmoss is a low-growing, evergreen plant with horizontal creeping stems and upright shoots that terminate in cone-like structures where spores are produced. Both the creeping and upright stems are closely covered with small scale-like leaves.

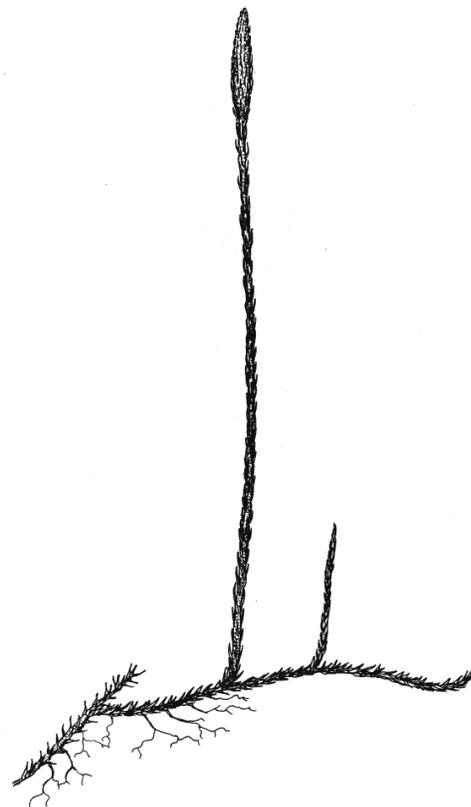
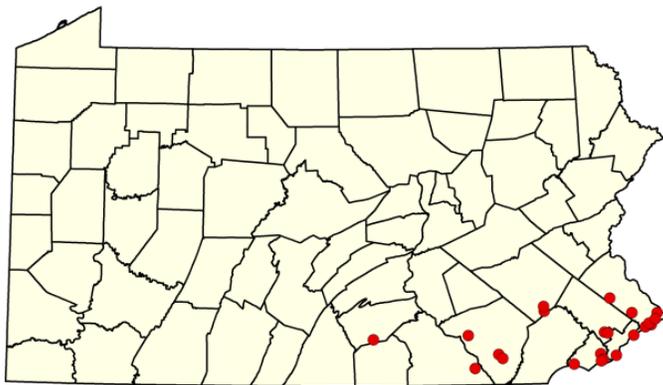
Habitat – Moist, acidic, sandy-peaty openings provide the habitat for this species. It does not compete well with taller, more vigorous plants.

Range – Southern bog clubmoss is a plant of coastal regions from Newfoundland to Florida and west to Texas, Oklahoma, and southern Missouri. It is ranked S1 (critically imperiled) in Maine, S2 (imperiled) in Pennsylvania and West Virginia, S3 (vulnerable) in Delaware, S4 (apparently secure) in New York, and S5 (secure) in New Jersey.

In Pennsylvania it was known from about 20 sites in the southeast, many of which have been destroyed or are threatened by development.

Traditional uses – none recorded

Management issues – Southern bog clubmoss requires moist, sandy, acidic openings with a minimum of competing vegetation. Nutrient enrichment is a threat because it enables invasion by more competitive species. In a few cases, where the species appeared for a few years but did not persist long term, spores may have been unintentionally introduced in sand imported for beaches at swimming areas.



References:

Flora of North American Editorial Committee. 1993. *Flora of North America*, Vol. 2. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 19 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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WATER-HOREHOUND

Lycopus rubellus L.

Mint Family (Lamiaceae)

State status S1, PE

Global status G5

Description – The water-horehounds are herbaceous perennials that grow in wet places. Their upright, generally unbranched, stems bear pairs of toothed leaves at the nodes. Tiny white flowers are produced in dense whorls at the nodes in mid to late summer through early fall. *Lycopus rubellus* is distinguished from other species of water horehound on the basis of calyx lobes that are 1-2 mm long and acuminate, but not subulate-tipped. In addition it produces long stolons and tubers.

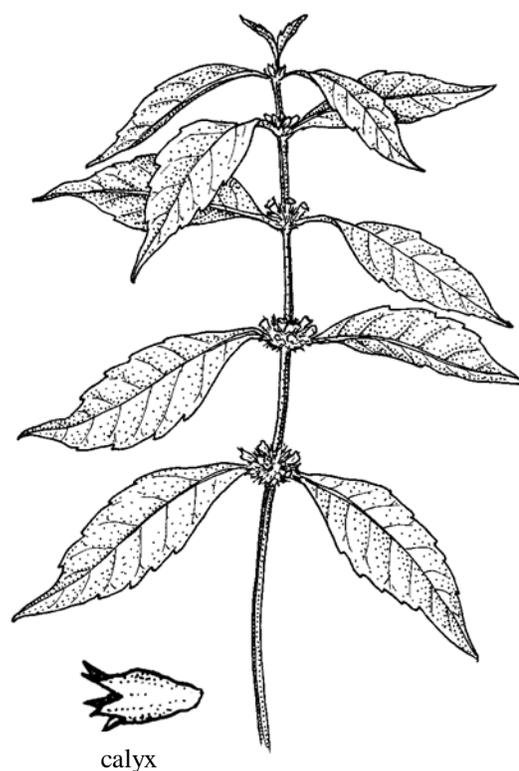
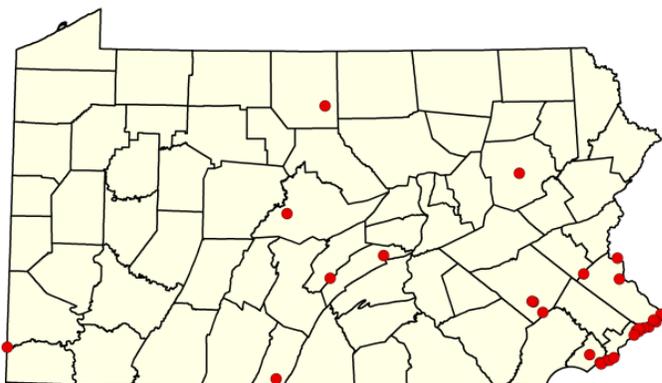
Habitat – *Lycopus rubellus* is a plant of wet shores including the upper edge of the freshwater intertidal zone where it can be found growing in crevices in the exposed roots of trees at the high tide line.

Range – The range of *Lycopus rubellus* extends from Maine to Florida and Texas, primarily on the coastal plain but also irregularly inland to southern Michigan, Illinois, Missouri and Arkansas.

In Pennsylvania *Lycopus rubellus* occurs on riverbanks, pond margins and wet ditches at scattered locations in the southern half of the state. It is present at the upper edge of the freshwater intertidal zone along the Delaware Estuary in southeastern Pennsylvania.

Traditional uses – Although there are no specific records for *Lycopus rubellus*, unspecified species of *Lycopus* were used by Native Americans, when compounded with other plants, to treat colds in children.

Management issues – Wet shores that are the habitat of water horehound are susceptible to colonization by very aggressive, non-native invasive plants including common reed (*Phragmites australis*) and Japanese knotweed (*Fallopia japonica*).



References

- Gleason, H.A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd edition. New York Botanical Garden, Bronx, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniśko, used with permission of University of Pennsylvania Press.

SWEETBAY MAGNOLIA

Magnolia virginiana L.

Magnolia Family (Magnoliaceae)

State status S2, PT

Global status G5

Description - Sweetbay magnolia is a small tree with smooth, glossy, oval-shaped leaves that persist well into the winter. Its smooth gray trunk can reach a height of 10 m or more. The undersides of the leaves are strongly whitened. Sweetbay magnolia blooms over a period of a month or more beginning in late May. The creamy white, 5–7 cm-wide flowers are extremely fragrant, with a scent that peaks in the early evening, presumably to attract late day and evening pollinators. The 5 cm-long, knobby fruits split open to release bright red seeds, which are sought by birds for the highly nutritious outer covering called an aril.



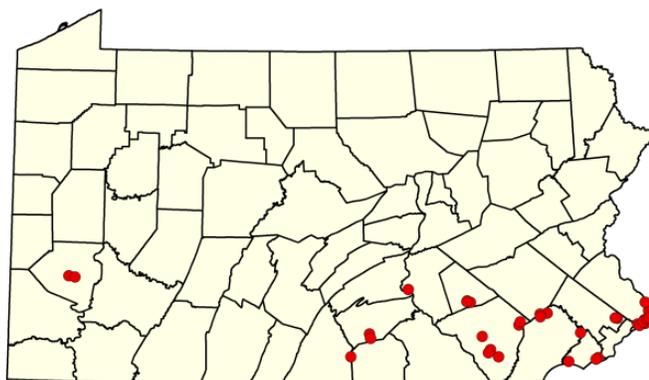
Habitat - Sweetbay magnolia grows in acidic peaty bogs or swampy woods.

Range - Pennsylvania is near the northern limit of this species, which ranges along the Atlantic and Gulf coasts from Massachusetts to Louisiana and Texas. It is ranked S1 (critically imperiled) in New York and Massachusetts, S2 (imperiled) in Pennsylvania, and S5 (secure) in New Jersey.

Sweetbay magnolia is a rare native plant in Pennsylvania where it is confined to a few scattered locations on the Coastal Plain and nearby areas of the Piedmont. Sites in southwestern Pennsylvania are likely the result of introductions.

Traditional uses - Native Americans used decoctions of leaves and twigs of sweetbay magnolia to warm the blood, and to treat chills and colds. In addition, sweetbay magnolia has long been grown as an ornamental in Europe and the United States. It was one of the earliest plants to be sent to England from the colonies, and remains a popular landscape specimen.

Management issues - Maintaining the acidic swamp conditions that provide habitat for sweetbay requires protecting the surface hydrology of the sites where it occurs. Several former sites on the Atlantic Coastal Plain have been fragmented and altered; all remaining populations should be protected. Even at protected sites, such as Delhaas Woods in Bucks County, overbrowsing by deer is inhibiting reproduction.



References:

- Flora of North America Editorial Committee. 1997. *Flora of North America*, Vol. 3. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, February 2011.

SMALL YELLOW POND-LILY

Nuphar microphylla (Pers.) Fernald

Water-lily Family (Nymphaeaceae)

State status: S1, TU/PE

Global status: G5

Description – Small yellow pond-lily is a miniature version of the more common spatterdock. The flowers are less than an inch in diameter and the floating leaf blades are approximately 2½ inches wide by 3½ inches long. This plant has been treated as a subspecies of *N. lutea* in the past, but recent molecular studies support its recognition at the species level (Padgett 1997).

Habitat – Glacial lakes and ponds and slow-moving streams provide habitat for small yellow pond-lily.

Range – Small yellow pond-lily is a plant of northeastern North America, its range extends from Nova Scotia to Manitoba and south to Pennsylvania and Illinois. It is ranked SH (possibly extirpated) in New Jersey and New Hampshire; S1 (critically imperiled) in Massachusetts, Michigan, and Pennsylvania; S3 (vulnerable) in New Brunswick and Ontario; S4 (apparently secure) in Quebec and Nova Scotia; and S5 (secure) in New York.

In Pennsylvania small yellow pond-lily is known from scattered sites in the east from Wayne County to Lancaster County and at Presque Isle.

Traditional Uses – There are no recorded uses of small yellow water-lily specifically, but Native Americans did use unspecified members of the genus *Nuphar* in several ways. An infusion of the roots was used by men as an anaphrodisiac to inhibit sexual drive. A preparation of the roots was used to treat chest pains.

Management issues – Small yellow pond-lily was recently rediscovered at a site in Bucks County in the Tohickon Creek in the vicinity of a record from the early 1900s. The small population may be subject to depredation by boaters who view the plant as an impediment. It may have been planted at one or more sites, at one site in Pike County it occurs with *Trapa natans*, the invasive, non-native European water-chestnut. The largest known population is at a natural glacial lake in Wayne County where a summer camp was operated for many years.

References

- Flora of North America Editorial Committee. 1997. *Flora of North America* Vol.3 Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Padgett, Donald J. 1997. A biosystematic monograph of the genus *Nuphar* Sm. (Nymphaeaceae). PhD Dissertation, University of New Hampshire.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, February 2011. Drawing by Anna Aniřko, used with permission of University of Pennsylvania Press.



CLUSTERED BLUETS

Oldenlandia uniflora L. [synonym: *Hedotis uniflora* (L.) Lam.]

Madder Family (Rubiaceae)

State status S1, N/PE

Global status G5

Description – Clustered bluets is an herbaceous annual, 10–50 cm tall; it typically has numerous spreading or prostrate branches. The leaves are simple, opposite, sessile, and hairy on the margins and the midvein. Small white flowers are produced in terminal and axillary clusters; they are 4-merous and have radial symmetry. The fruit, which develops from an inferior ovary, is a capsule with 4 persistent calyx lobes. It produces numerous tiny seeds.

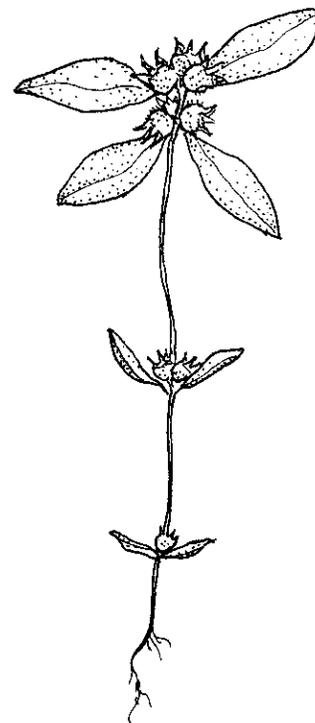
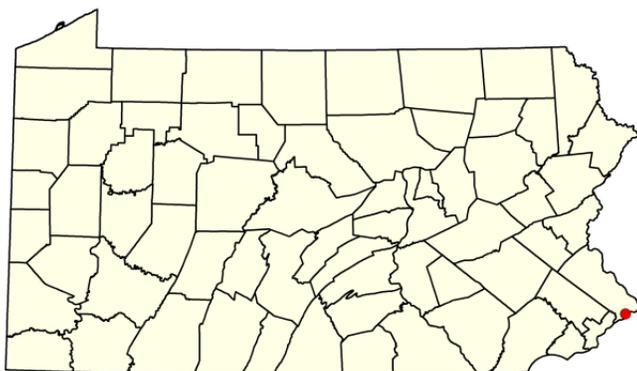
Habitat – Moist sandy, open soils of the coastal plain provide habitat for clustered bluets.

Range – The range of clustered bluets extends from Long Island, New York west to Missouri and south to Florida and Texas. It is ranked S1 (critically imperiled) in New York, Kentucky, and Missouri; S2 (imperiled) in North Carolina; S3 (vulnerable) in New Jersey and Maryland; and S4 (apparently secure) in Delaware and Virginia.

This plant has only recently (2008) been found in southeastern Pennsylvania. It was not unexpected as clustered bluets is known from southeastern New York, New Jersey, and Delaware. Here it is known from a single site on the Atlantic Coastal Plain where it grows in a powerline right-of-way.

Traditional uses – None recorded.

Management issues – Clustered bluets require areas of moist open soil with minimal competition. Right-of-way maintenance results in appropriate habitat at the Delhaas Woods Preserve in Bucks County.



References

- Gleason, H.A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd edition. New York Botanical Garden, Bronx, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 6 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawing by Anna Aniřko.

SOUTHERN ADDER'S-TONGUE***Ophioglossum vulgatum* L.****Ophioglossaceae (Adder's-tongue Family)****State status: S4, PX/SP****Global status: G5**

Description – Southern adder's-tongue is a small plant not more than 12–16 cm tall with a single leaf and an erect spore-bearing stalk. It comes up in late April or early May, and typically becomes dormant by mid-summer. It is known as *Ophioglossum pycnostichum* (Fernald) Löve & Löve in some manuals.



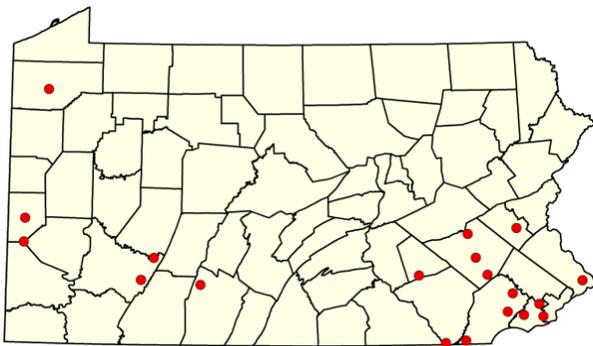
Southern adder's-tongue just coming up in early May, fertile stalk not yet fully elongated.

Habitat – Southern adder's-tongue is a plant of moist to dry open woods and floodplains.

Range – The range of southern adder's-tongue encompasses the southeastern United States from Pennsylvania and New Jersey to Georgia, Louisiana, and Texas. It is ranked as S1 (critically imperiled) in New Jersey and Michigan, S2 (imperiled) in Delaware, S4 (apparently secure) in Pennsylvania, and S5 (secure) in West Virginia and Virginia.

In Pennsylvania it has been documented at a cluster of sites in the southeast and a few additional locations to the west. Recent collections are from Bucks, Berks, and Chester Counties.

Management issues – Hydrology appears to be the most critical environmental factor in maintaining habitat for southern adder's-tongue fern.

**References**

- Flora of North America Editorial Committee. 1993. *Flora of North America*, Vol. 2. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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EASTERN PRICKLY-PEAR CACTUS

Opuntia humifusa (Raf.) Raf.

Cactus Family (Cactaceae)

State status: S1, PR

Global status: G5

Description – Eastern prickly-pear cactus is a low-growing, sprawling shrub. The fleshy, flattened, jointed stems bear spines (modified leaves) and glochids (modified bristles). Handle with care, the glochids can be very irritating if they become imbedded in your skin! Showy yellow flowers are produced in mid-summer and are followed by brownish-red fruits (prickly-pears) that are edible.

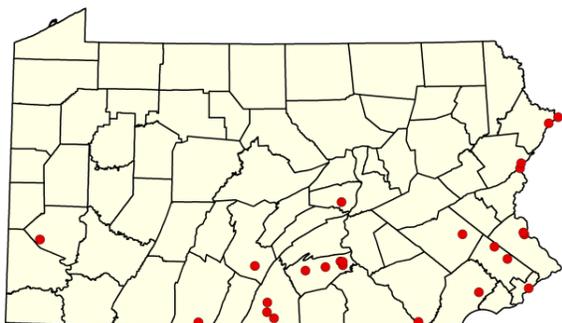
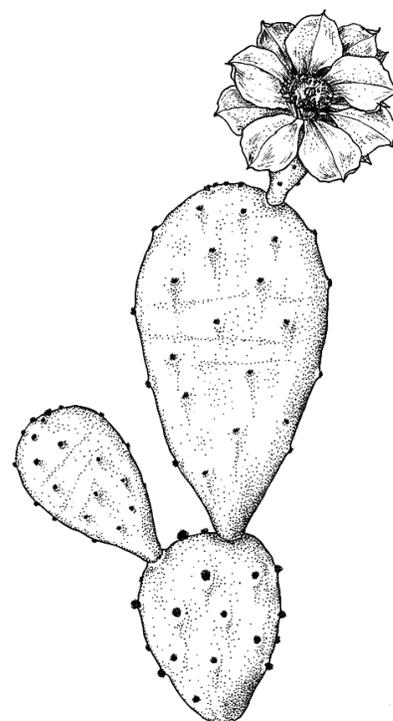
Habitat – South- or east-facing shaly cliffs and barrens provide habitat for eastern prickly-pear in Pennsylvania.

Range – Eastern prickly-pear cactus is a plant of eastern North America from Ontario to Michigan and south to Florida and Texas. It is ranked S1 (critically imperiled) in Ontario, Massachusetts and Rhode Island; S3 (vulnerable) in Connecticut, Pennsylvania, and Ohio; and S4 (apparently secure) in New York and West Virginia.

In Pennsylvania it occurs at scattered sites along the Delaware River and across the southern half of the state.

Traditional Uses – The fruits of prickly-pear were dried by Native Americans for winter use. The stems (“pads”) were also used as food when more desirable products were unavailable. In addition, cut pads were employed as poultices to treat snakebite and other wounds.

Management issues – Rock climbers could pose a threat to this species at some sites. Eastern prickly-pear cactus is also grown as a landscape ornamental. At one site in southeastern Pennsylvania a naturalized population has become established in an abandoned quarry where garden refuse was dumped.



References

- Flora of North America Editorial Committee. 2003. *Flora of North America* Vol. 4, Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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GOLDENCLUB
Orontium aquaticum L.
 Arum Family (Araceae)

State status S4, PR/SP
Global status G5

Description - Goldenclub is an aquatic plant in the same family as Jack-in-the-pulpit and skunk-cabbage. In May its bright yellow flowering stems are densely covered with small flowers. The fruit is a fleshy, pea-like structure with a single seed. The bluish green, elliptic leaves of goldenclub, which extend above the lake or pond surface, shed water and so appear dry at all times.

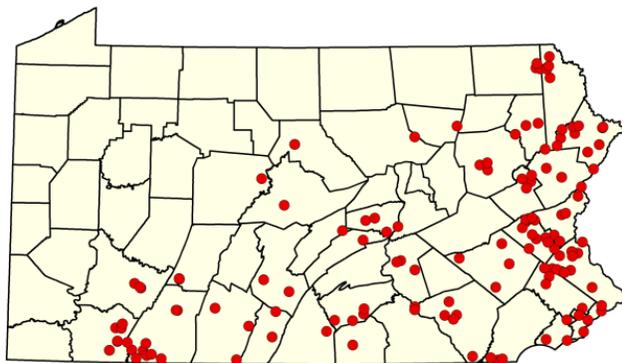
Habitat - Found in shallow water of lakes, ponds, swamps and slow-moving streams, goldenclub grows rooted in the bottom in sandy to mucky conditions. The leaves and flowering stems extend above the water surface or may be partially submerged or floating.

Range - Primarily a plant of the coastal plain, goldenclub extends from Massachusetts to Texas and irregularly inland. It is classified as S1 (critically imperiled) in Massachusetts and Rhode Island, S2 (imperiled) in New York, S3 (vulnerable) in Connecticut and West Virginia, and S4 (apparently secure) in Pennsylvania, New Jersey, and Delaware.

In Pennsylvania goldenclub occurs primarily south of a diagonal line drawn between the northeastern and southwestern corners of the state. It has disappeared from former locations in several southeastern counties.

Traditional Uses - Native Americans ate the thick, starchy roots and seeds.

Management Issues - Good water quality and appropriate year-round water levels are important factors in maintaining healthy populations of goldenclub. Deer browsing, and possibly grazing by waterfowl, are problems at some sites. It has been recommended that the status of goldenclub be changed from rare to watch list due to the number of large populations currently known in the state.



References:

- Flora of North America Editorial Committee. 2000. *Flora of North America*, Vol. 22. Oxford University Press, New York.
- Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

GINSENG

Panax quinquefolius L.

Ginseng Family (Araliaceae)

State status: S4, PV

Global status: G3

Description – Ginseng is a perennial, herbaceous plant that dies back to the root crown in the winter. Full-grown ginseng plants can be 0.3–0.6 m tall, with a single whorl of up to 4 palmately compound leaves, each with 5 leaflets. In mid to late June a single cluster of small greenish flowers arises from the angle formed by the leaf stalks; the flowers are followed in September by a cluster of red berries. Immature plants have only 1 or 2 compound leaves and are proportionally smaller.

Habitat – Ginseng is a plant of rich deciduous forests.

Range – The range of ginseng extends from Quebec to North Dakota and south to Georgia, Louisiana, and Oklahoma. It is ranked S2 (critically imperiled) in New Jersey and Delaware, S3 (vulnerable) in New York, Maryland and West Virginia, and S4 (apparently secure) in Pennsylvania. It occurs throughout Pennsylvania, but has declined greatly in abundance due to over-harvesting (see box below), and overbrowsing by deer.



Traditional Uses – Ginseng roots have long been sought for their purported medicinal value and use as an aphrodisiac. In the 1700s and 1800s huge amounts of ginseng (or “sang”) were collected from Pennsylvania and shipped to China (see box below).

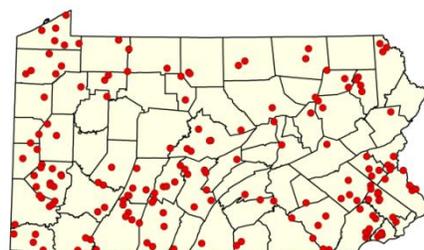
Management Issues – The export of ginseng is regulated by the Convention on International Trade in Endangered Species (C.I.T.E.S.) and the U.S. Fish and Wildlife Service in a program administered in Pennsylvania by DCNR. Collection of ginseng for private use is permitted on some public and private lands; however, permit requirements to harvest on public land are currently under review. Overbrowsing by deer has a strong negative effect on ginseng populations by a study conducted in West Virginia (McGraw and Furedi 2005).

Johan David Schoepf provides the following account from the Laurel Highlands of Pennsylvania in 1783 that illustrates the former abundance of ginseng in the state:

“A man met us who was taking to Philadelphia 500 pounds of ginseng-roots (*Panax quinquefolium* L.) on two horses. ...in these mountains the plant is still common, but in the lower parts it has pretty well disappeared. It grows in not too rich woods-earth from Canada down to North and South Carolina. Much is brought in to Fort Pitt. Industrious people who went out for the purpose have gathered as much as 60 pounds in one day. Three pounds of fresh make one pound of the well dried. ...The physicians in America make no use of this root; and it is an article of trade only with China.”
Schoepf, Johan David. Travels in the Confederation 1783-1784.

References

- McGraw, J.B. and M.A. Furedi. 2005. Deer browsing and population viability of a forest understory plant. *Science* 307: 920-922.
- Moerman, Daniel E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A. F. and T. A. Block. 2007. *The Plants of Pennsylvania, an Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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LONG-LEAVED PANIC GRASS

Panicum longifolium Torr.

Grass Family (Poaceae)

State status: S1, TU/PE

Global status: G4

Description – Long-leaved panic grass is a perennial grass with stems up to 1 m tall; the stem and leaf bases are somewhat flattened. The inflorescence is a panicle about 20 cm long. The spikelets are slender, 2.5–3 mm long and contain a single floret. The ciliate ligule is an important feature for identification (see illustration below). Long-leaf panic grass is a C4 (warm season) grass that flowers and fruits from August through October.

Panicum longifolium is considered a subspecies of *Panicum rigidulum* by some authors [*Panicum rigidulum* Torr. ssp. *pubescens* (Vasey) Lelong] (USDA Plants 2011).

Habitat – Long-leaved panic grass grows in seasonally wet, sandy, peaty soils. At Delhaas Woods Preserve in Bucks County it is abundant in the powerline right-of-way where it grows with other rare coastal plain rarities including *Sisyrinchium atlanticum*, *Viola brittoniana*, *Rhexia mariana*, *Adnropogon glomeratus*, and *Dichanthelium spretum*.

Range – This is a plant of the eastern United States from New Hampshire, and Michigan south to Florida and Texas. It is ranked S1 (critically imperiled) in Pennsylvania, S4 (apparently secure) in New Jersey and North Carolina, and S5 (secure) in Virginia. In Pennsylvania it is known from a few sites on the Atlantic Coastal Plain and several other scattered locations across the southern part of the state.

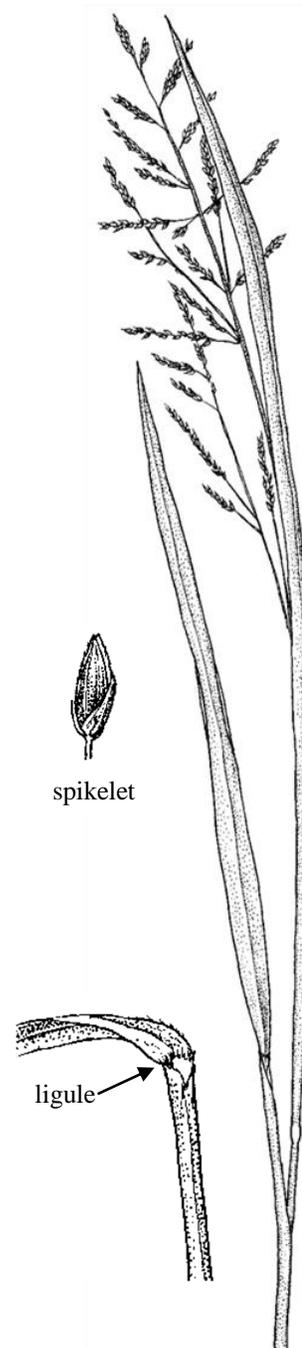
Traditional Uses – None recorded.

Management issues – Preventing succession by woody species is an important element of habitat management for this species.



References:

- Flora of North America Editorial Committee. 2003. *Flora of North America* Vol. 25. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 2/23/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.
- USDA, NRCS. 2011. The PLANTS Database (<http://plants.usda.gov>, 24 February 2011). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.



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SWAMP LOUSEWORT

Pedicularis lanceolata Michx.

Broom-rape Family (Orobanchaceae)

State status: S3, N/PE

Global status: G5

Description – Swamp lousewort is a short-lived herbaceous perennial. Like other members of its genus it is a hemiparasite, meaning that although it is green and photosynthetic, it also parasitizes the roots of other green plants. Its mostly unbranched stems grow to a height of 0.6–0.8 m; the leaves are opposite and pinnately lobed. Yellowish-white, snapdragon-like flowers appear at the top of the stem in August or September; they are followed by seed capsules that dry and split open at maturity to release the seeds.

Pedicularis and several other parasitic or hemiparasitic genera were traditionally included in the snapdragon family (Scrophulariaceae) but molecular data support including them in the Orobanchaceae. They attach to their host plants by means of modified roots known as haustoria.

Habitat – Swamp lousewort grows in moist or wet sites on diabase or limestone-derived soils in semi-open conditions. It can parasitize a wide range of herbaceous plants.

Range – The natural range of swamp lousewort extends from Ontario and Manitoba south to Arkansas, Georgia, and North Carolina. It is ranked as S1 (critically imperiled) in Pennsylvania and Maryland; S2 (imperiled) in Connecticut, New York, and West Virginia; and S3 (vulnerable) in New Jersey.

In Pennsylvania it is known from the diabase region in the southeast and scattered locations in the west.

Traditional Uses – Young shoots of swamp lousewort were eaten by the Iroquois as a cooked green vegetable.

Management Issues – Regular natural or man-made disturbance is necessary to maintain the moist, semi-open conditions that provide habitat for swamp lousewort.

References:

Gleason, Henry A., and Arthur Cronquist. 1991. *Manual of the Vascular Plants of Northeastern United States and Adjacent Canada*, second edition. New York Botanical Garden, Bronx, NY.

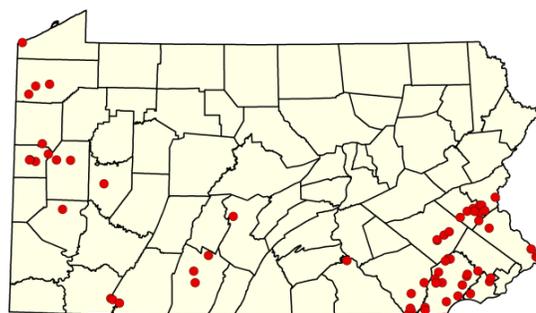
Judd, W.S., C.S. Campbell, E.A. Kellogg, P.F. Stevens, and M.J. Stevens. 2008. *Plant Systematics*, 3rd edition. Sinauer Associates, Inc, Sunderland, MA.

Moerman, Daniel E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A. F. and T. A. Block. 2007. *The Plants of Pennsylvania, an Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011.

DOWNY PHLOX

Phlox pilosa L.

Phlox Family (Polemoniaceae)

State status: S1-S2, TU/PE

Global status: G5

Description – Downy phlox is an herbaceous perennial to 0.2–0.3 m tall. The erect stems bear pairs of narrow leaves and a cluster of pink flowers at the tip. All parts of the plant, including the floral tube and calyx, are hairy. The flowers are followed by a 3-parted capsule surrounded by the persistent sepals. Flowering occurs from late May to early June. When they are not in flower, downy phlox plants are very difficult to find. They disappear completely by late June after the seeds are shed.

Habitat – Downy phlox grows in moist, open meadows, open woods, and edges. In Pennsylvania it is limited to diabase or limestone-derived soils where it frequently grows with Mead’s sedge (*Carex meadii*), another Midwestern prairie plant.



Range – Downy phlox is primarily a mid-western prairie plant; its range extends from Ontario and Manitoba south to Texas and Florida. It is widespread and secure in the center of its range in Iowa, but ranked as S1 (critically imperiled) in Pennsylvania and Maryland, S2 (imperiled) in Virginia, and S3 (vulnerable) in North Carolina. In Pennsylvania downy phlox occurs only in the southeastern corner of the state.

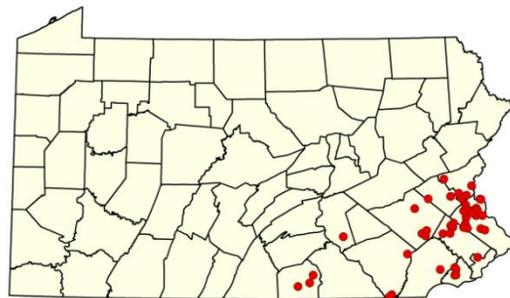
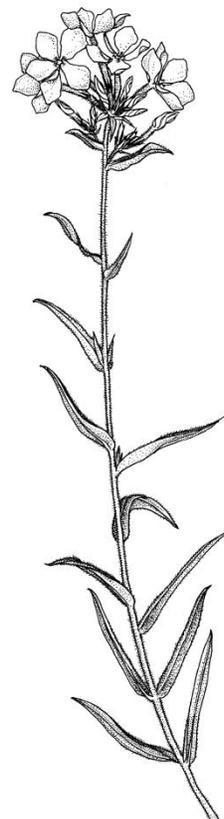
Traditional Uses – Downy phlox was used medicinally by Native Americans in the form of an infusion of the leaves that was taken to purify the blood, and also as a wash to treat eczema. A preparation containing the root was employed as a “love medicine”.

Management Issues – Downy phlox is one of several Midwestern prairie species that are found in Pennsylvania. These species require open habitat, high moisture, and soils that are high in calcium and/or magnesium. These sites would succeed to forest in the absence of human intervention; many are former pastures. A single annual mowing will control invasion by woody plants.

References

Gleason, Henry A., and Arthur Cronquist. 1991. *Manual of the Vascular Plants of Northeastern United States and Adjacent Canada*, second edition. New York Botanical Garden, Bronx, NY.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 2/20/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawing by Anna Aniśko, used with permission of University of Pennsylvania Press.



AUTUMN BLUEGRASS
Poa autumnalis Muhl. Ex Elliott
 Grass Family (Poaceae)

State status: S1, PE
Global status: G5

Description – Autumn bluegrass is tufted perennial grass with leaves crowded near the base. The erect flowering stem bears a branched inflorescence that is less than 25 percent of the total height of the plant. The spikelets contain 4–6 florets. Despite its common name, autumn bluegrass is a cool season (C3) grass; its period of active growth is mid-May through early June.

Habitat – Autumn bluegrass is a plant of moist, often alluvial, woodlands.

Range – This native grass occurs from Pennsylvania west to Michigan and Illinois and south to Florida and Texas. It is ranked SH (possibly extirpated) in New Jersey, S1 (critically imperiled) in Pennsylvania, S4 (apparently secure) in Delaware, and S5 (secure) in Virginia and Kentucky.

In Pennsylvania autumn bluegrass, which is at its northern limit of range, is limited to a few sites in the southeastern corner of the state.

Traditional Uses – None recorded.

Management Issues – This species grows in successional or alluvial woods suggesting that periodic disturbance is beneficial. However, a serious threat is non-native, invasive species that also thrive on disturbance.



References

- Flora of North America Editorial Committee. 2007. *Flora of North America* Vol. 24. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 24 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2009. www.paflora.org, accessed 3/18/2011.
- Rhoads, A. F. and T. A. Block. 2007. *The Plants of Pennsylvania*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.
- USDA, NRCS. 2010. The PLANTS Database (<http://plants.usda.gov>, 2 October 2010). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Fact sheet prepared by Ann F. Rhoads and Timothy A. Block, Morris Arboretum of the University of Pennsylvania, March 2011. Drawings by Anna Aniško, used with permission of University of Pennsylvania Press.

NUTTALL'S MILKWORT
Polygala nuttallii Torrey & A.Gray
 Milkwort Family (Poygalaceae)

State status **S3, N/PE**
 Global status **G5**

Description – Nuttall's milkwort is an herbaceous annual with an erect, unbranched stem to 20—40 cm tall. The milkworts were named for their milky sap. The pinkish flowers are in a slender raceme 5—6 mm thick.

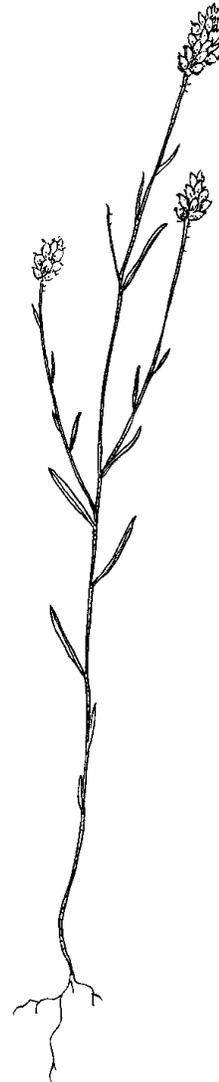
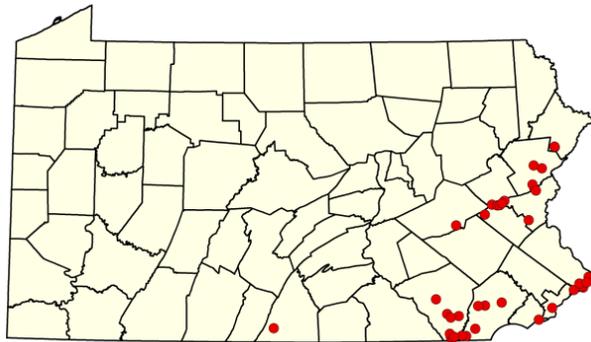
Habitat – Open woods, peaty thickets and sphagnum bogs are habitat for Nuttall's milkwort.

Range – The range of Nuttall's milkwort extends from New York and Massachusetts south to Florida and Mississippi. It is ranked S1 (critically imperiled) in Connecticut; S2 (imperiled) in Rhode Island and North Carolina; S3 (vulnerable) in Massachusetts, New York, and Pennsylvania; and S4 (apparently secure) in New Jersey, Delaware, and Virginia.

In Pennsylvania it occurs primarily in the east from Lancaster County north to Monroe County.

Traditional uses – none recorded

Management issues – Nuttall's milkwort requires a moist, peaty substrate with minimal competition. At one site it is growing in a powerline right-of-way where the growth of woody vegetation is actively suppressed.



References

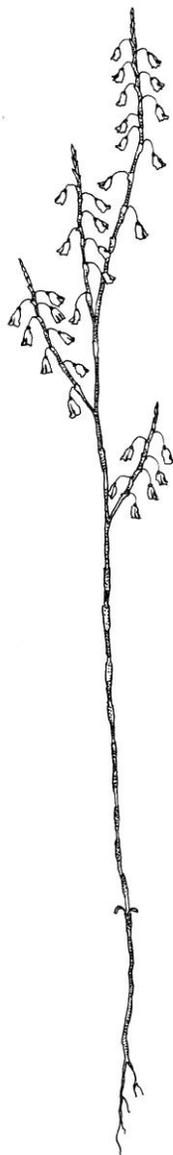
- Gleason, H.A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd edition. New York Botanical Garden, Bronx, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 6 March 2011).
- NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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JOINTWEED

Polygonella articulata (L.) Meisn.
Smartweed Family (Polygonaceae)

State status S1, TU/PE
Global status G5



Description - Jointweed is a slender annual with a wiry stem about 25–50 cm tall. It is lightly branched and has narrow leaves that fall early leaving a leafless stem at flowering time. The flowers are small and white or pinkish; they hang from slender stalks that protrude from floral bracts. The bracts give the stem a jointed appearance. Flowering occurs in September and October.

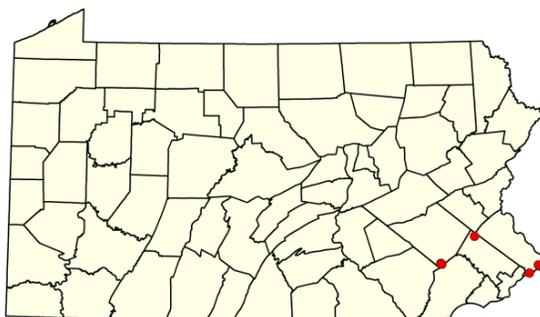
Habitat - Jointweed is a plant of dry, open, sandy, acidic soil.

Range - Jointweed occurs from Quebec and Ontario south to North Carolina, mostly on the coastal plain. It is also found on the shores of the Great Lakes and on inland sand dunes in the region of Minnesota to southern Illinois. It is ranked as S1 (critically imperiled) in Pennsylvania, S4 (apparently secure) in New York and Delaware, and S5 (secure) in New Jersey and Maryland.

In Pennsylvania it is currently known from only a few sites on the Atlantic Coastal Plain in Bucks County where it grows on old dredge spoil deposits along the Delaware River.

Traditional Uses - None recorded.

Management issues - This plant will only persist if areas of dry, open, sandy, acidic soils are available. It cannot compete with invasive, non-native plants such as common reed (*Phragmites australis*) or Japanese knotweed (*Fallopia japonica*).



References:

- Flora of North America Editorial Committee. 2005. *Flora of North America*, Vol. 5. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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SPOTTED PONDWEED

Potamogeton pulcher Tuck.

Pondweed Family (Potamogetonaceae)

State status: S1, PE

Global status: G5

Description – Spotted pondweed is an aquatic plant with both submersed and floating leaves. Submersed leaves are lanceolate and 1–3 cm long, the associated stipules are free from the leaves. Floating leaves are broadly elliptic and somewhat heart-shaped at the base. The inflorescence is 2–4 cm long and extends above the water surface; achenes have a well-developed keel. *Potamogeton* is our largest genus of aquatic plants and identifying them to species can be challenging. Spotted pondweed has one unique characteristic, which is reflected in its common name. There are black spots on the stems and petioles.

Habitat – Shallow, acidic water of swamps and peaty or muddy shores.

Range – Spotted pondweed is a plant of eastern North America. It occurs from Nova Scotia to Ontario and south to Florida and Texas. It is ranked SH (possibly extirpated) in Ontario, S1 (critically imperiled) in Nova Scotia, Maine, Pennsylvania, and West Virginia; S2 (imperiled) in New York and Ohio, S3 (vulnerable) in New Jersey; S4 (apparently secure) in Virginia, and S5 (secure) in Delaware.

In Pennsylvania, spotted pondweed is known from four widely separated locations, one on the Atlantic Coastal Plain, one in the Ridge and Valley, and two on the Allegheny Plateaus Physiographic Province.

Traditional Uses – There are no recorded uses for this specific pondweed, but unspecified *Potamogeton* species were used by the Iroquois in witchcraft medicine.

Management Issues – Water quantity and quality are the most critical elements in the maintenance of habitat for spotted pondweed.

References

Flora of North America Editorial Committee. 2000. *Flora of North America* Vol. 22. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 25 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org, accessed 3/18/2011.

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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PROSTRATE SAND CHERRY

Prunus pumila L.var. *depressa* (Pursh) Bean
Rose Family (Rosaceae)

State status S1, N/PE
Global status G5T4

Description - Prostrate sand cherry is a mat-forming, deciduous shrub that spreads widely but grows less than a foot tall. Its woody horizontal branches extend out from a short trunk to a distance of 2—3 m; short erect branches bear alternate, bluish-green leaves that are broader toward the tip than the base. The flowers are white; ripe cherries are about 1 cm in diameter and dark red.

Habitat - Gravelly or sandy beaches and shores provide the habitat for prostrate sand cherry, a plant that has evolved a low, creeping growth habit in response to frequent scouring by ice and flood waters. Prostrate sand cherry appears to be declining at the southern edge of its range, perhaps due to reduced ice-scouring caused by a trend toward milder winters. Without the scouring effect, competing vegetation in the form of upright trees, shrubs, and vines dominate the river shorelines and island areas that might otherwise provide habitat for sand cherry.

Range - Prostrate sand cherry is a northern species; it grows from Quebec, New Brunswick, and Ontario south to Pennsylvania. It is ranked S1 (critically imperiled) in Pennsylvania, New Jersey, and West Virginia; S2 (imperiled) in New York, New Hampshire, and Massachusetts; S3 (vulnerable) in Quebec, and S4 (apparently secure) in New Brunswick and Ontario.



In Pennsylvania it occurs along the northern portions of the Delaware and Susquehanna Rivers. It was collected on Treasure Island in Bucks County in 1992 and on Lynn Island in 1887, but Raubs and Whipoorwill Islands in Northampton County are as far south as significant stands are known today. A vigorous population is present on Whipoorwill Island in a big bluestem - Indian grass river grassland natural community.

Traditional Uses - Native Americans harvested the fruit of sand cherry for eating fresh or drying for the winter.

Management Issues - Camping and picnicking areas on the islands should be sited away from the remaining stands of sand cherry.

References

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 6 March 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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COMMON HOP-TREE, WAFER-ASH

Ptelea trifoliata L.

Rue Family (Rutaceae)

State status S2, PT

Global status G5

Description - Common hop-tree is a deciduous shrub or small tree with alternate, trifoliate leaves. Its flowers are greenish-white and borne in terminal clusters; both perfect and unisexual flowers are produced making the plants polygamous. Flowers have 4–5 petals and an equal number of stamens. The fruit, a samara, is flat, disk-shaped, and about 1 cm in diameter with a wing that completely surrounds the central seed cavity.

Habitat - Common hop-tree grows in moist, rich woods and thickets, usually on riverbanks, lake shores, or floodplains.

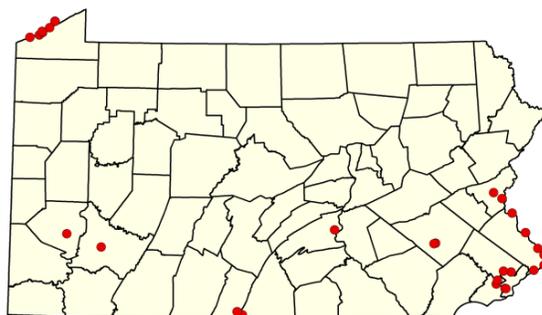
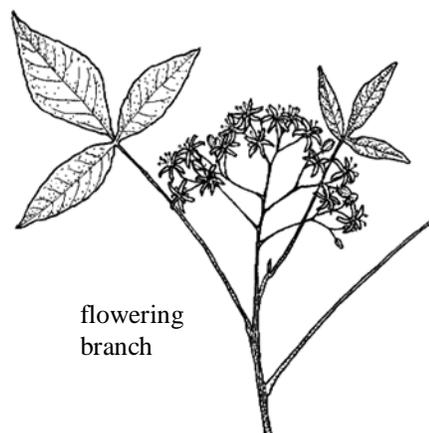
Range - A wide-ranging species, common hop-tree occurs from southern Quebec to New York, Pennsylvania, and New Jersey south to North Carolina and Florida. Its range also extends west to Ohio, Kansas and the southwestern United States and Mexico. It is ranked S1 (critically imperiled) in New York, S2 (imperiled) in Pennsylvania, and S3 (vulnerable) in Delaware and Maryland. In Pennsylvania it occurs at scattered sites in the southern half of the state, mostly along the Delaware River. It is also present along the Lake Erie shoreline in northwestern PA..

Traditional Uses - Common hop-tree was a very important medicinal plant to Native Americans; the root was considered a panacea that would cure many ailments. It was also added to other medicines to increase their potency.

Management Issues – Known populations of this species in Pennsylvania are small, sometimes only a few trees. Riparian habitats where this species is found often have competition from non-native invasive species that can further limit population size. Excessive browsing by deer is another factor that affects the species' ability to grow and reproduce.

References:

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011).
 NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 2/20/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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SOUTHERN RED OAK

Quercus falcata Michaux

Beech Family (Fagaceae)

State status S1, PE

Global status G5

Description – Southern red oak is a deciduous tree that can grow to almost 30 m in height. It has bristle-tipped leaf lobes typical of the red or black oak group. The flowers are produced as new growth begins in the spring; the male flowers are in slender, drooping catkins that eventually fall off. The female flowers become acorns, however it takes 2 years for an acorn to mature from flower to fruit in this species and others in the red or black oak group.

Habitat – Southern red oak is a tree of moist, sandy, acidic soils. It is a canopy tree in coastal plain forests and often grows with willow oak, another coastal plain species. However, southern red oak is generally found in drier, upland soils.

Range – Southern red oak ranges from southeastern New York, New Jersey, and Pennsylvania to Florida and Texas. It is ranked as S1 (critically imperiled) in Pennsylvania and S5 (secure) in New Jersey and Delaware.

In Pennsylvania it grows at several sites on the Atlantic Coastal Plain in the extreme southeastern corner of the state.

Traditional Uses - Native Americans used southern red oak to treat a variety of medicinal conditions. Bark was used to treat dysentery, it was chewed to relieve mouth sores, and infusions of bark were applied to chapped skin. Decoctions of the bark or wood were employed to treat asthma and fevers. Oak wood was also used in basketry.

Management issues - Patches of coastal plain forest that contain reproducing populations of southern red oak (trees of various ages), should be protected from further reduction or fragmentation.

References:

Flora of North America Editorial Committee. 1997.

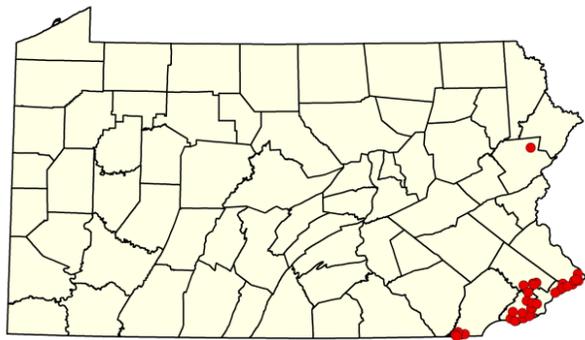
Flora of North America, Vol. 3. Oxford University Press, New York, NY.

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflo.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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BASKET OAK

Quercus michauxii Nuttall

Beech Family (Fagaceae)

State status S1, N/PE

Global status G5

Description – Basket oak is a deciduous tree that can grow to almost 30 m in height. It has rounded leaf lobes typical of the white oak group. The flowers are produced as new growth begins in the spring; the male flowers are in slender, drooping catkins that eventually fall off. The female flowers become acorns, which are borne in clusters of 2—3 on a long stalk. Acorns mature in a single year.

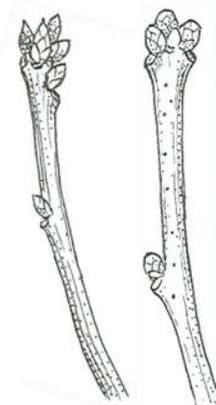
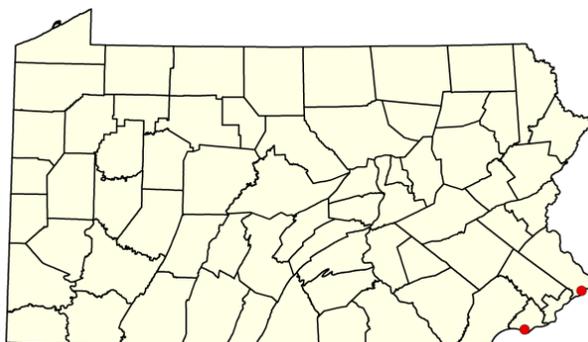
Basket oak is very similar to swamp white oak (*Quercus bicolor*), so much so that its presence in Pennsylvania was only recognized very recently. Although some manuals describe differences in the leaf pubescence, we find that the most reliable way to distinguish basket oak from swamp white oak is to look at the buds. The buds of basket oak are pointed where as those of swamp white oak have rounded tips (see illustrations below).

Habitat – Basket oak is a tree of moist, sandy woods and swamps. It is a canopy tree in coastal plain forests and often grows with willow oak, another coastal plain species.

Range – Basket oak ranges from New Jersey and Pennsylvania south to Florida and Texas. It is ranked as S1 (critically imperiled) in Pennsylvania, S3 (vulnerable) in New Jersey and S5 (secure) in Delaware. In Pennsylvania it is known at several sites on the Atlantic Coastal Plain in the extreme southeastern corner of the state.

Traditional Uses – None listed.

Management issues - Patches of coastal plain forest that contain reproducing populations of southern red oak (trees of various ages), should be protected from further reduction or fragmentation.



pointed buds of basket oak, left, rounded buds of swamp white oak, right

References:

Flora of North America Editorial Committee. 1997. *Flora of North America*, Vol. 3. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

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WILLOW OAK
***Quercus phellos* L.**
Beech Family (Fagaceae)

State status S2, PE
Global status G5

Description – Willow oak is a deciduous tree that can grow to almost 30 m in height. Unlike most oaks, it has narrow leaves about 7–10 cm long that are without lobes or teeth; it is in the red or black oak group. The flowers are produced as new growth begins in the spring; the male flowers are in slender, drooping catkins that eventually fall off. The female flowers become acorns, however it takes 2 years for an acorn to mature from flower to fruit.

Natural hybridization between willow oak and red oak (*Q. rubrum*) produces *Quercus x heterophylla* which has narrow leaves with a few irregular lobes.

Habitat – Willow oak is a tree of moist, sandy, acidic soils. It is a canopy tree in coastal plain forests. The roots are tolerant of standing water, which can occur for prolonged periods in the winter and spring at some sites.

Range – Willow oak ranges from New York, New Jersey, and Pennsylvania to Florida and Texas. It is ranked as S1 (critically imperiled) in New York, S2 (imperiled) in Pennsylvania, and S5 (secure) in New Jersey and Delaware.



In Pennsylvania willow oak grows at several sites on the Atlantic Coastal Plain in the extreme southeastern corner of the state. It is also widely planted as a street tree outside its natural range.

Traditional Uses – Native Americans made preparations of willow oak for a variety of medicinal uses. Decoctions of the bark or wood were employed to treat back or limb pains and hemorrhoids. A decoction of wood ashes was placed on the tongue to cleanse the body and strengthen a marriage. The acorns were used for food.

Management issues – Patches of coastal plain forest that contain reproducing populations of willow oak (trees of various ages), should be protected from further reduction or fragmentation.

References:

Flora of North America Editorial Committee. 1997. *Flora of North America*, Vol. 3. Oxford University Press, New York, NY.

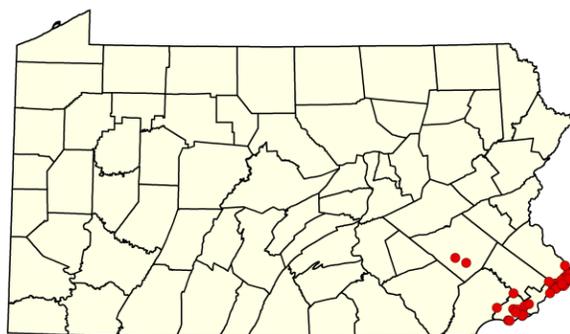
Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 18 February 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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MARYLAND MEADOW-BEAUTY

Rhexia mariana L.

Melastome Family (Melastomataceae)

State status S1, PE

Global status G5

Description – Maryland meadow-beauty is a native herbaceous perennial. It, and the very similar *Rhexia virginica*, are the only Pennsylvania members of the Melastome Family, an otherwise tropical plant group. Both species grow to 0.5 m tall and have opposite leaves. The flowers have 4 showy petals and 8 stamens each of which has a conspicuous spur-like appendage. The fruits are flask-shaped capsules. Maryland meadow beauty is distinguished by its pale pink corolla and longer hypanthium (the neck of the flask in fruit). *Rhexia virginica* has deep pink petals and a short neck on the capsule.

Habitat – Maryland meadow-beauty grows in moist, open, sandy soils of the Atlantic Coastal Plain. It and *Rhexia virginica*, which is more widespread, often grow together.

Range – Maryland meadow-beauty is a plant of the eastern United States. It occurs from Massachusetts to Michigan and south to Florida and Texas. It is ranked SX (presumed extirpated) in New York; S1 (critically imperiled) in Massachusetts, Pennsylvania, and West Virginia; S4 (apparently secure) in Kentucky; and S5 (secure) in Virginia and North Carolina.

Traditional Uses – Native Americans used leaves and stems of *Rhexia* species to prepare a brew used to clear the throat.

Management issues – The most significant stand of Maryland meadow-beauty in the state is preserved at Delhaas Woods in Bucks County. The plant is abundant in the powerline right-of-way, where the growth of woody species is suppressed. It also grows in the margin of a pond when the water level drops in mid to late summer. Maintenance of early successional conditions is critical to its continued existence.

References:

Judd, W.S., C.S. Campbell, E.A. Kellogg, P.F. Stevens, and M.J. Stevens. 2008. *Plant Systematics*, 3rd edition. Sinauer Associates, Inc, Sunderland, MA.

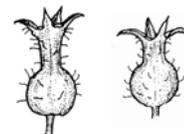
Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 28 February 2011).

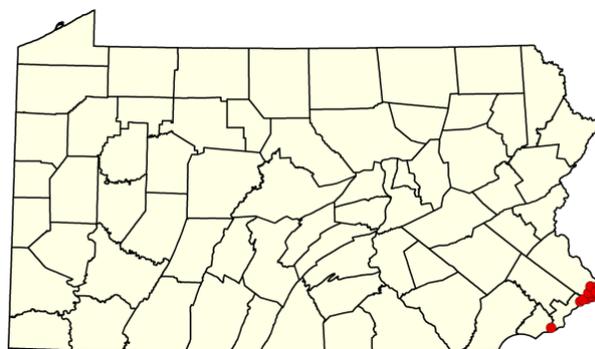
NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 1/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



fruits of *Rhexia mariana* (left) and *R. virginica* (right)



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TOOTHCUP

Rotala ramosior (L.) Koehne
Loosestrife Family (Lythraceae)

State status S3, PR
Global status G5

Description – Toothcup is an erect or prostrate annual with opposite leaves. The flowers are solitary in the leaf axils, they have 4 pink or white petals which drop quickly. The fruit (the “toothcup”) is a capsule topped by 4 persistent sepals that alternate with 4 similar-shaped appendages.

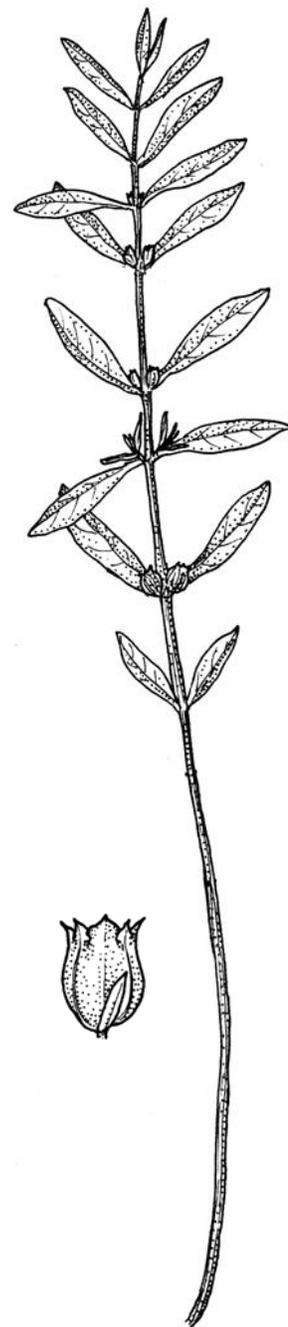
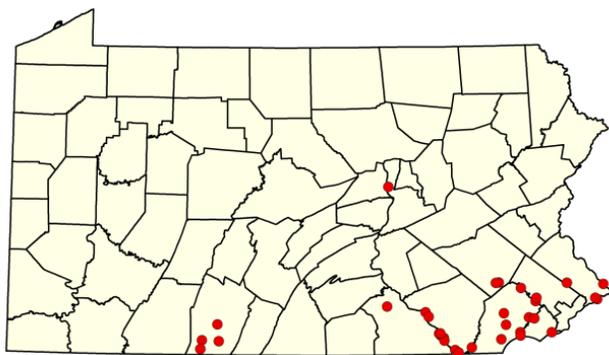
Habitat – Wet, sandy shores and other swampy, open ground including seasonal wetlands.

Range – Toothcup is a widespread plant that occurs throughout the continental United States except Nevada, New Mexico, Utah, and North Dakota, plus Ontario and British Columbia. It is ranked S1 (critically imperiled) in Vermont and Rhode Island; S2 (imperiled) in New York; S3 (vulnerable) in Pennsylvania, New Jersey, Delaware, and West Virginia; S4 (apparently secure) in Maryland; and S5 (secure) in Virginia and North Carolina.

In Pennsylvania it occurs at scattered sites across the southern tier of counties including a cluster along the lower portion of the Susquehanna River.

Traditional uses – none recorded

Management issues – Stream and pond margins with naturally fluctuating water levels are essential habitat for toothcup.



References

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
 NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 6 March 2011). NatureServe, Arlington, Virginia.
 Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
 Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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LONG-LOBED ARROWHEAD

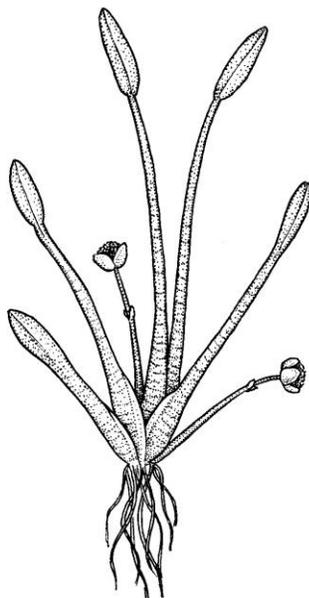
Sagittaria calycina Engelm.

Water-plantain Family (Alismataceae)

State status **S1, PE**

Global status **G5T4**

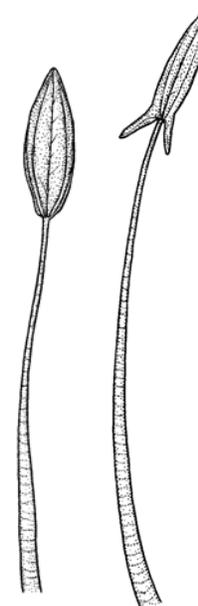
Description – Long-lobed arrowhead is an annual plant with a cluster of stalked leaves arising from the base; total height ranges from 3 to 12 inches. The leaf blades vary in shape from a small oval barely wider than the stalk, to an expanded arrowhead shape. The flowering stalk bears several whorls of flowers of which the upper are male and the lower female. As the fruits form, the stalks bend downward and the sepals clasp the developing fruit. Unlike *Sagittaria subulata*, with which it often grows, long-lobed arrowhead is not turf-forming, but rather occurs as individual plants or in twos or threes.



Habitat – This species is a plant of brackish to freshwater riverbank tidal marshes and mudflats.

Range – The range of long-lobed arrowhead extends along the east coast from New Brunswick to Maryland. It is ranked as S1 (critically imperiled) in Pennsylvania, S2 (imperiled) in Maryland, and S3 (vulnerable) in Delaware.

In Pennsylvania long-lobed arrowhead is confined to freshwater tidal marshes and mudflats along the Delaware Estuary. It was first collected in Pennsylvania in 1974 and has spread throughout the freshwater intertidal habitat in the estuary in recent years.



Traditional Uses – None reported.

Management issues – Riverbank tidal marshes must be protected from erosion from passing boats and the impact of invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*).

References

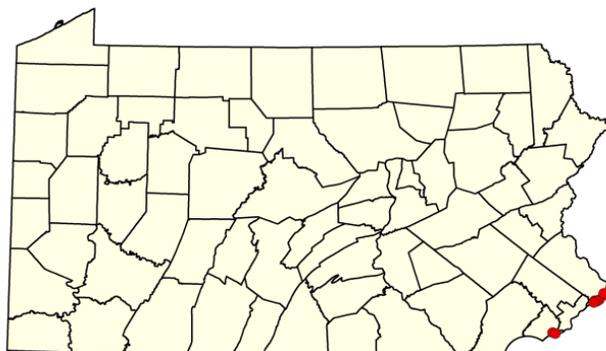
Ferren, W.R. and A.E. Schuyler. 1980. Intertidal vascular plants of river systems near Philadelphia. Proceedings of the Academy of Natural Sciences of Philadelphia 132:86-120.

Flora of North America Editorial Committee. 2000. *Flora of North America*, Vol. 22. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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SUBULATE ARROWHEAD
***Sagittaria subulata* (L.) L. Buch**
Water-plantain Family (Alismataceae)

State status S3, PR
Global status G4

Description – Subulate arrowhead is a low-growing plant with narrow leaves about 5—8 cm long. It spreads to form a turf-like carpet on the surface of tidal mudflats. It is completely inundated a high tide and exposed to the sun when the tide is low. In July flowering stems are produced and small white flowers appear. The flowers, which are shown here at low tide, are insect pollinated. At high tide they are covered by 1—2 m of water.

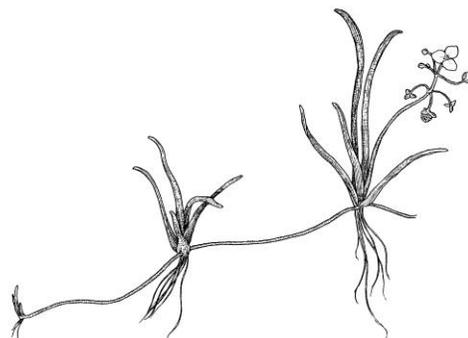
Habitat – Subulate arrowhead typically forms a loose turf in the lower portion of the riverbank tidal marsh; it frequently grows under a canopy of spatterdock (*Nuphar advena*).

Range – Subulate arrowhead occurs in coastal regions from Massachusetts to Florida and Alabama. It is ranked S2 (imperiled) in New Jersey and S3 (vulnerable) in New York, Pennsylvania, and Delaware. In Pennsylvania subulate arrowhead is confined to freshwater tidal shores and mud flats of the Delaware Estuary.



Traditional Uses – None recorded.

Management issues – Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the river, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*) are also serious threats.



References:

Flora of North America Editorial Committee. 2000. *Flora of North America*, Vol. 22. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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WATER PIMPERNEL
Samolus parviflorus Raf.
 Primrose Family (Primulaceae)

State status: S2, TU/PR
Global status: G5

Description – Water pimpernel is a short-lived perennial 10—25 cm tall. It has a basal rosette of leaves from which a slender flowering stem arises. The tiny white flowers have five petals and are followed by small rounded capsules, which split open to release tiny seeds. Immature plants may persist in the rosette stage for a year or two before flowering.

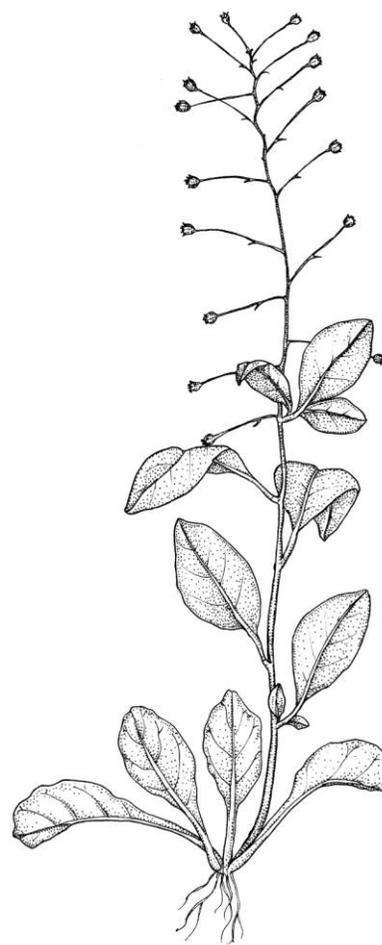
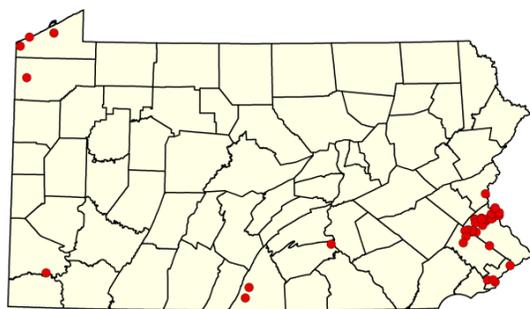
Habitat – Water pimpernel grows on brackish shores, wet meadows, and muddy stream banks; it is sometimes partially or completely submersed, especially in the rosette stage. It is shade tolerant, growing on shaded stream banks. In eastern Pennsylvania it is most often found associated with diabase geology.

Range – Water pimpernel ranges from Nova Scotia, New Brunswick, and Ontario south to Florida, across the southern United States and Mexico to California, Oregon, Washington and British Columbia. It also extends into Mexico. It is ranked as S2 (imperiled) West Virginia, S3 (vulnerable) in Pennsylvania, S4 (apparently secure) in New York, New Jersey, and Delaware.

In Pennsylvania it occurs in the diabase region of Bucks and Montgomery Counties and at widely scattered sites in south central and western counties. It has disappeared from former sites along the tidal portion of the Delaware River.

Traditional Uses – none recorded

Management Issues – As long as the forested areas on diabase remain intact and relatively free of invasive non-native species and water flow in the streams is maintained, water pimpernel should continue to thrive.



References:

- Gleason, Henry A., and Arthur Cronquist. 1991. *Manual of the Vascular Plants of Northeastern United States and Adjacent Canada*, second edition. New York Botanical Garden, Bronx, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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ROSEROOT

Sedum rosea (L.) Scop. (synonym: *Rhodiola rosea* L.)
 Stonecrop Family (Crassulaceae)

State status **S1, PE**
 Global status **G5**

Description – Roseroot is an herbaceous perennial with a thick, scaly root stock. The leaves are thick, fleshy, bluish in color, and toothed toward the tip; their arrangement on the stem is alternate. The yellowish, unisexual flowers occur at the stem tip; female flowers have a cluster of 3—5 ovaries that are joined at the base, male flowers have 8—10 stamens.

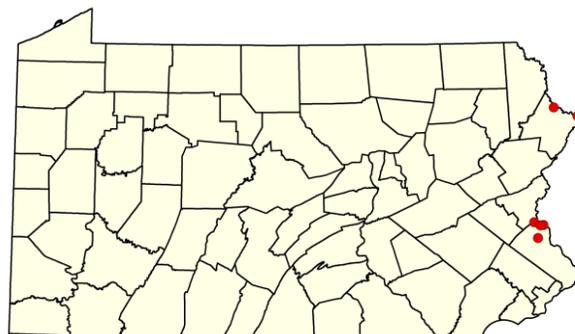
Habitat – Moist, north-facing cliffs and ledges, often near the coast, provide habitat for this plant.

Range – Roseroot sedum is an arctic-alpine species that grows in northern areas around the globe. In North America it is found along the Atlantic coast from Newfoundland and Labrador south to Maine, Pennsylvania, North Carolina, and Tennessee and also in Alaska and Greenland. Rare and local in eastern North America, roseroot is ranked SX (presumed extirpated) in North Carolina and Tennessee, S1 (critically imperiled in Vermont, New York, and Pennsylvania; S3 (vulnerable) in Quebec, New Brunswick, and Maine; and S4 (apparently secure) in Newfoundland and Nova Scotia.



In Pennsylvania roseroot is currently known at 2 locations along the Delaware River. It is considered a glacial relic, a remnant of glacial era displacement of species to the south by the advancing ice sheet, which has persisted due to favorable microclimate.

Traditional Uses – Native Americans and Eskimos used roseroot flowers to treat stomachache and tuberculosis. The roots, leaves, and stems were used for food.



Management Issues – Microhabitat very important to roseroot; Nockamixon Cliffs is a 300-foot high north-facing stretch of cliff. Water seeping out of the cliffs is an important factor in creating appropriate habitat for this northern species. The hydrology of the upland above the cliffs must be protected in order to maintain these conditions. Another concern is the potential for damage by climbers who are drawn to the cliff in the wintertime. Although the plant is dormant at that time and encased in curtains of ice, population status should be monitored to detect any damage that might occur. Climbing must not be permitted other than when ice is covering the cliff.

References:

- Flora of North America Editorial Committee. 2009. *Flora of North America*, Vol. 8. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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EASTERN BLUE-EYED GRASS
Sisyrinchium atlanticum E.P. Bicknell
 Iris Family (Iridaceae)

State status: S1, PE
Global status: G5

Description – Eastern blue-eyed grass is an herbaceous perennial. Its leaves and stems arise in tufts and are bluish in color. The leaves are The inflorescence is subtended by a sheathing bract (spathe); flowers are pale blue-violet.

Eastern blue-eyed grass could be confused with other *Sisyrinchium* species. Important characteristics include the glaucous (bluish-waxy) appearance of the stems and leaves, pedunculate spathe, and narrowly winged stem.

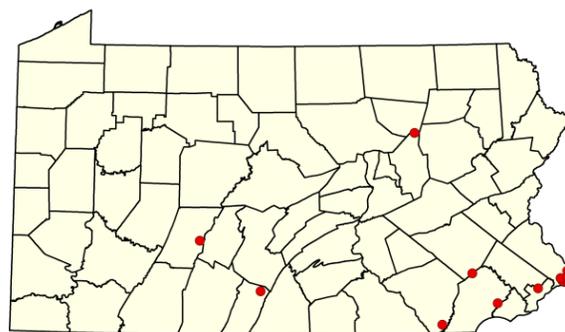
Habitat – Moist sandy, peaty soils of fields and open woods.

Range – Eastern blue-eyed grass is a plant of eastern North America. It occurs from Nova Scotia to Michigan and south to Florida and Texas. It is ranked S1 (critically imperiled) in Vermont, Pennsylvania, and West Virginia; S3 (vulnerable) in Nova Scotia and Delaware; and S4 (apparently secure) in New York, New Jersey, and Virginia.

In Pennsylvania eastern blue-eyed grass is known from the Atlantic Coastal Plain and a few other scattered sites.

Traditional Uses – Eastern blue-eyed grass was used by Native Americans to prepare a decoction used to help expel the placenta after the birth of a baby.

Management Issues – The only known extant population of this species in Pennsylvania is at Delhaas Woods Preserve in Bucks County where it grows in a powerline-right-of-way. Right-of-way maintenance that suppresses the growth of woody plants perpetuates the wet meadow habitat that eastern blue-eyed grass requires.



References:

- Flora of North America Editorial Committee. 2002. *Flora of North America* Vol. 26. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 24 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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WILD BEAN

Strophostyles umbellata (Muhl. ex Willd.) Britton
Pea or Bean Family (Fabaceae)

State status S2, N/PE
Global status G5

Description – Wild bean is a twining, herbaceous vine, its leaves are compound with 3 leaflets. The flowers are pinkish-purple and nearly an inch long. The seeds are produced in long slender, rounded pods clustered at the top of a long stalk.

Three species of wild bean (*Strophostyles helvola*, *S. leiosperma*, and *S. umbellata*) grow in Pennsylvania, and all 3 may be present at a single location. They are distinguished by leaflet shape and the size of the seeds.

Habitat – Dry sandy upland woods and fields; at one site wild bean grows at the edge of an old field thicket, twining on such plants as goldenrods and grasses.

Range – Wild bean occurs from New York to Florida and Texas, mainly on the coastal plain; it also ranges west to Indiana, Missouri and Oklahoma. It is ranked as S1 (critically imperiled) in New York, S2 (imperiled) in Pennsylvania, and S4 (apparently secure) in New Jersey and Delaware. In Pennsylvania it is known from only a few sites in the southeastern corner of the state.

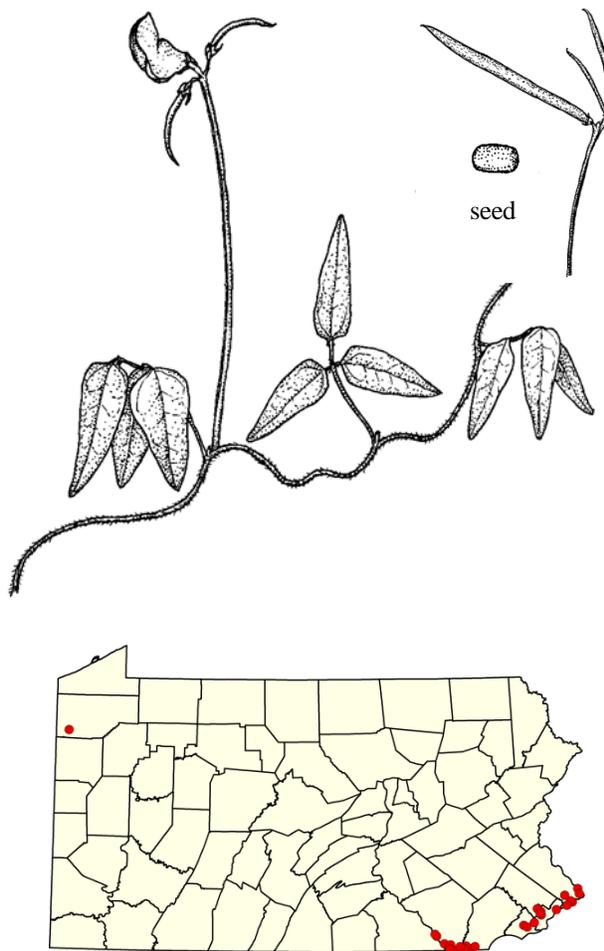
Traditional Uses – There is no record of the use of *Strophostyles umbellata* specifically, but the closely related *S. helvola* was employed by Native Americans to relieve poison ivy and warts and as part of a compound decoction used to treat typhoid.

Management issues – Succession may alter old field areas that currently provide habitat for wild bean. Action to prevent succession by woody species helps to maintain habitat in a powerline right-of-way at Delhaas Woods. Annual mowing would also be beneficial as long as the mowing was done during the fall or winter after the plants have become dormant.

References:

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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BUSHY ASTER

Symphotrichum dumosum (L.) Nesom
Aster Family (Asteraceae)

State status: S1, TU/PE
Global status: G5

Description – Bushy aster is an herbaceous perennial with stems to 1 m which arise from rhizomes singly or in clusters. The leaves are linear to spatulate. Flowering heads are borne in a paniculate inflorescence the branches of which bear numerous highly reduced leaves or bracts (see illustration below). These tiny leaves make this species distinctive among the “little white asters”, an otherwise difficult group.

Bushy aster was formerly known as *Aster dumosus* L.

Habitat – Bushy aster grows in wet to dry meadows and old fields on serpentine barrens and diabase geology.

Range – Bushy aster grows from Maine to Ontario and south to Florida and Texas. It is ranked SH (possibly extirpated) in Maine; S2 (imperiled) in Pennsylvania and Ohio; S3 (vulnerable) in New York; S4 (apparently secure) in West Virginia; and S5 (secure) in Virginia, Kentucky, and North Carolina.

In Pennsylvania, bushy aster is known mainly from the southeastern corner of the state and a few scattered sites elsewhere.

Traditional Uses – Some Native American groups ate the fruits of this plant.

Management Issues – Active management meadows and old fields is required to retard succession by woody plants. On serpentine barrens, periodic burning is recommended to maintain the meadow/savannah habitat where bushy aster grows. Excessive browsing by deer threatens this species in many locations.

References:

Flora of North America Editorial Committee. 2006. *Flora of North America*, Vol. 20. Oxford University Press, New York, NY.

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1.

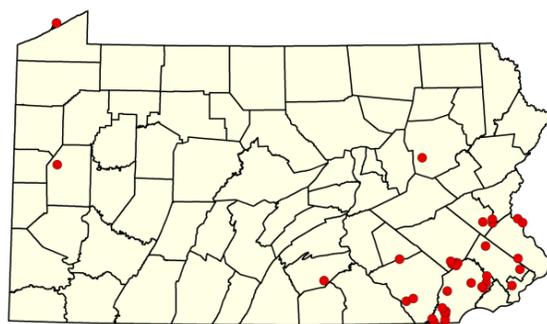
(<http://www.natureserve.org/explorer>, 25 February 2011).

NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org, accessed 3/18/2011.

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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WHITE HEATH ASTER

Symphotrichum ericoides (L.) Nesom ssp. *ericoides*
Aster Family (Asteraceae)

State status S3, TU/PT
Global status G5

Description – This plant is one of many "little white asters" that bloom in late summer and fall. The plants are up to 1 m with flowering stems that arise singly from long rhizomes. The numerous, small flowering heads are usually arranged along the upper side of the somewhat curved branches. The leaves are small and narrow; the lower ones on the main stem usually drop well before the plants come into bloom in September. A distinctive feature of white heath aster is the sharp tips on the bracts that surround each head of flowers.

White heath aster was previously known as *Aster ericoides* L.

Habitat – White heath aster is a plant of dry, open places, usually on limestone or other sites with a limey influence in the underlying geology.

Range – This aster has a wide range covering most of North America except the extreme southeast and southwest. It is ranked SH (possibly extirpated) in Delaware; S3 (vulnerable) in Pennsylvania, New Jersey, and Virginia; S4 (apparently secure) in Maryland; and S5 (secure) in New York.

In Pennsylvania it is found at scattered sites along the Delaware River in the east and historical sites in Perry and Erie Counties.

Traditional Uses – Some Native American groups used this plant to make a herbal steam in the sweat lodge.

Management Issues – Several extant occurrences of white heat aster are on cliffs or rock outcrops that provide protection by their inaccessibility. At other sites, woody plant succession and/or excessive browsing by deer threaten this species.

References:

- Flora of North America Editorial Committee. 2006. *Flora of North America*, Vol. 20. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 25 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



flowering
head of white
heath aster



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NEW YORK ASTER

Symphotrichum novi-belgii (L.) Nesom var. *novi-belgii*
Aster Family (Asteraceae)

State status: S2, PT
Global status: G5

Description – New York aster is an herbaceous perennial up to 1.5 m tall. The branching stems arise from long rhizomes; the leaves are narrow and lack petioles. Flowering heads are produced in a leafy, paniculate inflorescence; each head is surrounded by an involucre of loose, spreading bracts. The rays are blue. The loose, spreading involucral bracts are a good identification character.

This species was formerly known as *Aster novi-belgii* L.

Habitat – New York aster grows in swamps and moist meadows in acidic soils.

Range – New York aster is a plant of northeastern North America.



It occurs from Nova Scotia to Ontario and south to Georgia. It is ranked S2 (imperiled) in Pennsylvania and West Virginia, S4 (apparently secure) in Delaware, and S5 (secure) in the northern part of its range in Maine and eastern Canada.

In Pennsylvania, New York aster is known from just a few sites in the southeast. The largest known population is at Delhaas Woods Preserve in Bucks County where it grows with other coastal plain rarities including *Gentiana saponaria*, and *Andropogon glomeratus*.



Traditional Uses – There are no recorded uses for this specific aster.

Management Issues – New York aster benefits from management

to retard succession by woody plants in the powerline right-of-way at the Delhaas Woods Preserve. It also grows on hummocks in the shrub-dominated portion of the bog, but not in adjacent forested areas.

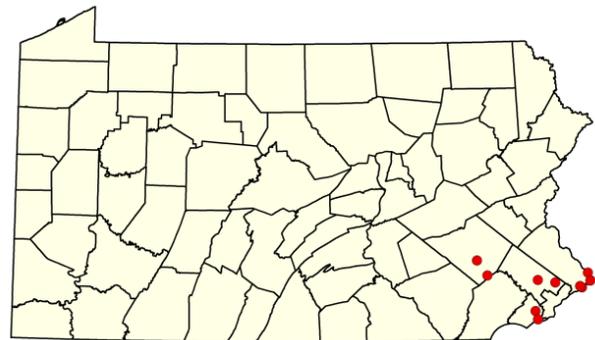
References:

Flora of North America Editorial Committee. 2006. *Flora of North America* Vol. 20. Oxford University Press, New York, NY.

NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 25 February 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.



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CANADIAN YEW
Taxus canadensis Marshall
 Yew family (Taxaceae)

State status: S3S4, TU/SP
Global status: G5

Description – Canadian yew is a rhizomatous, spreading evergreen shrub that grows to about 1 m tall. Its flat green needles have a short stalk at the base and are arranged in flat rows on each side of the twig. The seeds are covered with a cup-shaped red aril.

Habitat – Our native yew grows on cool, moist forested slopes, usually with a conifer component in the canopy. It is often found on steep north-facing slopes under canopy of mixed conifer and hardwood trees.

Range –The range of Canadian yew extends from Newfoundland and Labrador to Manitoba, and south to Virginia, Kentucky, and Iowa. It is ranked S1 (critically imperiled) in Rhode Island and North Carolina; S2 (imperiled) in New Jersey, Maryland, and West Virginia; S3 (vulnerable) in Pennsylvania and Virginia; and S5 (secure) in Maine and New York.

In Pennsylvania Canadian yew was once fairly common on cool, shaded north-facing slopes across the state. However, it has disappeared or declined in many areas due to browsing by overabundant deer. It persists only on cliffs or other very rocky sites that deer cannot reach.

Traditional uses – Several Native American tribes used preparations of Canadian yew to treat rheumatism, gynecological problems, colds, and fever.

All parts of this plant, except the fleshy red aril that surrounds the seed, contain alkaloids that are poisonous to humans and livestock. Deer however, appear to be able to adapt through induction of detoxification systems (Handeland (2008).

Management issues – The decline of eastern hemlock, due to infestation by hemlock woolly adelgid and elongate hemlock scale threatens stands of Canadian yew, especially in the southern part of Pennsylvania. As the hemlock component in the overstory thins and dies, growing conditions for the shade-tolerant yew change, subjecting it to higher temperatures and drying. Overbrowsing by deer is a very severe problem as well; the slow growing yew is a highly preferred winter browse species. It has been reduced to a few severely depleted shoots at many locations.

References

Flora of North American Editorial Committee. 1993. *Flora of North America*, Vol. 2. Oxford University Press, New York, NY.

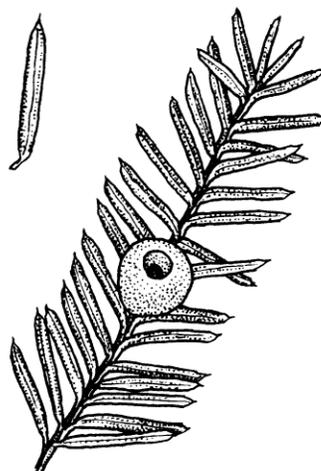
Handeland, K. Acute yew (*Taxus*) poisoning in moose (*Alces alces*). *Toxicon* 52(7): 829-832.

Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.

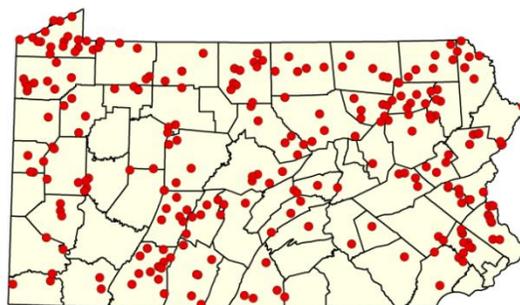
Pennsylvania Flora Database. 2009. www.paflo.org, Accessed, 3/18/2011.

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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Canadian yew severely browsed by deer



CRANEFLY ORCHID

Tipularia discolor (Pursh) Nuttall
Orchidaceae (Orchid Family)

State status: S3, PR
Global status: G4G5

Description – Cranefly is a native orchid that produces a winter leaf, visible from October to May. 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. Flowering occurs in July or early August when no leaves are present. The flowers are greenish-purple and have a long spur.



flowering stem

Habitat – Cranefly is a plant of deciduous forests, often along stream banks. The winter-green strategy takes advantage of the increased availability of sunlight during the season when deciduous 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 prolonged snow cover could be a problem.

Cranefly is classified as S1 (critically imperiled) in New York and Massachusetts, S3 (vulnerable) in Pennsylvania and New

Jersey, and S4 (apparently secure) in West Virginia. In Pennsylvania it is limited to a cluster of sites in the southeastern corner of the state.

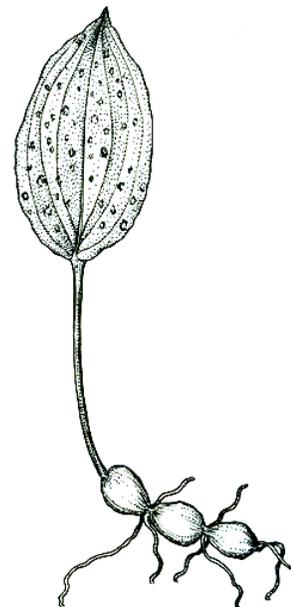
Traditional uses – None recorded.

Management issues – Overbrowsing 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 conspicuous on the forest floor in winter when little else is green.

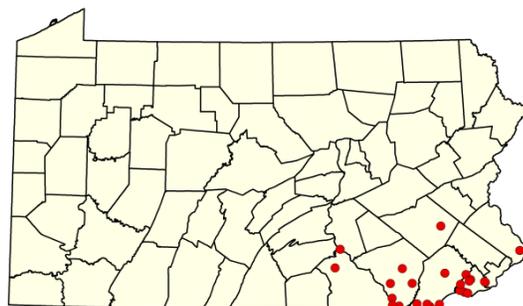
References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2008. www.paflora.org. Accessed 3/18/2011.
- Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.
- Whigham, Dennis F. 1989. The effect of experimental defoliation on the growth and reproduction of a woodland orchid, *Tipularia discolor*. *Canadian J. Botany* 68: 1812-1816.

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vegetative shoot showing leaf and corms



NODDING TRILLIUM

Trillium cernuum L. var. *cernuum*

Lily Family (Liliaceae)

State status: S3, N/PT

Global status: G5

Description – Nodding trillium is an herbaceous perennial about 20–40 cm tall; like all the trilliums, it has a single erect stem with a whorl of 3 leaves at the top. A solitary flower emerges from the center of the cluster of leaves; the name nodding trillium refers to the fact that the flower stalk is bent downward so that the bloom appears below the leaves. Each flower has 3 creamy white petals and 3 green sepals. The fruit is a fleshy berry that turns dark red at maturity. Nodding trillium blooms in early May, fruiting plants remain green through most of the summer; non-flowering plants die back by mid-summer. Nodding trillium plants grow from an underground rhizome and tend to grow in patches or colonies in the woods.

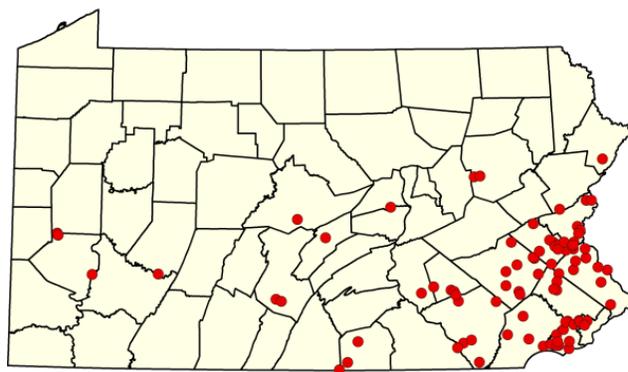
Habitat – Nodding trillium is a plant of moist, deciduous or mixed deciduous and evergreen forests.

Range – A plant of northeastern North America, Nodding trillium ranges from Nova Scotia and Newfoundland west to Saskatchewan and south to South Dakota, Iowa, Illinois, and Virginia. It is ranked SX (presumed extirpated) in Ohio, S2 (imperiled) in Delaware, S3 (vulnerable) in Pennsylvania and Delaware, and S4 (apparently secure) in New York. In Pennsylvania nodding trillium is found primarily in the southeastern part of the state.



Traditional Uses – Although some Native American groups considered them poisonous, *Trillium* species were used by others to treat rheumatism, colds, stiff muscles, and gynecological problems.

Management Issues – Deer overabundance is the single greatest threat to this species. All species of trillium are extremely susceptible to grazing by deer. A single bite removes an entire year's growth of flower and leaves; grazing in successive years will kill a plant. Forest fragmentation and invasion by invasive, non-native species is another serious threat.



References:

- Flora of North America Editorial Committee. 2002. *Flora of North America*, Vol. 26. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 20 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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PURPLE SANDGRASS

Triplasis purpurea P.Beauv.

Grass Family (Poaceae)

State status S1, PE
Global status G4G5

Description – Purple sandgrass is a low-growing annual or perennial grass with narrow leaves that are smaller toward the tips of the stems. Flowers and fruits are produced in a 2–7 cm-long panicle at the stem tip. The spikelets, which are purplish in color, contain 2–5 florets.

Habitat – Although typically a plant of maritime dunes, in southeastern Pennsylvania purple sandgrass grows in old dredge spoil deposits along the Delaware River. Glacial sand deposits along Lake Erie support this plant in northwestern Pennsylvania.

Range – Purple sandgrass occurs from Maine and Ontario to the Dakotas and south through Mexico and Costa Rica. It is ranked SH (possibly extirpated) in New Hampshire, S1 (critically imperiled) in Pennsylvania, S3 (vulnerable) in Ohio and North Carolina, S4 (apparently secure) in New York and New Jersey, and S5 (secure) in Delaware.

In Pennsylvania it is known from the Atlantic Coastal Plain and the shore of Lake Erie in opposite corners of the state.

Traditional Uses – None recorded.

Management Issues – Invasive species such as common reed (*Phragmites australis*) and Japanese knotweed (*Fallopia japonica*) often compete with this species for habitat.

References:

Flora of North America Editorial Committee. 2000. *Flora of North America*, Vol. 22. Oxford University Press, New York.

Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, OR.

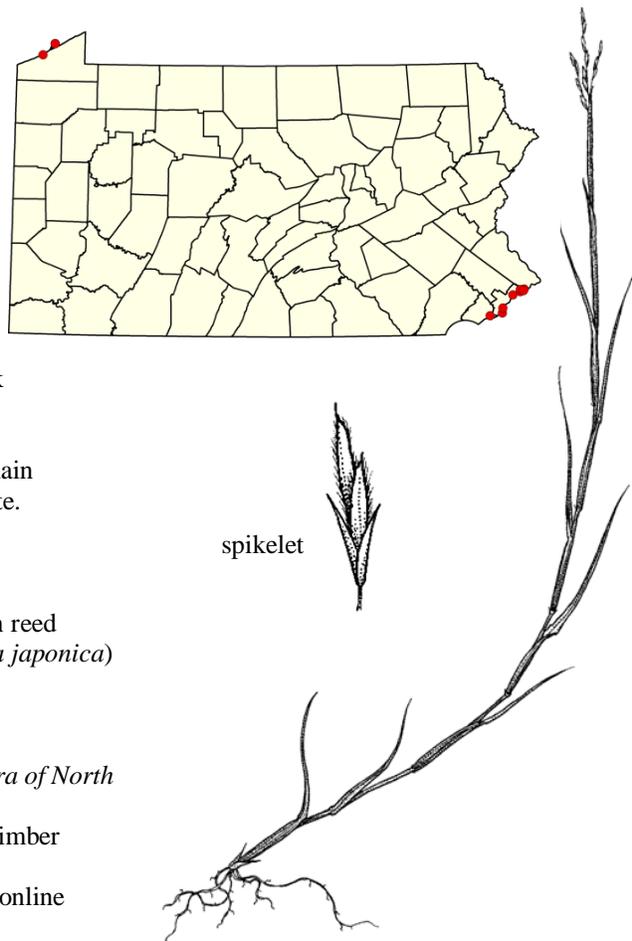
NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1.

(<http://www.natureserve.org/explorer>, 1 March 2011). NatureServe, Arlington, Virginia.

Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.

Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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POSSUM-HAW*Viburnum nudum* L.**Muskroot Family (Adoxaceae)****State status S1, PE****Global status G5**

Description – Possum-haw is a native deciduous shrub. Like all members of its genus, it has opposite leaves and flowers and fruits that are produced in rounded clusters at the branch tips. The fruits are bluish-black drupes.

Viburnum nudum L. is considered to include two varieties by some authors, var. *nudum* and var. *cassinoides*. Others recognize *V. nudum* var. *cassinoides* as a separate species (*Viburnum cassinoides* L.). *Viburnum nudum* var. *cassinoides* (or *Viburnum cassinoides* L.), which has a more northern range, is common throughout Pennsylvania. The plant under discussion here is *Viburnum nudum* (*V. nudum* var. *nudum*), which occurs only in the southeastern corner of the state on the Atlantic Coastal Plain and at a few scattered sites in nearby areas of the Piedmont.

The genus *Viburnum* was recently removed from the Honeysuckle Family (Caprifoliaceae) and placed in the Adoxaceae based on morphological and molecular data.

Habitat – Possum-haw grows in hummocky, acidic swamps.

Range – Possum-haw occurs from New York south to Florida and Texas. It is ranked SH (possibly extirpated) in Connecticut, S1 (critically imperiled) in Pennsylvania, S4 (apparently secure) in West Virginia, and S5 (secure) in New York and Delaware.

Possum-haw is also commonly planted as a landscape ornamental. Several named cultivars are present in the nursery trade.

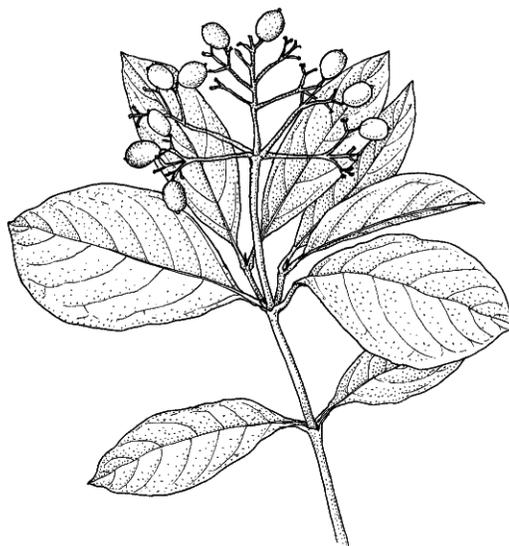
Traditional Uses - Native Americans ate the fruits of *Viburnum nudum* (or *V. cassinoides*). Preparations of root bark were used as a diaphoretic and infusions were prepared to treat fever and spasms.

Management issues - The most significant stand of possum-haw in the state is preserved at Delhaas Woods in Bucks County. Other remaining native stands should be protected to preserve as much genetic diversity as possible. The most serious threat to the future of possum-haw in the state may be overbrowsing by deer, which inhibits regeneration and growth of seedlings.

References:

- Judd, W.S., C.S. Campbell, E.A. Kellogg, P.F. Stevens, and M.J. Stevens. 2008. *Plant Systematics*, 3rd edition. Sinauer Associates, Inc, Sunderland, MA.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 21 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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COAST VIOLET

Viola brittoniana Pollard var. *brittoniana*

Violet Family (Violaceae)

State status: S1, PE

Global status: G5

Description – Coast violet is a low-growing herbaceous perennial. As one of the "stemless" violets, its leaves and flowers arise directly from the below-ground rhizome. It is distinctive among the stemless blue violets because its leaves are lobed nearly to the base resulting in a series of narrow segments. Bird's-foot violet (*Viola pedata*) is the only other species with which it could be confused, but bird's-foot violet has a distinctly flattened corolla unlike the petals of coast violet which are oriented forward.

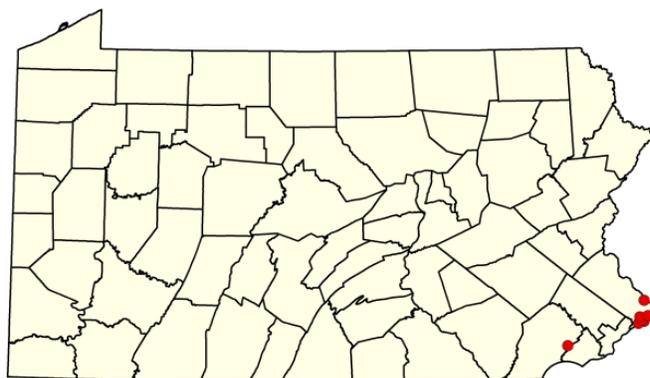
Habitat – Coast violet grows in moist sandy woods, wet meadows, and flats on or near the coastal plain.

Range – Coast violet occur along the Atlantic coast from Maine to South Carolina. It is ranked SH (possibly extirpated) in Maine; S1 (imperiled) in Massachusetts, Connecticut, New York, and Pennsylvania; and S4 (apparently secure) in Delaware and Maryland.

Historically, coast violet occurred at scattered sites in extreme southeastern Pennsylvania. The only known extant population of coast violet is in a powerline right-of-way where suppression of woody growth maintains wet meadow habitat.

Traditional Uses – There are no specific records of the use of coast violet, but unspecified *Viola* species were used by Native Americans to prepare a poultice to be applied to wounds, and an eyewash. An infusion of the roots was taken by mother and baby when the baby was sick. Leaves and stems were cooked and eaten as potherbs.

Management issues – Coastal plain habitat in Pennsylvania is greatly reduced and highly fragmented. Despite the highly urbanized nature of southeastern part of the state, deer overabundance threatens many herbaceous species. Succession by woody species would also a threat. Monitoring should be done on a regular basis.



References:

- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 23 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.pafloora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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NETTED CHAINFERN

Woodwardia areolata L.

Fern Family (Polypodiaceae)

State status S1, N/PT

Global status G5

Description –Netted chainfern is a native fern, 2 types of fronds are produced annually from creeping rhizomes. Sterile fronds are once pinnate and somewhat resemble sensitive fern (*Onoclea sensibilis*); the fertile fronds are also pinnate but the pinnae are contracted with a single row of sori along each side of the midrib. The sterile fronds sensitive fern have fewer and larger pinnae and the fertile fronds are narrower.

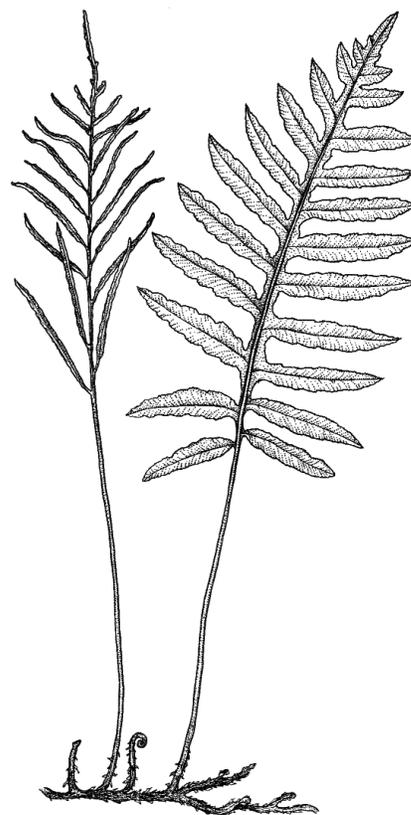
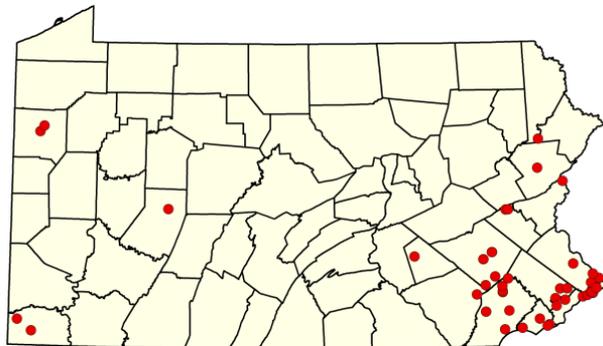
Habitat – Netted chainfern grows in moist, humus-rich, strongly acidic soils.

Range – Netted chainfern occurs from Nova Scotia to Michigan and south along the coast to Florida and Texas. It is ranked S2 (imperiled) in Pennsylvania and West Virginia, S3 (vulnerable) in New York and Ohio, and S5 (secure) in New Jersey and Delaware.

In Pennsylvania netted chainfern occurs primarily on the Atlantic Coastal Plain. However there are also scattered sites in the Piedmont, Ridge and Valley, and Allegheny Plateaus Physiographic Provinces.

Traditional Uses – Fibers extracted from unspecified *Woodwardia* species were used for basketry by Native Americans.

Management issues – Several large populations of netted chainfern are present at protected sites on the coastal plain including the largest one known which is at the Delhaas Woods Preserve in Bucks County. All known sites should be protected in order to maximize the preservation of genetic diversity within the species.



References

- Flora of North America Editorial Committee. 1993. *Flora of North America* Vol. 2. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 22 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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INDIAN WILD RICE

Zizania aquatica L.

Grass Family (Poaceae)

State status **S3, PR**

Global status **G5**

Description - Indian wild rice is a robust, annual grass that grows 7–8 feet tall. It has long strap-shaped leaves and an unbranched stem with a flowering/fruiting head at the top. The flowers are arranged in the inflorescence with the female flowers on erect upper branches and the male flowers on spreading branches below.

Habitat - Wild rice grows in freshwater tidal marshes and shores and occasionally in non-tidal wetlands. In Pennsylvania it reaches its best development in the high marsh portion of the freshwater tidal marshes, but also occurs at the upper edge of the riverbank tidal marsh.



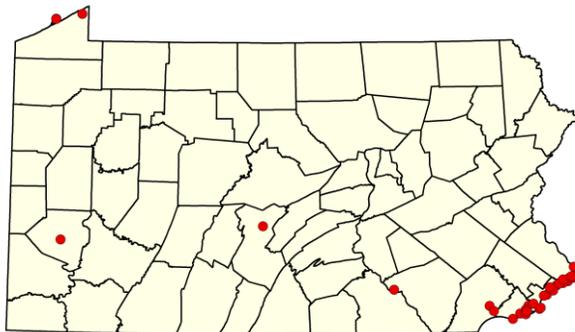
Range - Wild rice grows from Quebec and New Brunswick south to Pennsylvania and west to Iowa and Minnesota. It is ranked as S3 (vulnerable in Pennsylvania and S5 (secure) in New York and Delaware.

In Pennsylvania it is found along the Delaware Estuary in the southeastern corner of the state and at a few other scattered locations.

Traditional Uses - Native Americans made extensive use of wild rice for food. The closely related *Zizania*

palustris is cultivated as a crop in some areas of the United States.

Management issues - Freshwater tidal marsh is an endangered habitat in Pennsylvania. Confined to the estuary, the tidal portion of the river, the marshes have long been impacted by filling and bulkheading activities along the riverfront. Another threat is erosion from the wakes of passing boats which removes fine sediments leaving only coarse gravel which is not a suitable seedbed for the tidal marsh plants, many of which are annuals. Invasive species such as Japanese knotweed (*Fallopia japonica*) and common reed (*Phragmites australis*) are also serious threats.



References:

- Flora of North America Editorial Committee. 2007. *Flora of North America*, Vol. 24. Oxford University Press, New York, NY.
- Moerman, D.E. 2000. *Native American Ethnobotany*. Timber Press, Portland, OR.
- NatureServe Explorer. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. (<http://www.natureserve.org/explorer>, 17 February 2011). NatureServe, Arlington, Virginia.
- Pennsylvania Flora Database. 2011. www.paflora.org. Accessed 3/18/2011.
- Rhoads, A.F. and T.A. Block. 2007. *The Plants of Pennsylvania, An Illustrated Manual*, 2nd edition. University of Pennsylvania Press, Philadelphia, PA.

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Bat Count at Heritage Conservancy's Durham Township Bat Mine Offers a Glimmer of Hope

April 14th, 2015



A tri-colored bat found hibernating in the Durham cave

[Click to help Heritage Conservancy save our bats!](#)

Heritage Conservancy recently discovered a glimmer of hope at its bat hibernaculum in Durham Township, PA.

Last month, the Pennsylvania Game Commission performed its biannual survey of the Durham bat hibernaculum, which resides on a 90-acre preserved property that was acquired in 2002 by Heritage Conservancy for the purpose of ensuring the protection of the bat population's hibernating haven. In April 2013, Heritage Conservancy reported on the alarming news that virtually all of the bats in the Durham mine had been wiped out due to White Nose Syndrome (WNS).

WNS is the result of a white, cottony fungus on the nose and wings that irritates bats and causes them to lose their fat reserves. Making it nearly impossible for them to survive a winter in hibernation, they eventually leave their hibernaculum in search of food during unbearable temperatures and either starve or freeze to death.

White Nose Syndrome was confirmed at the Durham bat cave in the fall of 2009. In 2008, it was estimated that the cave hosted 8,000-10,000 healthy hibernating bats, including all bat species native to PA except for the Indiana bat, and population numbers were increasing yearly. During the 2013 survey of the Durham mine, only 23 bats were found hibernating in the cave.

During this month's survey, 13 bats were found. There are seven vertical depth levels within the mine, and Shannon Fredebaugh, Heritage Conservancy's Volunteer Coordinator, along with biologists from the PA Game Commission traversed through each one, sometimes having to crawl through narrow, dark spaces to get to the next chamber—certainly not an exciting activity for the claustrophobic! Bats were found scattered throughout various sections of the mine.

Although the numbers remained low, a promising sign is the increase in bat species that were found. The species that Heritage Conservancy and the PA Game Commission discovered hibernating in the mine were little browns, big browns, tricolored, and eastern small-footed. The little browns have been hit the hardest by WNS because of their small size and



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inability to store enough fat reserves to make it through a winter while infected. The eastern small-footed bat, which is a PA state-threatened species, wasn't even found in the mine during the 2013 survey. These signs could hint at a possible rebound in the future.

Another small hint at possible recovery is the stabilization in numbers during summer bat counts around the area. This suggests that bats might be adjusting their behavior and hibernating in different areas than in previous years, possibly even in warmer climates farther south.

We should all hope for a rebound. The ramifications of the decline in bat populations could take a devastating toll on our ecosystem. One bat eats about 800,000 to one million insects per year; without bats to control pest levels, insects will fly rampant. As a keystone species, no other animal can fill the critical role that bats play in our ecosystem. Farmers will have little help from bats in repelling bugs, which could increase the use of insecticides. With insects like mosquitoes that carry disease, we could see an increase in human disease contractions like those from West Nile virus.

Heritage Conservancy is doing its part to help bats with their plight. The organization gated the cave at both entry points to prevent intruders from coming in and disturbing the bats while allowing for the bats to come and go freely. Also, through monitoring and stewardship of the mine and its surrounding area, the Conservancy provides good habitat for them.

"The over 90 acres of preserved land that surrounds the Durham bat mine includes wooded habitat and waterways. These resources provide bats with the means to survive right when they awake from hibernation in springtime, which in turn increases their chance to bear young and repopulate the colony," says Shannon Fredebaugh. "Hopefully, Heritage Conservancy's commitment here will help with their future recovery."

To learn more, contact us at 215-345-7020.

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(<http://www.pgc.pa.gov/Wildlife/HabitatManagement/Pages/default.aspx>) > Important Mammal Areas

Important Mammal Areas Project Overview



The Pennsylvania Important Mammal Areas Project was initiated in 2001 to promote the conservation of mammals by identifying sites or regions that include habitats critical to their survival, and to educate the public about mammals and their needs. The Project was the first of its kind in the United States and perhaps in the world. Patterned after the Important Bird Areas Project, the philosophy and methodologies are comparable. While selection as an Important Mammal Area does not provide legal protection, it focuses public awareness on mammals and provides landowners and governmental agencies with information to compliment land management and land use decisions to better protect mammals and their habitat. This project is a joint partnership of the Pennsylvania Game Commission, National Wildlife Federation, Pennsylvania Wildlife Federation, Pennsylvania Federation of Sportsmen's Clubs, Mammal Technical Committee/Pennsylvania Biological Survey and the Carnegie Museum of Natural History. Financial support has come primarily through the State Wildlife Grants Program, a federally-funded program administered in Pennsylvania by the game Commission.

The criteria used to determine whether a site qualifies as an Important Mammal Area were developed by the Mammal Technical Committee of the Pennsylvania Biological Survey. Sites were chosen on the basis of meeting at least one of the following attributes, although many sites were nominated in more than one category.

CATEGORY 1

These sites contain habitats that support diverse or unique mammal communities. The sites include a habitat type that either: 1.) Supports significant populations of species or subspecies with specific habitat requirements, or 2.) Is representative, rare, threatened, or unique.

CATEGORY 2

These sites contain habitats that support high density mammal populations. The sites include a habitat type that 1.) Supports significant aggregations of mammals during one or more seasons, or 2.) Supports important core populations or population segments.

CATEGORY 3

These sites support species or subspecies listed as endangered or threatened by the Pennsylvania Bio-logical Survey. 1.) The site supports a confirmed viable local population, or 2.) The species or subspecies regularly occurs at the site during one or more seasons.

CATEGORY 4

These sites support species or subspecies that are declining or vulnerable nationally or listed as candi-date species by the Pennsylvania Biological Survey (specifically candidate-proposed, candidate-at risk, candidate-rare). 1. The site sustains a confirmed viable local population, or 2. The species or subspecies regularly occurs at the site during one or more seasons.

CATEGORY 5

These sites are important for wildlife viewing and public education. 1.) The site includes wild populations of mammals that can be viewed in their natural habitat, or 2.) The site is a natural area associated with an established educational program that interprets natural history of resident mammals.

IMPORTANT MAMMAL AREAS MAPS

All links below are PDFs.

1. Presque Isle State Park	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%201%20Presque%20Isle%20State%20Park.pdf)
2. Pymatuning Wildlife Management Area/SGL 214	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%202%20Pymatuning%20Wildlife%20Management%20Area%20-%20SGL%20214.pdf)
3. Maurice K. Goddard State Park	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%203%20Maurice%20K.%20Goddard%20State%20Park.pdf)
4. Hickory Creek and Tionesta Creek Drainages	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%204%20Hickory%20Creek%20and%20Tionesta%20Creek%20Drainages.pdf)
5. CS & M Mine	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%205%20CS%20and%20M%20Mine.pdf)
6. Long Run Mine	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%206%20Long%20Run%20Mine.pdf)
7. US Steel Mine	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%207%20US%20Steel%20Mine.pdf)
8. Northern Allegheny Plateau	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%208%20Northern%20Allegheny%20Plateau.pdf)
9. Hills Creek State Park	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%209%20Hills%20Creek%20State%20Park.pdf)
10. Chestnut Ridge/Laurel Ridge	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2010%20Chestnut%20Ridge%20Laurel%20Ridge.pdf)
11. Yellow Creek State Park	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2011%20Yellow%20Creek%20State%20Park.pdf)
12. Kimberly Run Natural Area	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2012%20Kimberly%20Run%20Natural%20Area.pdf)
13. Allegheny Mountain	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2013%20Allegheny%20Mountain.pdf)

14. Forbes State Forest / Mt. Davis Section	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2014%20Forbes%20State%20Forest%20Mt.%20Davis%20Section.pdf)
15. Salisbury Mine	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2015%20Salisbury%20Mine.pdf)
16. Canoe Creek Watershed	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2016%20Canoe%20Creek%20Watershed.pdf)
17. The Barrens (SGL 176)	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2017%20The%20Barrens%20SGL%20176.pdf)
18. 1000 Steps	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2018%201000%20Steps.pdf)
19. Blacklog Mountain	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2018%201000%20Steps.pdf)
20. Central Mountains	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2020%20Central%20Mountains.pdf)
21. Tuscarora/Blue Mountain South	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2021%20Tuscarora%20Blue%20Mountain%20South.pdf)
22. Eisenhower Least Shrew Site	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2022%20Eisenhower%20Least%20Shrew%20Site.pdf)
23. East Berlin Shrew Site	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2023%20East%20Berlin%20Shrew%20Site.pdf)
24. Conodoguinet Creek	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2024%20Conodoguinet%20Creek.pdf)
25. Central Susquehanna Valley	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2025%20Central%20Susquehanna%20Valley.pdf)
26. Stony Mt. Woodrat Complex	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2026%20Stony%20Mtn%20Woodrat%20Complex.pdf)
27. Wyoming State Forest	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2027%20Wyoming%20State%20Forest.pdf)
28. Ricketts Glen State Park/SGL 57, 13, 66	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2028%20Ricketts%20Glen%20State%20Park%20SGLs%2057%2013%2016.pdf)
29. Wyoming Valley	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2029%20Wyoming%20Valley.pdf)
30. Middle Creek Wildlife Management Area/SGL 46	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2030%20Middle%20Creek%20Wildlife%20Management%20Area%20SGL%2046.pdf)
31. Hopewell Big Woods	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2031%20Hopewell%20Big%20Woods.pdf)
32. Hawk Mountain Sanctuary and Environs	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2032%20Hawk%20Mountain%20Sanctuary%20and%20Environs.pdf)

33. Lehigh Valley/Lehigh Gorge State Park	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2033%20Lehigh%20Valley%20Lehigh%20Gorge%20State%20Park.pdf)
34. SGL 129/Hickory Run State Park/Holiday Pocono	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2034%20SGL%20129%20Hickory%20Run%20State%20Park%20Holiday%20Pocono)
35. Pocono Lake/Adams Swamp/Two Mile Run	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2035%20Pocono%20Lake%20Adams%20Swamp%20Two%20Mile%20Run.pdf)
36. Tobyhanna & Gouldsboro State Parks/SGL 127	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2036%20Tobyhanna%20and%20Gouldsboro%20State%20Parks%20SGL%20127.pdf)
38. Long Pond Preserve	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2038%20Long%20Pond%20Preserve.pdf)
39. Tannersville Cranberry Bog	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2039%20Tannersville%20Cranberry%20Bog.pdf)
40. Delaware State Forest, Bushkill Creek Area	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2040%20Delaware%20State%20Forest%20Bushkill%20Creek%20Area.pdf)
41. Delaware Water Gap	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2041%20Delaware%20Water%20Gap.pdf)
42. Cherry Valley Watershed	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2042%20Cherry%20Valley%20Watershed.pdf)
43. Durham Mine	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2043%20Durham%20Mine.pdf)
45. Latodami Environmental Education Center	Overview (http://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2045%20Latodami%20Environmental%20Education%20Center.pdf)



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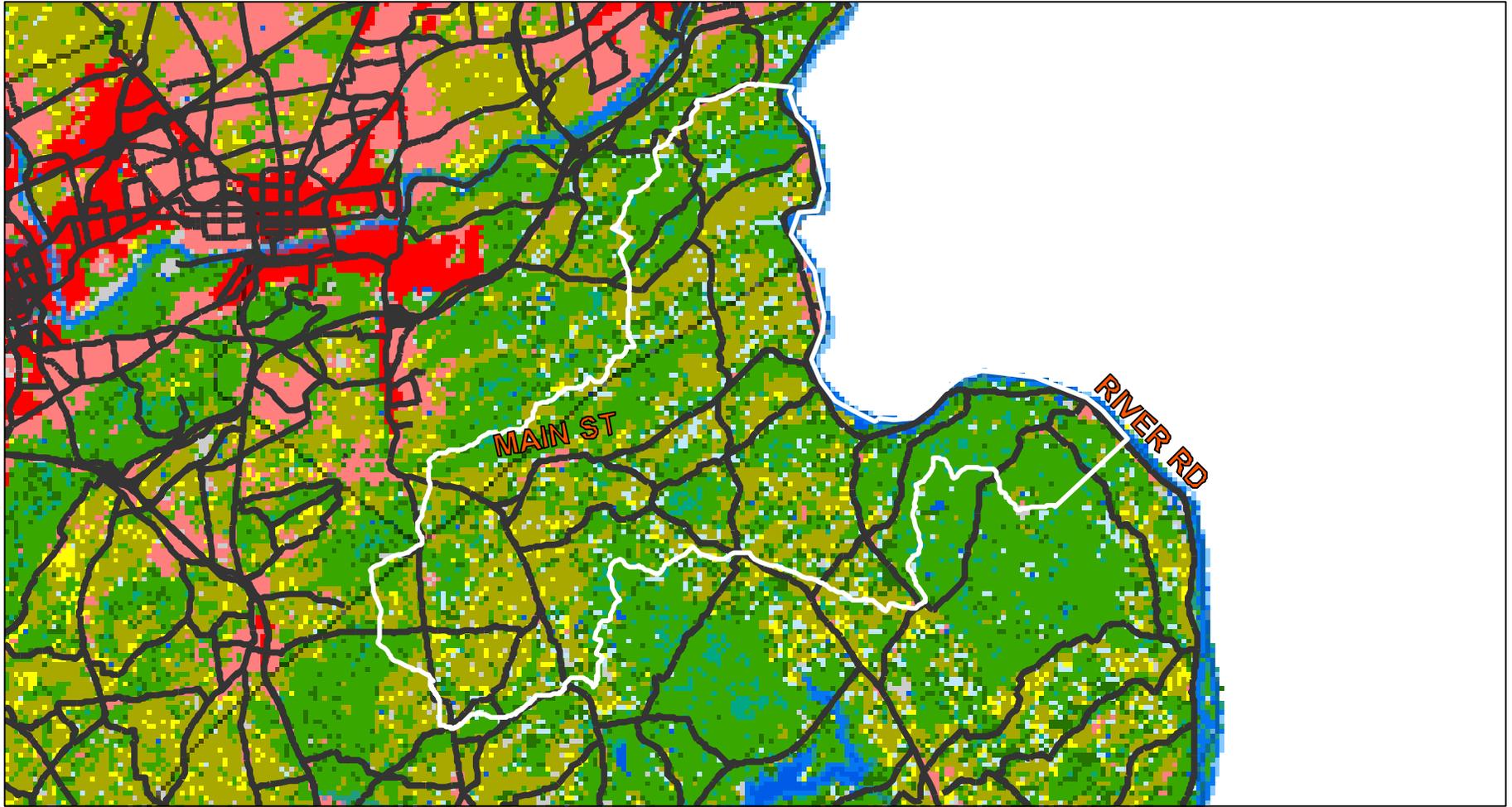


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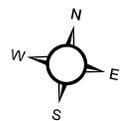
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Durham Mine IMA



Legend

State Roads	Open Water	Mixed Forest
Important Mammal Area Boundary	Low Density Urban	Deciduous Fores
	High Density Urban	Barren
	Hay/Pastures	Transitional
	Row Crops	Beach
	Conifer Forest	



0 0.5 1 2 3 4
Miles

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Special Protection Waters (SPW) Program

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Program Overview

The SPW program, initially adopted by the DRBC in 1992 and expanded in 1994 and 2008 (see below for detailed history), is designed to prevent degradation in streams and rivers where existing water quality is better than the established water quality standards through stricter control of wastewater discharges and reporting requirements. Currently, the entire 197-mile non-tidal Delaware River from Hancock, N.Y. to Trenton, N.J. is considered Special Protection Waters, three-quarters of which is also included in the National Wild and Scenic Rivers System.

The program states that there will be no measurable change in existing water quality (EWQ) of SPW waters except towards natural conditions. This is accomplished by taking a watershed approach, looking also at the drainage area of the designated waters, and by regulating both point and non-point source discharges. It allows new or expanded pollutant loadings as long as they do not measurably change the existing water quality and considers the cumulative impacts of these loadings, rather than just looking at them individually.

DRBC believes that these regulations establish an anti-degradation policy on the longest stretch of any river in the nation. Ensuring that the level of water quality in SPW is not degrading over time is the ultimate goal of the program: to keep water quality above existing standards, or, simply, to keep the clean water clean.

Brief Description of SPW Regulations



Within the drainage area to Special Protection Waters (shaded gray in the map on the left), DRBC approval is required for new and expanding industrial and municipal wastewater treatment plants when the proposed facility is designed to discharge a daily average rate of 10,000 gallons a day or more during any consecutive 30-day period. In the rest of the basin, the review threshold remains 50,000 gallons a day or more during any consecutive 30-day period.

The regulations discourage new and increased discharges of wastewater directly to the designated waterways by prohibiting new wastewater treatment facilities and substantial alterations and additions to existing facilities discharging directly to Special Protection Waters unless all non-discharge/load reduction alternatives have been fully evaluated and rejected because of technical and/or financial infeasibility.

In addition, new discharges and substantial alterations and additions to existing discharges are prohibited within the drainage area to waters classified as SPW unless natural treatment alternatives for all or a portion of the discharge have been evaluated and rejected because of technical and/or financial infeasibility. Non-discharge alternatives and natural treatment alternatives include land applications like spray irrigation where treated wastewater is applied to the ground.

To obtain DRBC approval, new discharges and substantial alterations and additions to existing discharges within the drainage area to waters classified as SPW must demonstrate no measurable change to existing water quality as defined by the regulations for a list of seven or eight parameters (depending on the location of the discharge) at established water quality control points.

The SPW regulations further require that the minimal level of wastewater treatment for all new discharges and substantial additions or alterations to existing discharges directly to Special Protection Waters will be "Best Demonstrable Technology." Best Demonstrable Technology is defined for municipal facilities by 30-day average effluent criteria for seven parameters plus ultraviolet light disinfection. Equivalent criteria for industrial facilities are identified on a case-by-case basis.

Projects located in the drainage area of Special Protection Waters that are subject to DRBC review must also have a Non-Point Source Pollution Control Plan (NPSPCP) that has been approved by the commission. The NPSPCP describes the Best Management Practices that will be used at the project site and service area to control the increases in non-point source pollutant loadings resulting from the project.

SPW regulations are unique in that they require monitoring to determine if measurable change is occurring at designated interstate and boundary control points where existing water quality has been defined. This monitoring program is conducted through an informal partnership between the National Park Service (NPS) and the DRBC called the Scenic Rivers Monitoring Program (see next section). Data collected are also used in computer models developed for priority tributaries, i.e. those that have a high number of existing discharges or are expected to have new growth and associated wastewater discharge needs. The models are used to predict possible changes to water quality and to establish discharge limits to prevent a measurable change.

More Information

Lower Delaware River SPW Assessment of Measurable Changes to Existing Water Quality (August 2016 Report)

Map of SPW Drainage Area (pdf 2.2 MB; includes the entire non-tidal river)

National Wild and Scenic Rivers System

DRBC and the National Park Service (NPS) partner in this effort to monitor and manage the water quality in the Special Protection Waters and [National Wild and Scenic River](#) segments of the Upper Delaware Scenic and Recreational River (UPDE), Delaware Water Gap National Recreation Area (DEWA), and the Lower Delaware Scenic and Recreational River (LDEL). All of these river segments are considered to have exceptionally high scenic, recreational, ecological, and/or water supply values.

NPS staff lead the monitoring programs in UPDE and DEWA, while commission staff are in charge of the LDEL program. The goals are to assess compliance with water quality criteria and to allow revised definitions of EQW and/or determine that EQW is currently being maintained in Special Protection Waters. In August 2016, the DRBC released its [Lower Delaware River Special Protection Waters Assessment of Measurable Changes to Existing Water Quality, Round 1: Baseline EQW \(2000-2004\) vs. Post-EQW \(2009-2011\)](#) report.

Throughout the 197-mile non-tidal river, close to 60 sites are sampled between May and September and analyzed for nutrients, dissolved oxygen and other conventional pollutants, solids, bacteria, macroinvertebrates, periphyton (alga), and flow. Samples are taken from the main stem river and also at tributary confluences and are analyzed by academic institutions or state laboratories.

- [Antidegradation Protection of Water Quality for the Delaware River Basin: Expansion of the Control Point Approach to Monitoring and Assessment](#) (pdf 3.3 MB; presentation by DRBC staff at 2014 National Water Quality Monitoring Conference)
- [Scenic Rivers Monitoring Program for the Non-Tidal Delaware River: Quality Assurance Project Plan 2013](#) (pdf 887 KB)
- Multi-Parameter Water Quality Meters: Standard Operating Procedures (2011):
 - [Conductivity](#) (pdf 2 MB)
 - [Dissolved Oxygen](#) (pdf 2.5 MB)
 - [pH](#) (pdf 2 MB)
 - [Temperature](#) (pdf 1.5 MB)
- [Scenic Rivers Monitoring Program for the Non-Tidal Delaware River: Quality Assurance Project Plan 2008-2009](#) (pdf 899 KB)
- [DRBC/NPS Scenic Rivers Monitoring Program Fact Sheet](#) (pdf 323 KB)

Program History

In 1992, DRBC adopted SPW regulations for point source (or "end-of-pipe") discharges, which were amended in 1994 to also include non-point source pollutant loadings carried by runoff. The regulations were enacted to protect existing high water quality in areas of the Delaware River Basin deemed "to have exceptionally high scenic, recreational, ecological and/or water supply values." They initially applied to a 121-mile stretch of the Delaware River from Hancock, N.Y. downstream to the Delaware Water Gap, and its drainage area. This includes the upper and middle sections of the non-tidal river federally designated as "Wild and Scenic" in 1978, as well as an eight-mile reach between Millrift and Milford, Pa., which is not federally designated.

- [Map of 1992 SPW-classified area](#) (pdf 313 KB)

In 2000, federal legislation was enacted adding key segments of the Lower Delaware and selected tributaries to the National Wild and Scenic Rivers System. This designation was followed in April 2001 with a petition from the Delaware Riverkeeper Network to classify the Lower Delaware, the 76-mile stretch of the non-tidal river between the Delaware Water Gap National Recreation Area and the head of tide at Trenton, N.J., as SPW. Extensive data were collected from 2000 through 2004 which confirmed that existing water quality in this stretch of river exceeded most state and federal standards.

- [Lower Delaware River Eligibility Determination for DRBC Declaration of Special Protection Waters](#) (pdf 1.25 MB; August 2004)
- [Lower Delaware Monitoring Program: 2000-2003 Results and Water Quality Management Recommendations](#) (pdf 3.3 MB; August 2004)
- [Lower Delaware Water Quality Monitoring Program Quality Assurance Project Plan](#) (pdf 1.9 MB; July 2003)
- Lower Delaware Monitoring Data:
 - [2000-2004 Base Data](#) (xls 2.8 MB)
 - [Additional Supporting Water Quality Data](#) (xls 3.5 MB)
- [Map Depicting Lower Delaware Scenic River Segments, Dischargers, and Monitoring Locations](#) (pdf 1.9 MB)
- [Lower Delaware Monitoring Program - 1999 Survey of the Lower Non-Tidal Delaware River and Pilot Study for a Long-Term Water Quality Monitoring Network](#) (pdf 1.23 MB)

In 2005, based in part upon these findings, the DRBC temporarily classified the Lower Delaware as SPW. This temporary designation made the Lower Delaware subject to all SPW regulations except those that required the use of numeric values for existing water quality. Temporary designation provided a measure of protection while allowing time for the public rulemaking process to take place and for implementation details to be thoroughly considered.

- [Resolution 2005-2](#) (pdf 20 KB; temporarily classifies the Lower Delaware as SPW)
- [Map of the temporarily-designated-as-SPW Lower Delaware River](#) (pdf 501 KB)

The commission extended the temporary designation on four different occasions:

- [Resolution 2005-15](#) (pdf 13 KB; extended through September 30, 2006)
- [Resolution 2006-22](#) (pdf 12 KB; extended through September 30, 2007)
- [Resolution 2007-13](#) (pdf 10 KB; extended through May 15, 2008)
- [Resolution 2008-3](#) (pdf 12 KB; extended through July 31, 2008)

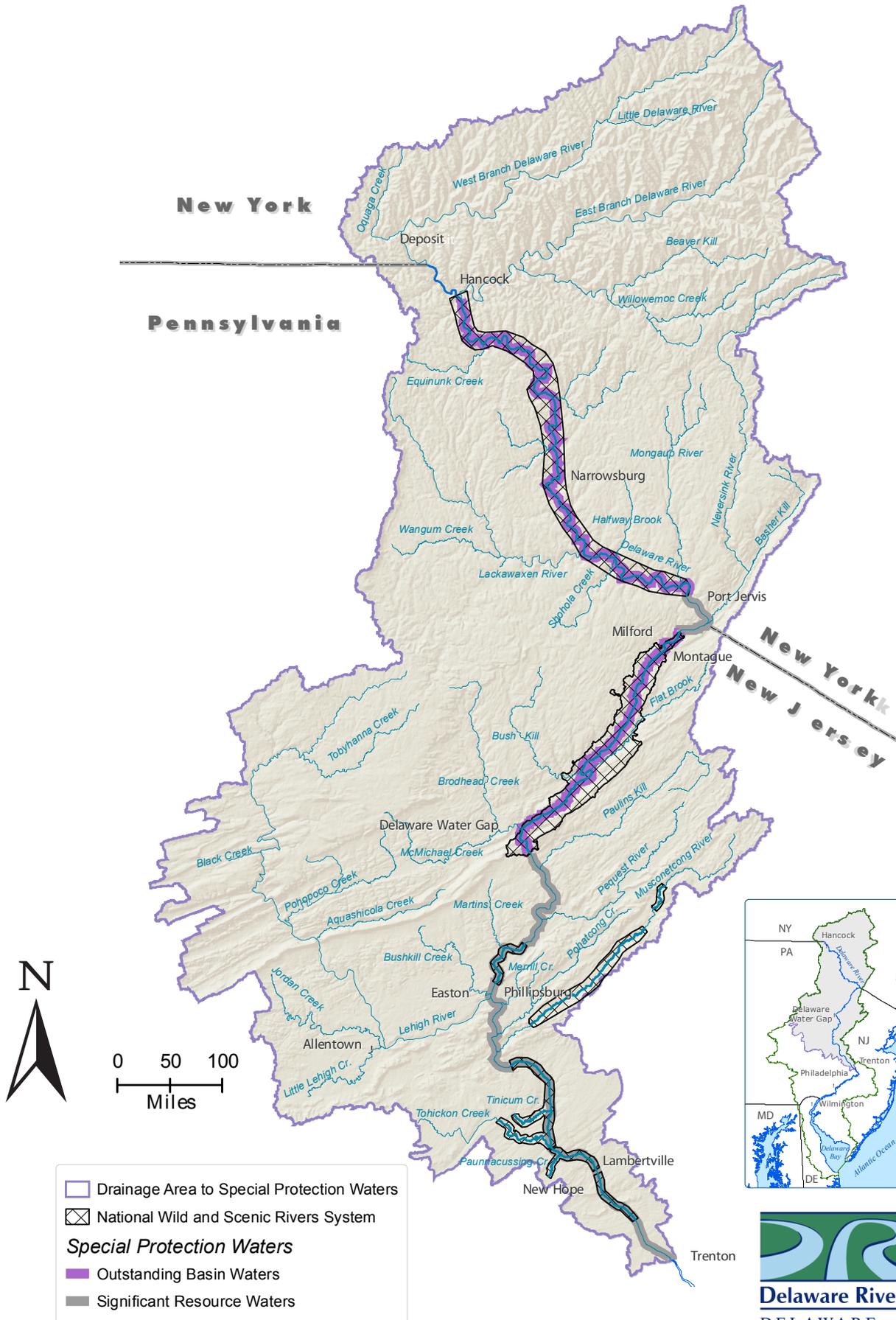
On July 16, 2008, by unanimous vote, the DRBC permanently designated the Lower Delaware as Significant Resource Waters, one of the two available SPW classifications.

- [Resolution 2008-9](#) (pdf 711 KB; permanently designates the Lower Delaware as Significant Resource Waters)
- [July 17, 2008 News Release Announcing the Permanent Designation](#)
- [Lower Delaware SPW Classification Response to Comments Document](#) (pdf 1.1 MB)
- [SPW Final Rule](#) (pdf 60 KB; as appears in the September 26, 2008 Federal Register)

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Drainage Area to Special Protection Waters



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2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name

HUC

Use Assessed (Assessment ID) - Miles**Source****Cause****Date Listed****TMDL Date**

Hydrologic Unit Code: 02040101-Upper Delaware

Delaware River

HUC: 02040101

Fish Consumption (16835) - 0.35 miles

Source Unknown

Mercury

2002

2015

Hydrologic Unit Code: 02040103-Lackawaxen

Ariel Creek

HUC: 02040103

Aquatic Life (16578) - 0.8 miles

Upstream Impoundment

Organic Enrichment/Low D.O.

2012

2025

Lackawaxen River

HUC: 02040103

Aquatic Life (2428) - 0.9 miles

Industrial Point Source

Organic Enrichment/Low D.O.

2002

2015

Middle Creek Unnamed Of (ID:25941442)

HUC: 02040103

Aquatic Life (4770) - 0.9 miles

Land Development

Siltation

2004

2017

Wallenpaupack Creek Unnamed To (ID:25930548)

HUC: 02040103

Aquatic Life (16580) - 0.56 miles

Package Plants

Organic Enrichment/Low D.O.

2012

2025

Upstream Impoundment

2012

2025

West Branch Wallenpaupack Creek Unnamed To (ID:25928208)

HUC: 02040103

Aquatic Life (16577) - 1.53 miles

Urban Runoff/Storm Sewers

Siltation

2004

2017

2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name

HUC

Use Assessed (Assessment ID) - Miles Source	Cause	Date Listed	TMDL Date
<u>Cooks Creek</u>			
HUC: 02040105			
Aquatic Life (17839) - 8.6 miles			
Agriculture	Cause Unknown	2016	2029
Aquatic Life (17840) - 5.66 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19002) - 3.74 miles			
Source Unknown	Pathogens	2016	2029
Recreational (19009) - 8.6 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040800)</u>			
HUC: 02040105			
Aquatic Life (17835) - 0.63 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029
<u>Cooks Creek Unnamed Of (ID:26040802)</u>			
HUC: 02040105			
Aquatic Life (17835) - 0.96 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029
<u>Cooks Creek Unnamed Of (ID:26040816)</u>			
HUC: 02040105			
Aquatic Life (17835) - 2.38 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029
<u>Cooks Creek Unnamed Of (ID:26040820)</u>			
HUC: 02040105			
Aquatic Life (17835) - 0.75 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029
<u>Cooks Creek Unnamed Of (ID:26040828)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.78 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040840)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.39 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040844)</u>			
HUC: 02040105			
Aquatic Life (17835) - 0.75 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029

2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name

HUC

Use Assessed (Assessment ID) - Miles Source	Cause	Date Listed	TMDL Date
<u>Cooks Creek Unnamed Of (ID:26040862)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.62 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040866)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.74 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040896)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.59 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.59 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040918)</u>			
HUC: 02040105			
Aquatic Life (17839) - 1.62 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 1.62 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed Of (ID:26040980)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.31 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.31 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed Of (ID:26054302)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.66 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed To (ID:132737491)</u>			
HUC: 02040105			
Aquatic Life (17840) - 1.59 miles			
Agriculture	Cause Unknown	2016	2029
<u>Cooks Creek Unnamed To (ID:26040812)</u>			
HUC: 02040105			
Aquatic Life (17835) - 3.92 miles			
Agriculture	Cause Unknown	2016	2029
Urban Runoff/Storm Sewers		2016	2029
<u>Cooks Creek Unnamed To (ID:26040830)</u>			
HUC: 02040105			
Aquatic Life (17839) - 2.48 miles			
Agriculture	Cause Unknown	2016	2029

2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name

HUC

Use Assessed (Assessment ID) - Miles Source	Cause	Date Listed	TMDL Date
<u>Cooks Creek Unnamed To (ID:26040850)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.75 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.75 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040868)</u>			
HUC: 02040105			
Aquatic Life (17839) - 1.63 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 1.63 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040894)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.3 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.3 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040898)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.69 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.69 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040904)</u>			
HUC: 02040105			
Aquatic Life (17839) - 0.73 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 0.73 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040910)</u>			
HUC: 02040105			
Aquatic Life (17839) - 1.4 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 1.4 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26040916)</u>			
HUC: 02040105			
Aquatic Life (17839) - 3.5 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19009) - 3.5 miles			
Source Unknown	Pathogens	2016	2029

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Stream Name

HUC

Use Assessed (Assessment ID) - Miles Source	Cause	Date Listed	TMDL Date
<u>Cooks Creek Unnamed To (ID:26054132)</u>			
HUC: 02040105			
Aquatic Life (17840) - 0.96 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19002) - 0.96 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26054158)</u>			
HUC: 02040105			
Aquatic Life (17840) - 1.58 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19002) - 0.79 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26054176)</u>			
HUC: 02040105			
Aquatic Life (17840) - 1.51 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19002) - 1.11 miles			
Source Unknown	Pathogens	2016	2029
<u>Cooks Creek Unnamed To (ID:26054204)</u>			
HUC: 02040105			
Aquatic Life (17840) - 0.9 miles			
Agriculture	Cause Unknown	2016	2029
Recreational (19002) - 0.9 miles			
Source Unknown	Pathogens	2016	2029
<u>Deep Run</u>			
HUC: 02040105			
Aquatic Life (19215) - 2.56 miles			
Agriculture	Nutrients	2002	2015
	Siltation	2002	2015
Aquatic Life (19223) - 1.32 miles			
Agriculture	Nutrients	2002	2015
	Siltation	2002	2015
Municipal Point Source	Nutrients	2002	2015
Aquatic Life (19225) - 4.16 miles			
Agriculture	Nutrients	2016	2029
	Siltation	2016	2029
Municipal Point Source	Nutrients	2016	2029
<u>Deep Run Unnamed Of (ID:26030572)</u>			
HUC: 02040105			
Aquatic Life (19217) - 0.74 miles			
Agriculture	Nutrients	2016	2029
	Siltation	2016	2029
Urban Runoff/Storm Sewers		2016	2029

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